Exploring Wellness:
A Self-Report Monitoring Application and Mindfulness Intervention for Professional Ballet Dancers

Carly Harrison

MHSc (Rehabilitation Counselling)

BSc (Psychology)

A thesis in total fulfilment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

College of Science, Health and Engineering

School of Psychology and Public Health

La Trobe University, Victoria, Australia

March 2021

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Picture 1: The Australian Ballet.

ABSTRACT

Athlete Management Systems (AMS) and self-report wellness applications (Apps) have been found to be valuable for monitoring preparation, performance, and recovery in professional sport. Subjective ratings of wellness (e.g., fatigue, regions of soreness, stress, sleep) appear sensitive to changes in work-demands and provide a useful tool to monitor adaptive responses to training and competition in professional athletes. In the Australian professional ballet industry, self-reported wellness fluctuations during training and performance periods are scarce and have not been established.

This thesis sought to investigate wellness fluctuations in professional ballet, via the use of a wellness App and explored the practicality of a mindfulness intervention for enhancing awareness of holistic well-being in a professional ballet company. Study 1, a pilot study, explored the feasibility of a ballet-specific wellness App with professional ballet dancers. Study 2 investigated wellness, activity (e.g., training and performance) and participation status between professional ballet dancers and professional athletes. Study 3 explored the perceptions and experiences of professional ballet dancers using a wellness App. Study 4 sought to explore the practicality of a mindfulness intervention via a randomised controlled trial (RCT) with a Mindfulness-Acceptance-Commitment (MAC) group and a control group (who were provided with meaningful education sessions).

Overall, the findings of this thesis indicate that wellness scores appear sensitive to activity type, specifically stress, and fatigue during performance, and highlight the challenges dancers experience in acknowledging their holistic wellness. Thus, providing valuable information for the development of interventions that promote positive adaptive behavioural responses to changes in wellness, for optimal health in training and performance. To further develop monitoring tools in professional ballet companies, it is recommended that dancers are provided with education, support structures and strategies

for acknowledging and coping with fluctuating wellness. In addition, further mindfulness research is required to guide the development of mindfulness-based practice in ballet and the performing arts industry, to enhance holistic health and well-being, and potentially decrease injury risk.

STATEMENT OF AUTHORSHIP

This thesis includes work by the author that has been published or accepted for publication as described in the text. Except where reference is made in the text of the thesis, this thesis contains no material published elsewhere or extracted in whole or in part from a thesis accepted for the award of any other degree or diploma. No other person's work has been used without due acknowledgement in the main text of the thesis. This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

CARLY HARRISON

31st March 2021

PREFACE

This thesis comprises work that has been submitted for publication. In all research studies, the author was the doctoral student, however there were other contributors who must be acknowledged and have been credited as co-authors. For the four submitted papers, the author wrote the initial drafts. These were reviewed by all co-authors, who provided comments and suggestions for improvement.

Pre-candidature publication: Master of Rehabilitation Counselling

Harrison, C., & Ruddock-Hudson, M. (2017). Perceptions of pain, injury, and transition-retirement the experiences of professional dancers. *Journal of Dance Medicine & Science, 21*(2), 43. doi:10.12678/1089-313X.21.2.43

Peer-reviewed publications during candidature

Study 1:

Harrison, C., Ruddock, S., O'Halloran, P., Mayes, S., Cook, J., & Ruddock-Hudson, M. (2021a). Wellness Monitoring for Professional Ballet Dancers: A Pilot Study. Journal of Dance Medicine & Science, 25(2),80–85. https://doi.org/10.12678/1089-313X.061521b

Study 2:

Harrison, C., Ruddock-Hudson, M., Ruddock, S., Mayes, S., Cook, J., O'Halloran, P., and Ferrar, K. (2020). Self-reported wellness in training and performance: a comparison of professional ballet dancers and professional athletes. *Medical Problems of Performing Artisits*, 35 (4), 196-201. https://doi.org/10.21091/mppa.2020.4028

Manuscripts under review

Study 3:

Harrison, C., Ruddock-Hudson, M., Mayes, S., O'Halloran, P., Ferrar, K., Ruddock, S. and Cook, J. (2021b). An exploration of the perceptions and experiences of professional ballet dancers using a wellness application. *Qualitative Research in Sport, Exercise and Health*.

Manuscript submitted for publiction: currently under review.

Study 4:

Harrison, C., Ruddock-Hudson, M., Mayes, S., O'Halloran, P., Ferrar, K., Ruddock, S. and Cook, J. (2021c). Exploring mindfulness practice for professional ballet dancers: a pilot study. *Applied Psychology: Health and Wellbeing*.

Manuscript submitted for publiction: currently under review.

Conference abstracts

Harrison, C., Ruddock-Hudson, M., Ruddock, S., Mayes, S., O'Halloran, P., and Cook J. (2019). Wellness monitoring in Professional Ballet Dancers: A pilot study. *Australian Journal of Science and Medicine in Sport.* 22(S2): S75–S115. Sports Medicine Australia Conference, Twin Waters, QLD, Australia.

Harrison, C., Ruddock-Hudson, M., Ruddock, S., Mayes, S., O'Halloran, P., and Cook J. (2019). Self-reported Wellness Profiles: Comparing Professional Ballet Dancers to Professional Athletes. *Journal of Science and Medicine in Sport* 22: S51. Sports Medicine Australia Conference, Twin Waters, QLD, Australia.

MANUSCRIPTS INCLUDED IN THIS THESIS

Peer-reviewed publication

Harrison, C., Ruddock, S., O'Halloran, P., Mayes, S., Cook, J., & Ruddock-Hudson, M. (2021a). Wellness Monitoring for Professional Ballet Dancers: A Pilot Study. Journal of Dance Medicine & Science, 25(2),80–85. https://doi.org/10.12678/1089-313X.061521b

Study 1, incorportaed as Chapter five.

Contributor	**Statement of contribution**
Author Carly Harrison (candidate)	Designed experiments (50%) Statistical analysis (45%) Wrote and edited paper (60%)
Author Mandy Ruddock-Hudson	Designed experiments (10%) Statistical analysis (10%) Wrote and edited paper (8%)
Author Scott Ruddock	Designed experiments (10%) Statistical analysis (35%) Wrote and edited paper (8%)
Author Paul O’Halloran	Designed experiments (10%) Statistical analysis (10%) Wrote and edited paper (8%)
Author Susan Mayes	Designed experiments (10%) Wrote and edited paper (11%)
Author Jill Cook	Designed experiments (10%) Wrote and edited paper (5%)

Peer-reviewed publication

Harrison, C., Ruddock-Hudson, M., Ruddock, S., Mayes, S., Cook, J., O'Halloran, P., and Ferrar, K. (2020). Self- reported wellness in training and performance: a comparison of professional ballet dancers and professional athletes. *Medical Problems of Performing Artisits*., 35 (4), 196-201. https://doi.org/10.21091/mppa.2020.4028.

Study 2, incorporated as Chapter six.

Contributor	**Statement of contribution**
Author Carly Harrison (candidate)	Designed experiments (50%) Statistical analysis (55%) Wrote and edited paper (60%)
Author Mandy Ruddock-Hudson	Designed experiments (10%) Wrote and edited paper (5%)
Author Scott Ruddock	Designed experiments (10%) Statistical analysis (45%) Wrote and edited paper (10%)
Author Susan Mayes	Designed experiments (10%) Wrote and edited paper (10%)
Author Jill Cook	Designed experiments (10%) Wrote and edited paper (5%)
Author Paul O’Halloran	Designed experiments (10%) Wrote and edited paper (5%)
Author Katia Ferrar	Wrote and edited paper (5%)

Manuscript under review

Harrison, C., Ruddock-Hudson, M., Mayes, S., O'Halloran, P., and Ferrar, K., Ruddock, S., and Cook, J. (2020b). An exploration of the perceptions and experiences of professional ballet dancers using a wellness monitoring application. Qualitative Research in Sport, Exercise and Health. Submitted. Status: under review.

Study 3, incorportaed as Chapter seven.

Contributor	**Statement of contribution**
Author Carly Harrison (candidate)	Designed experiments (50%) Statistical analysis (65%) Wrote and edited paper (60%)
Author Mandy Ruddock-Hudson	Designed experiments (10%) Statistical analysis (20%) Wrote and edited paper (10%)
Author Susan Mayes	Designed experiments (10%) Wrote and edited paper (5%)
Author Paul O’Halloran	Designed experiments (10%) Statistical analysis (15%) Wrote and edited paper (10%)
Author Katia Ferrar	Wrote and edited paper (7%)
Author Scott Ruddock	Designed experiments (10%) Wrote and edited paper (5%)
Author Jill Cook	Designed experiments (10%) Wrote and edited paper (2%)

Manuscript under review

Harrison, C., Ruddock-Hudson, M., Ruddock, S., Mayes, S., Cook, J., O'Halloran, P., and Ferrar, K. (2020c). Exploring mindfulness practice for professional ballet dancers: a pilot study. *Applied Psychology: Health and Well-being*. Submitted. Status: under review.

Study 4, incorportaed as Chapter nine.

Contributor	**Statement of contribution**
Author Carly Harrison (candidate)	Designed experiments (50%) Statistical analysis (60%) Wrote and edited paper (60%)
Author Mandy Ruddock-Hudson	Designed experiments (10%) Statistical analysis (5%) Wrote and edited paper (8%)
Author Susan Mayes	Designed experiments (10%) Wrote and edited paper (5%)
Author Scott Ruddock	Designed experiments (10%) Statistical analysis (30%) Wrote and edited paper (12%)
Author Katia Ferrar	Wrote and edited paper (8%)
Author Paul O’Halloran	Designed experiments (10%) Statistical analysis (5%) Wrote and edited paper (5%)
Author Jill Cook	Designed experiments (10%) Wrote and edited paper (2%)

Statement of parts of the thesis submitted to qualify for the award of another degree

None

LIST OF ABBREVIATIONS

AAQ-II	Acceptance and Action Questionnaire, version II
AFL	Australian Football League
AMS	Athlete Management System
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
ANZCTR	Australian New Zealand Clinical Trials Registry
App	Application
ASRM	Athlete Self-Report Measure
BCE	Brief centring exercise
CI	Confidence Interval
EAP	Employee Assistance Program
IADMS	International Association Dance Medicine and Science
M	Mean
MAC	Mindfulness-Acceptance-Commitment
MAAS	Mindful Attention Awareness Scale
MIS	Mindfulness Inventory for Sport
OR	Overreaching
OSTRC	Oslo Sports Trauma Research Centre
OTS	Overtraining syndrome
PAHM	Performing Artist and Athlete Health Monitor
PIS	Participant Information Statement
PST	Psychological Skills Training
RCT	Randomised Controlled Trial
REST-Q	Recovery-Stress Questionnaire

RPE	Rate of perceived exertion
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
sRPE	Session-rating perceived exertion
TAB	The Australian Ballet
TL	Training load
WHO	World Health Organisation

ACKNOWLEDGEMENTS

I would firstly like to thank and acknowledge my La Trobe supervisory team who have been a great support to me throughout this doctorate journey. Your guidance, trust and wisdom over the years has been phenomenal. Thank you for being such inspiring role models. A special thank you to Mandy Ruddock for encouraging me to pursue further research to expand my skills, knowledge and qualifications. As a supervisor, mentor and friend, it has been a pleasure working with you, extending our research collaboration over subsequent years through this doctorate process. A big thank you also to Scott Ruddock for the hundreds of hours you have dedicated to working through the research design, statistics and analyses with me. As the statistics guru, I have really valued your willingness to be available to me consistently over the journey and for further educating me in quantitative research methods. Finally, thank you to Paul O'Halloran for your support and assistance, specifically in the earlier components in developing the framework for this research and your feedback throughout the years.

A massive thank you to The Australian Ballet for supporting this research. You have encouraged, trusted, and enabled me to complete this PhD which has been an absolute dream. Researching with you has been so rewarding and I hope to further connect with, and work with you in the future. Thank you to Sue Mayes especially for your support and for all of your guidance and assistance with the compilation of the manuscripts. Your trust in me to co-develop the App and mindfulness intervention and to present findings to peers at conferences is greatly appreciated. I feel extremely lucky to have worked with you throughout this journey and cannot thank you enough for the opportunity to work with the dancers. Thank you also to Jill Cook for your wisdom and encouragement especially through the planning and development process and for connecting me with The Australian Ballet as part of the La Trobe University partnership. A final thank you to Katia Ferrar for joining the team more recently and assisting with the development of manuscripts. Your guidance and feedback have been greatly appreciated.

To all of the research participants, dancers and athletes, I cannot thank you enough. You have enabled this dream to come alive and I am in awe of you as professionals, as friends and as my idols. Without your input this research would not have been possible, and I am forever grateful to you. It was such a special experience for me to work with you in the development of the wellness App and to meet with you to explore your experiences and perceptions through the focus groups and individual interviews. Your willingness to open up and be honest about your experiences has added great insight and I truly cannot thank you enough. What an absolute pleasure it was to work with you.

Thank you to my work colleagues, my parents, my family and friends for your ongoing encouragement, patience, and support. I feel incredibly lucky to have such a supportive environment. Special acknowledgement of Harvey (my fur baby) throughout this journey, thanks for always sitting beside me or on me while I was busy typing and entering stats and for your company on the late nights and early mornings writing this thesis.

From the moment my primary supervisor Mandy suggested I apply to complete a PhD I have been committed to this challenge. There have been a number of obstacles throughout this time both within and outside of my PhD research, however I will always be grateful for the lessons this PhD journey has taught me. I am both ecstatic to complete this degree and reach such a milestone, and sad that it’s finished at the same time. Thanks again Mandy for seeing the potential in me and encouraging me to take on this challenge. What a journey it has been. Thank you also to La Trobe University for funding a scholarship to pursue this research.

Fall asleep with a dream, wake up with a purpose and live life to the fullest.

Keywords

Ballet, wellness, prevention, holistic well-being, coping, avoidance, psychological health, wellness monitoring, mindfulness, mindfulness-acceptance-commitment.

Scholarship

This work was supported by an Australian Government Research Training Program Scholarship.

Ethical considerations

All research procedures reported in this thesis were approved by the appropriate ethics committee (Appendix A) (Studies 1-3: HEC Number S17-224) (Study 4: HEC19093).

The Australian Ballet images

Permission has been provided to include images from The Australian Ballet throughout this documentation. Photographers: Taylor-Ferne Morris, Georges Antoni, Justin Ridler. Artists: Valerie Tereshchenko, Benedicte Bemet, Isobelle Dashwood, Chris Rodgers-Wilson.

ORGANISATION OF THIS THESIS

This thesis comprises framing material and four chapters presented in journal publication format. Chapters four and eight comprise information about the development of a wellness application (App) and the development of a mindfulness intervention. Chapters five and six contain published journal manuscripts and Chapters seven and nine comprise manuscripts that are under review. The final discussion chapter of this thesis highlights the contribution of this research.

Chapter one introduces the key overarching themes for this thesis. High performance sport has adopted monitoring systems to explore wellness, training load and injury however in professional ballet such systems are scarce. Dancers are required to maintain strong body-mind awareness and connections, and the incorporation of mindfulness practice to enhance holistic well-being requires further exploration.

Chapter two contains research that examines wellness, work-related activity, and injury in dance and in sport and the application of Athlete Management Systems (AMS) and wellness monitoring Apps. This chapter also explores mindfulness application with athletes and dancers. Further this chapter reviews the stress-injury theoretical model (Andersen & Williams, 1988).

Chapter three provides a summary of the thesis aims and concludes with the research objectives and specific aims for each of the four research studies.

Chapter four outlines the development process of a dance-specific wellness App and explains how the App was established from sporting frameworks for consistency, whilst also aiming to be specific for the dance population.

Chapter five presents a published pilot study exploring the use of a wellness App over 1-month. The paper titled ‘Wellness monitoring for professional ballet dancers: a pilot study’ was published in the Journal of Dance Medicine and Science, 2021. A wellness App had not been previously trialled in an Australian professional ballet company. Accordingly, the aim was to explore the use and feasibility of a wellness App with a sample of dancers from a professional ballet company. The findings supported the use of a dance-specific wellness App and focus group data guided alterations to the App for use in subsequent research studies for this thesis.

Chapter six presents the manuscript arising from Study 2. This manuscript titled 'Self-report wellness in training and performance: a comparison of professional ballet dancers and professional athletes' was published in the Medical Problems of Performing Artists journal in December 2020. The overarching aim of the study was to compare wellness profiles of athletes and dancers over 4-months. Dancers' wellness was found to be comparable to athletes, with poorer wellness recorded by both groups in performance for stress and fatigue. Monitoring wellness patterns in training and performance may help guide early intervention strategies to prevent illness and injury.

Chapter seven comprises a manuscript that has been submitted and is under review for consideration by the journal of Qualitative Research in Sport, Exercise and Health. The aim of the study was to explore the perceptions and experiences of dancers using a wellness App over 4-months. Wellness Apps may provide opportunities for dancers to develop positive adaptive attitudes, behaviours, and responses to poorer wellness scores. The findings of this chapter highlight the importance of education and support when implementing self-monitoring Apps for dancers and athletes, to enhance optimal well-being in training and performance.

Chapter eight outlines the development process of a mindfulness intervention and a description of the session topics for both the intervention and control groups in Study 4.

Chapter nine comprises a manuscript that has been submitted and is under review for consideration by the journal of Applied Psychology: Health and Well-being. The aim of the study was to explore the practicality of a mindfulness intervention via a randomised controlled trial (RCT) with a mindfulness group and a control group. Although no statistically significant differences between pre- and post- intervention for both mindfulness and control groups were found, trends were observed that warrant further exploration. A decrease in non-judgement scores, an upward trend in levels of refocusing and an upward trend in levels of acceptance and action for the MAC group between pre- and post-intervention was identified. Dancers were interviewed to help guide future designs for the potential embodiment of mindfulness practice into ballet and dance companies.

Chapter ten brings together the findings of the doctoral research. Collectively, the findings of this thesis provide preliminary support for wellness monitoring and mindfulness practice in ballet. A dance-specific App appears to be a practical method for monitoring wellness, work-related activity, and participation, sensitive to changes and fluctuations. An improved understanding of the value of mindfulness practice in ballet and how this may be incorporated into dancer's schedules requires further exploration. Dancer's provided suggestions to improve future development and implementation of a wellness App and mindfulness practice. This chapter concludes with a discussion of the limitations of the studies, implications for dancers and dance companies and directions for future research.

Picture 2. The Australian Ballet.

CHAPTER ONE:

INTRODUCTION

This chapter comprises a brief introduction to wellness and well-being and discusses the use of systems to monitor these variables in professional sport. Brief details on how mindfulness can influence performance and well-being are also included to provide a rationale for the doctoral research.

According to the World Health Organisation (WHO) health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (WHO, 2014). The New Economics Foundation (2012) define well-being as a construct that incorporates how people feel and function on personal and social levels and how people perceive and evaluate the quality of their lives as a whole. The multi-dimensional composition of holistic well-being generally includes at least 6 dimensions; physical, mental, emotional, social, spiritual, and environmental (see Figure 1) measured on a continuum that extends from illness to a state of optimal well-being. Whereas wellness is the active pursuit of activities, choices and lifestyles that lead to a state of holistic health (National Wellness Institute, 2010). Whilst there are common elements among wellness, health and well-being terms, wellness is distinguished by not referring to a static state of being (e.g., happiness) and is instead associated with an active process of being aware and making choices that lead toward an outcome of optimal holistic health and well-being (National Wellness Institute, 2010).

Figure 1. Six dimensions of wellness.

(National Wellness Institute, 2010).

Holistic well-being and wellness have not traditionally been integrated into the operations of most organisations (Dickson-Swift, Fox, Marshall, Welch, & Willis, 2014), however companies are now seeking to invest money into these areas, as the benefits of encompassing holistic well-being in workplaces is becoming further apparent and expanding (Burton, 2010; Debbie, 2016; Dickson-Swift et al., 2014). Workplace wellness initiatives have evolved with the development and application of assessments such as diagnostic tests and technological advances (for example wearable monitoring devices), that represent a growing market worth $40.7 billion globally (Burton, 2010). The WHO advise that a healthy workplace involves collaboration between workers and managers with a focus on continual improvement processes to protect and promote the health, safety and well-being of all workers (Burton, 2010; WHO, 2014). Well-being programs that are cost-effective, flexible, and easily accessible (e.g., via smart phones and Apps) are more often adopted by organisations (Meyers, van Woerkom, & Bakker, 2013; Seth et al., 2014). Well-being programs have been found to positively impact physical health by decreasing cardiovascular disease and pain, and enhancing longevity, immune functioning, and overall health (Boehm, Vie, & Kubzansky, 2012; Diener & Chan, 2011; Pressman, Gallagher, & Lopez, 2013). Furthermore, organisations can profit from well-being initiatives that are associated with reductions in absenteeism, enhanced job satisfaction (Bowling, Eschleman, & Wang, 2010), fewer staff turnover (Jenkins & Delbridge, 2014), and enhanced performance and productivity (Cropanzano & Wright, 2001).

High performance sporting organisations have adopted corporate models where athletes are accountable to a range of stakeholders such as team managers, CEOS, coaches, and sponsors. Professional ballet companies alike, provide a working environment for dancers to pursue a career and obtain an income. Professionalism in ballet, as in sport, derives from a combination of training, career commitment, income and time allocation (Jeffri & Throsby, 2006).

The Australian Ballet (TAB) was established in 1962 and is Australia's national ballet company. TAB is comprised of 74 professional dancers supported by artistic staff and a medical team compromising specialists in physiotherapy, strength, and conditioning, myotherapy, rehabilitation, sport and exercise physiology and psychology. In 2019, TAB successfully produced over 160 mainstage performances in four capital cities and 14 regional performances, with a total audience attendance of 245,270. Artists at the TAB have high workloads, performing up to 200 times a year and travelling nationally and internationally for 5-months of the year. They work approximately 48-hour weeks, and their daily schedule usually includes over one hour of technique training in a ballet class, at least three hours of repertoire rehearsals, and at least one half-hour warm-up before a performance that can last for an average of three hours. Between their dance commitments, dancers may take part in strength and conditioning, and attend medical appointments or treatment to manage or prevent injury. Therefore, exploration of dancer activity and wellness at TAB could provide valuable insight into the possible injury risks to guide intervention developments and supports for dancers.

Although engagement in sport and physical activity have been promoted as important for sustaining and improving good health (Artero et al., 2011; Blair, Kohl, Gordon, & Paffenbarger, 1992; Fernhall, Heffernan, Jae, & Hedrick, 2008), physical activity can also increase the risk of injury (Mummery, Schofield, & Spence, 2002; Stevenson, Hamer, Finch, Elliot, & Kresnow, 2000). For athletes and dancers, aches and pains have been conceptualised as expected and an integral component of their profession (Anderson & Hanrahan, 2008; Harrison & Ruddock-Hudson, 2017a). Comparable with athletes, professional ballet dancers are at risk of injuries that can impact quality of performance and diminish a career (Deleget, 2010; Jeffri & Throsby, 2006) and this can have devastating impacts on individuals, families, and ballet companies.

In ballet there is often a culturally embedded perspective that dancers may need to "suffer for their art" (Aalten, 2007; Jeffri & Throsby, 2006; McEwen & Young, 2011; Tajet-Foxell & Rose, 1995). Performing arts institutions appear to be in the experimental phases of developing strategies and processes to enhance and strengthen the health and well-being of their artists (Brandfonbrener, 2004; Clark, Gupta, & Ho, 2014; Hopper et al.; Karreman, Keizer-Hulsebosch, & Stubbe, 2019). To enhance dancer's holistic health and functional capacity, additional research is therefore required to further expand the industry's awareness, knowledge and competency to detect, rehabilitate and prevent health ailments (Liederbach, Schanfein, & Kremenic, 2013). A multi-dimensional and holistic approach to dancer well-being may provide a comprehensive understanding of injury causality, and further extend the development of specific holistic well-being interventions and guidelines (Mendiguchia, Alentorn-Geli, & Brughelli, 2012; Plsek & Greenhalgh, 2001; Quatman, Quatman, & Hewett, 2009). Links between wellness variables (for example sleep quality and quantity, fatigue, stress and muscle soreness), injury incidence and training load (Killen, Gabbett, & Jenkins, 2010; Watson, Brickson, Brooks, & Dunn, 2017) have been collectively monitored in professional sport such as in the Australian Football League (AFL), Cricket, Tennis, Rugby League, Rugby Union, Baseball and the National Basketball Association (Gastin, Meyer, & Robinson, 2013; Halson, 2014a; McLellan, Lovell, & Gass, 2011; Nunes et al., 2014), but not consistently in professional ballet. Wellness Apps in ballet companies could be further developed and programmed to alert dancers and medical staff to possible fluctuations in wellness and potential injury risk. Additionally, in professional ballet, there is limited published research that explores possible relationships between wellness, work-related activity and the potential impact on injury, illness and participation in training and performance. Accordingly, a wellness monitoring App was developed and implemented into TAB via an Athlete Management System (AMS) framework to monitor wellness and promote awareness of holistic well-being.

To further assist in the development of optimal performance states, psychological interventions established from evidence-based mindfulness and acceptance-based approaches have been designed specifically for professional athletes, to further enhance athletic well-being and performance (Moore, 2009). Mindfulness has been explored throughout athletic research and has been associated with reduced burnout levels (Bernier, Thienot, Codron, & Fournier, 2009; Gardner & Moore, 2012; Jouper & Gustafsson, 2013; Moore, 2009; Walker, 2013) and reduced injury incidence (Ivarsson, Johnson, Andersen, Fallby, & Altemyr, 2015). The core focus of mindfulness practice is that internal cognitive and emotional states should not be regulated, altered or excluded to achieve positive behavioural outcomes (Moore, 2009). Instead, when adopting a high level of mindfulness, it is suggested that athletes are better connected to internal and external stimuli without overreacting or losing their focus, which can benefit performance quality and output (Gardner, 2007; Gardner & Moore, 2004). Dancers are required to maintain strong body-mind connections and awareness, however review of the current literature exploring mindfulness specifically in dance is relatively scarce (Moyle, 2016). Mindfulness may be a viable practice for professional ballet dancers to adopt and further exploration of the potential benefits is required (Moyle, 2016). Subsequently, a mindfulness intervention was developed and implemented, including both mindfulness education and practical techniques, to preliminarily explore the usefulness of an intervention aimed at improving well-being in professional ballet.

CHAPTER TWO:

BACKGROUND

To establish the feasibility of a self-report wellness measure in ballet, this chapter explores professional ballet dancer work demands, injury and illness, wellness in dance and preliminary dance-health surveillance systems. In an effort to understand subjective wellness monitoring in comparable professions, exploration of AMS with professional athletes are also included in this chapter. Mindfulness research with athletes and dancers is also reviewed. Mindfulness practice may be a valuable tool for dancers to embrace to potentially enhance performance, decrease injury risk and improve well-being and mindfulness interventions aligned with the core principles of the stress-injury theoretical model have been recommended.

The aim of this chapter is to therefore introduce and review the literature pertaining to the key research objectives for this doctoral research, distributed into the following sections:

i) Professional dancers: injury, illness, training load, pain, wellness, and dance health surveillance systems.

ii) AMS: monitoring athlete wellness (fatigue, stress, muscle soreness, sleep), wellness and athletic work-related activity, overreaching and the Oslo Sports Trauma Research Overuse (OSTRC) injury questionnaire.

iii) Mindfulness: The Mindfulness-Acceptance-Commitment (MAC) approach, mindfulness and injury prevention and mindfulness and dance.

iv) The athletic stress-injury theoretical model: personality, history of stressors, coping resources and interventions.

2.1 The Professional Dancer

Professional ballet dancers are highly skilled artists and athletes (Gamboa, Roberts, Maring, & Fergus, 2008; Koutedakis & Jamurtas, 2004) performing complex repertoires that require aesthetic and athletic ability (Downs, 2013; Gamboa et al., 2008; Koutedakis & Jamurtas, 2004; Twitchett, 2010). As in most sports, dancers are required to be physically fit, able to work under aerobic and anaerobic demands, with high levels of muscular strength (Gallotta, Emerenziani, Luigi, Guidetti, & Baldari, 2005; Koutedakis & Jamurtas, 2004) agility, control, and be psychologically ready to perform (Koutedakis & Jamurtas, 2004).

Ballet is an art-form that encompasses the expression of emotion portrayed through movement of aesthetic quality and exquisite technique. Ballet dancers have unique abilities to perform graceful, vigorous, and explosive repertoires appearing effortless to their audiences. The development of strength, coordination, technique, skill, elegance and artistry is the central focus (Kelman, 2000). To achieve these qualities, for the majority of dancers specialist ballet training commences from an early age, with the average full-time dancer commencing from 15 years old (Ekegren, Quested, & Brodrick, 2014). The number of dancers who progress to professional status however is minimal and very competitive. Out of 20,000 students auditioning annually for company-affiliated schools, approximately 10% are selected and only 0.1% of these dancers progress to perform on stage professionally (Liederbach et al., 2013).

Artistic directors and company staff rank professional dancers ascending from Corps de ballet, Coryphee, Soloist, Senior Artist and Principal Artist, with each rank comprised of varying workload pressures and associated demands (Table 1).

Table 1. Professional dancer ranks.

Corps de ballet	Dancers perform in a group, working together as one unit. Corps de ballet tend to complete the same chorography in unison performing complicated steps and movements at the same time. Corps de ballet means the “body” of the ballet company—they form the backbone.
Coryphee	Coryphee are leading dancers in the Corps de ballet and are sometimes given solo parts because of their experience, expertise, and skills.
Soloist	Soloists may perform both group dances and solo roles. Soloists may often learn principal roles as understudies.
Senior Artist	Defined as rising stars, Senior Artists perform solos predominantly, and less frequently perform group dances.
Principal Artist	A Principal Artist is the highest rank in a professional ballet company. Principals regularly perform both solo and pas de deux (partner work). Principal Artists are the leaders of the company on stage and are public role models. There is a responsibility both on stage and in being an ambassador for the company.

A professional dancer’s work schedule generally commences with class, consisting of low to modest intensity, with short peaks of elevated intensity for approximately 90 minutes (Twitchett, 2010). A ballet class conventionally consists of three distinct elements: a) barre exercises, representing low to moderate intensity, b) centre floor sequences of moderate intensity, and c) centre floor sequences, including jumps, travelling, and mid-air turns of higher intensity (Twitchett, Koutedakis, & Wyon, 2009). Dancers' oxygen uptake (%Vo2 max) were explored in each of these three elements and found to be 36% in barre exercises, 43% in moderate intensity of centre floor sequences, and 46% of maximum capacity in elevated centre floor exercises (Twitchett et al., 2009). These oxygen capacity percentages indicate the intensity required to complete the technical components in each element. In classical performances, heart rates increase rapidly during the first one to two minutes of dancing (Twitchett et al., 2009). During the allegro (jumping) sections, the average peak heart rate increases rapidly to values comparable to vigorous athletic challenges such as short and middle-distance running (Twitchett et al., 2009). The work-rest proportions during allegro sections have been found to range from 1:1.6 to 1:3, comparable to racquet sports such as squash or tennis (Glaister, 2005). Slower adagio sections involve balances and controlled movements at a lower intensity, are often sustained for greater intervals, and produce lower heart rates in contrast to allegro sections (Twitchett et al., 2009). To further enhance fitness, it was recommended that 2-3 classes per week be substituted with physical conditioning classes, adopting dance movements to elicit a training effect and for these conditioning classes to amalgamated into class plans and schedules (Twitchett et al., 2009).

A further study was conducted by Twitchett and colleagues (2010) to explore possible fatigue relationships with workload and rest durations in professional ballet dancers. Fifty-one female ballet dancers' activities were mapped in a company across a standard workday from a range of ranks (*n*=7 Corps de ballet, *n*=16 Senior Artists, *n*=12 Soloists, *n*=16 Principal Artists). Data regarding a single workday, from 9.30am to 6.30pm was collected over a 3-week period. Participants wore an accelerometer armband device daily that estimated energy disbursement in kilocalories and training intensity in metabolic counterparts in their right upper arm. The main conclusion of the study was that dependent on their rank in the company, dancers had dissimilar workloads within one day, with Soloists having the highest average exercise intensity rating and the least amount of rest. Ninety percent of the dancers had less than 60 successive minutes of rest, and one-third had less than 20 minutes rest during the day (Twitchett, 2010). Soloists and Principal Artists had shorter rest breaks than did Senior Artists and Corps de ballet dancers. Twitchett and colleagues (2010) concluded that all dancers in their study, across differing ranks were potentially at a heightened risk of fatigue and injury due to minimal rest time, compared to work periods. Thus, it was suggested that further insight into dancers' work and rest durations be explored, as these factors may be valuable to company healthcare teams in establishing whether daily schedules and intensity of work are contributing to the onset of injury and specific injury trends among dancer ranks. It was therefore recommended that future research 1) engage a greater number of dancers over longer periods of time; and 2) include a varied sample of dancers from alternate companies, to further explore injury trends and risks related to workload and work-related demands across different ranks of professional dancers (Twitchett, 2010).

2.1.1 Dance injuries

Identifying and defining injury

The dance profession involves extensive exertion, athleticism, artistry, preparation, dedication and determination (Bronner, 2011), and consequently, dancers may be at risk of injuries during training, rehearsal and performance periods (Noh, Morris, & Andersen, 2005). Systematic overload (e.g., overuse injuries) involving the lower extremities and lower back have been consistently reported, with professional ballet dancers training up to 40 hours per week in addition to performances (Allen, Nevill, Brooks, Koutedakis, & Wyon, 2012; Zaletel et al., 2017). The injury incidence rates of professional dancers range from 0.62 to 5.6 per 1000 hours of exposure (Allen et al., 2012; Bronner, Ojofeitimi, & Rose, 2003) with the variation attributed to injury definition, dance style and repertoire. In professional ballet specifically, dancers have recorded an incidence of 4.44 injuries over twelve months per 1000 hours of dance (Allen et al., 2012), professional soccer players have recorded 9.4 injuries per 1000 hours of exposure (Hägglund et al., 2013), professional rugby players have recorded 20.7 injuries per 1,000 training hours (Gabbett & Godbolt, 2010) and 41.7 injuries per club per season in AFL have been reported (Saw et al., 2018). Comparatively, incidence of injury in ballet appears lower than other sports, however caution must be considered when interpreting these findings as injury definition, reporting, and recording measures are not consistently and systematically applied across various sports, impacting overall generalisability and comparison despite recommendations for consistent methodologies to be adopted (Brooks, Fuller, Kemp, & Reddin, 2005; Finch & Boufous, 2008; Williams et al., 2016). Further, injury complaints may be under-reported by some athlete groups dependent on the accessibility of healthcare professionals or pressure to perform (Bronner & Wood, 2017).

As a result of conflicting injury definitions, recording of injury data in dance is challenging (Bronner, 2011). Varying injury definitions have impacted generalisability of research findings, with some studies defining injuries by time loss due to an inability to train or compete (Hootman, Dick, & Agel, 2007) and others categorised as medical attention following care from a medical practitioner (Hiller, Refshauge, & Beard, 2004). To address differing injury descriptions in the dance literature, the International Association for Dance Medicine and Science (IADMS) recommended in 2012 that the definition of dance-related injury be classified by full time loss and be diagnosed by a medical practitioner (Liederbach & Richardson, 2007). However, dance literature has also revealed that dancers are reluctant to report injuries, indicating that dancers may not feel comfortable seeing a physician in fear they may be instructed to stop dancing (Lai, Krasnow, & Thomas, 2008; Thomas & Tarr, 2009) and therefore these injuries would not be categorised according to the IADMS definition. Adopting time loss definitions in dance may result in underreporting of injuries and similarly in Cirque du Soleil performers a parallel concern was identified (Bolling, Mellette, Pasman, van Mechelen, & Verhagen, 2019). The circus environment comparable with dance, combines artistic and athletic performance and a typical workweek for an artist consists of an average of 8–10 shows, spread over 5–6 consecutive days (Bolling et al., 2019). The requirement to modify training and show performances has been described as a common consequence of an injury in Cirque du Soleil performers, therefore reflecting the potential underreporting of injuries when applying time-loss definitions for these artists (Bolling et al., 2019). A high prevalence of chronic and overuse problems in dance has been reported (Allen et al., 2012; Bronner & Wood, 2017; Gamboa et al., 2008). Therefore adopting an injury definition of time loss in dance may consequently underestimate injury burden (Kenny, Palacios-Derflingher, Whittaker, & Emery, 2018).

Injury location

In ballet, it has been consistently reported in the literature that dance injuries occur most frequently in the foot, ankle, knee, and lumbar spine regions, due to the technical composition and extreme demands on the lower limbs (Allen et al., 2012; Dawson, 2000; Ekegren et al., 2014; Gamboa et al., 2008; Garrick & Requa, 1993; Koutedakis & Jamurtas, 2004; Nilsson, Leanderson, Wykman, & Strender, 2001; Sobrino, de La Cuadra, & Guillén, 2015). The number of days lost from work due to injury range from 7-28 days among professional dancers (Bronner et al., 2003; Byhring & Bø, 2002; Nilsson et al., 2001), with 90% of time loss due to foot and ankle injuries (Byhring & Bø, 2002). Exploring injury incidence and severity with 52 professional ballet dancers over 12-months, Allen and colleagues (2012) reported the magnitude of injuries sustained in their study were to the lower leg, ankle and lumbar regions (Figure 2). Differing injury pathologies have been reported between genders according to the work-related demands required. For example, in males, an increase in shoulder, lumbar and thoracic injuries have been attributed to the nature of lifting female dancers. Whereas the incidence of foot muscle spasms strains/ tears and first metatarsophalangeal joint pain has been found to be more prevalent in female dancers and related with performing en pointe (Allen et al., 2012; Prisk, O'Loughlin, & Kennedy, 2008; Russell, 2013).

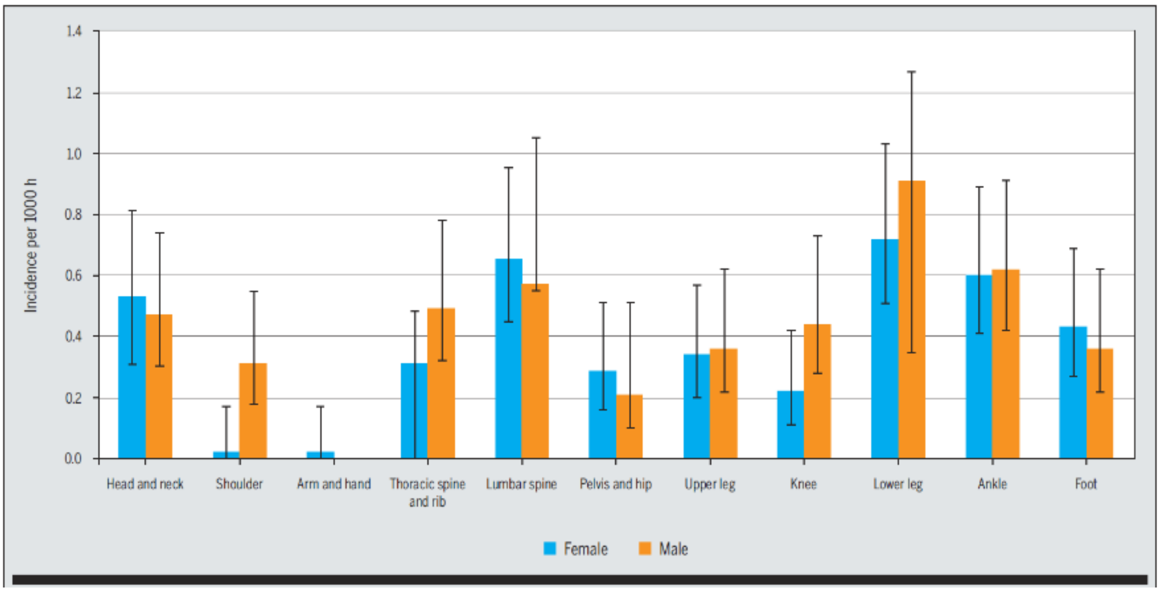

Figure 2. Incidence and injured region for male and female dancers.
(Allen et al., 2012)

Injury incidence

Varying accounts of injury incidence trends have been reported in the dance literature, with no general consensus as to when injuries most occur (Bronner, 2011). It has been reported that there is a greater risk of injury and higher injury incidence when new work is being learned, with repetitive practice to consolidate the choreography (Bronner et al., 2003; Evans, Evans, Carvajal, & Perry, 1996; Liederbach, Gleim, Dilgen, & Rose, 2008; Scialom, Goncalves, & Padovani, 2006). During performance seasons, injuries have also been found to occur more frequently when dancers are engaged in additional work-related activity, such as an extra four hours per day (Garrick & Requa, 1993; Liederbach & Gleim, 1992; Liederbach et al., 2008; Liederbach & Richardson, 2007) and in transitioning from rehearsal to performance periods (Bronner & Wood, 2017). For example, just over half of the injuries reported (52%) in a modern dance company arose during the rehearsal period compared to 48% of injuries that occurred in the performance period (Bronner, 2011). These findings suggest that the intensity of rehearsal may contribute to an increased incidence of injuries as a result of the constant repetition of movement during rehearsal (Bronner, 2011).

Further insights into injury incidence were identified in a prospective study involving 50 professional dancers (Allen et al., 2012). A total of 335 injuries were documented, using the time loss definition (mean of 6.8 injuries per dancer) with a mean severity higher in male dancers (9-days) compared with female dancers (4-days) (Allen et al., 2012). An overall injury incidence of 4.4 injuries per 1000 hours in one year was found, with a greater incidence in overuse injuries than traumatic injuries (Allen et al., 2012). A significantly lower incidence of injury during rehearsal periods for both male and female dancers was found, with an average severity of 2-4 days, in comparison to injury incidence in performance which resulted in a significantly greater time loss, with an average of 7 days per injury recorded. Considering the steady exposure to high-impact, high-intensity work in class compared to the more sporadic exposures during rehearsals or performances, Allen and colleagues (2012) stated that they anticipate that with an injury definition based on the ability to undertake all dance activity required, a higher proportion of injuries would be reported during class, as it would be within this element that a limitation would be noted. Therefore, in response to the findings of differing injury incidence and time loss durations between dance-related activities, Allen and colleagues (2012) recommended to reduce injury risk future research incorporate interventions that acknowledge differing work demands in their design, considering the potentially damaging impact of dance injury for dancers and companies alike.

Dancers often train for 9-10 months of the year (Bronner & Wood, 2017; Fuller, Moyle, Hunt, & Minett, 2020; Gamboa et al., 2008), with 2-3 months of no formal training or work over a calendar year. Accordingly, dance researchers have sought to explore when, throughout a year injury most frequently occurs for injury prevention strategy developments. Over a 40-week contract year, Bronner and colleagues (2003) reported 37%

of injuries occurred in the first ten weeks of training in modern dancers (Bronner et al., 2003). Byhring and Bø (2002) similarly found a relationship with injury and ballet dancers returning to dance at the start of the year, with 59.4% of injuries occurring in the first 2-months of the year (Byhring & Bø, 2002). These findings have implications for artistic staff in considering and planning class components and expectations in the earlier weeks of training following leave periods. An inactive period before intense training and rehearsal periods may contribute to an increased incidence of injuries (Bronner, et al., 2003; Byhring and Bø, 2002) therefore graduated return to dance programs following leave should be incorporated into dancer schedules. For example, the incorporation of cross-training programs into the return to dance scheduling, including aerobic conditioning (treadmill, stationary bike, or swimming), reducing imbalances (strengthening weak muscles and stretching tight muscles), and addressing technique problems (including studying floor barre, yoga, or alternative "body work," such as Pilates training) to build capacity, strength and agility from leave is recommended (Bronner et al., 2003).

A recent retrospective study was conducted at the Royal Ballet with 123 professional ballet dancers, exploring intraseason and interseason differences in medical attention and time loss injury incidence across ranks in five consecutive seasons (Mattiussi et al., 2021). Individualised exposure hours for class, rehearsal and performance were extracted from an online data management system and calculated for each dancer. Time-loss injury severity was calculated as median days lost and the number and percentage of medical attention and time-loss injuries by activity, mechanism, footwear, occurrence, classification and nature were calculated. Among the 2015/2016 and 2019/2020 seasons 1596 medical attention injuries and 543 time-loss injuries were recorded (Mattiussi et al., 2021). Differences in medical attention incidence rates were observed across company rank, with First Soloists and Principals demonstrating an almost two-fold greater incidence rate compared with Apprentices and medical attention injury incidence rates were greater during the start and the end of the season compared with mid-season (Mattiussi et al., 2021). Time-loss injury incidence rate in Mattiussi and colleagues (2021) research is consistent with published literature in dance (Allen et al., 2012; Byhring & Bo, 2002; Nilsson et al., 2001); however, the severity of time-loss injures was greater, with 35% of injuries resulting in more than 28 days of modified dance activity (Allen et al., 2012; Byhring & Bo, 2002). The most common mechanism of time-loss injury was jumping and landing activities, with 56% of all days lost to time-loss injury were classified as 'restricted' as opposed to 'off, suggesting that dancers may have been participating in some form of dance activity while injured (Mattiussi et al., 2021). A high proportion of injuries were overuse in nature and it was suggested that improved management of the rehearsal and performance schedule may mitigate the burden of these injuries (Mattiussi et al., 2021). This research is the first to report longitudinal incidence rate of medical attention and time-loss injuries in professional ballet dancers with differing incident rates across company ranks providing important practical implications to inform targeted injury prevention strategies (Mattiussi et al., 2021).

Changes in a dancer's career status when progressing to full-time training or professional dance present further injury incidence considerations for dancers and dance companies to recognise. Fuller and colleagues (2020) explored the relationship of injuries with transition periods in a dance year and the transition from rehearsal to performance periods in their systematic review and metanalysis. Meta-analyses of seven cohort studies examining pre-professional and professional ballet and contemporary dancers found that the second and third months after returning to dance had a significantly higher rate of injury, potentially signifying a delayed response to the increase in training when transitioning to full training hours. These findings are consistent with fast bowler research in cricket, where similarly a latent response to injury was shown to occur three to four weeks after a spike in training load (Orchard, Seward, & Orchard, 2013). Additionally, increased rates of injury in ballet and contemporary dancers were found to coincide with progression to full-time and professional status (Fuller et al., 2020).

It has therefore been recommended that dance practitioners consider modifying training loads to support dancer health and reduce injury risk in transitioning from pre-professional to professional status and between training, rehearsal and performance periods (Fuller et al., 2020). Additionally, Fuller and colleagues (2020) recommended that future research in dance quantify workloads and consider the intensity of training in injury surveillance practice to provide further depth and insight into injury risk and causality. Elements of periodisation are consistently used in sport for performance optimisation, fatigue management and injury prevention, however these practices are less common in dance and merit further attention (Cunanan et al., 2018; Vassallo, Trevor, Mota, Pappas, & Hiller, 2019; Wyon, 2010).

2.1.2 Training load, injury, and illness

Increased risk of injury and illness has been associated with an inadequate balance between training load (TL) and recovery (Schwellnus et al., 2016), and consequently may induce fatigue and abnormal training responses (Meeusen et al., 2013b). For example, sudden increases and higher than normal weekly TLs were found to be risk factors for musculoskeletal injury in a sample of 46 AFL players (Rogalski, Dawson, Heasman, & Gabbett, 2013). Rogalski and colleagues (2013) therefore recommended that to reduce injury risk, load values should be monitored individually, and load management modifications be included such as reductions in training or game loads to reduce injury risk associated with load increases.

In the dance literature, there is limited of evidence that TL is correlated with the development of physical injuries, or symptoms of overuse injury, and further exploration is required. Boeding and colleagues (2019) sought to investigate TL and overuse injury with 21 professional contemporary dancers and found that the TL of dancers with self-reported symptoms of overuse injury were higher than the TL of dancers with no symptoms (Boeding, Visser, Meuffels, & de Vos, 2019). It was suggested that a combination of TL findings from multiple dance cohorts, may provide greater insight and external validity in examining and exploring associations between TL and injury in dance (Boeding et al., 2019). Therefore, investigations that are longitudinal in nature, and provide comprehensive data on injury incidence and TL are encouraged (Boeding et al., 2019).

In a recent prospective study of 16 professional contemporary dancers (*n*=7 males), injury, illness, and TL data were collected during a 1-year period (2018–2019), in Sydney, Australia (Jeffries et al., 2020). Injuries were defined as medical-attention injury or time loss injury (Jeffries et al., 2020), illness was measured using the Wisconsin Upper Respiratory Tract Infection Survey and TL was collected for each dance session using the session rating of perceived exertion (sRPE). A total of 79 injuries were documented over the 12-months, with most of the injuries resulting in no time loss from dance performance or training, and the majority of injuries occurred to the knee, upper leg and torso. A total of 134 illness episodes were reported with a symptom range from 1-96 days (Jeffries et al., 2020). It was demonstrated that professional contemporary dancers were exposed to high TLs, with participants in the high TL group experiencing the highest injury incidence rate. Additionally, participants in the high and medium TL groups had the highest illness incidence compared to the low TL group. Injury incidence rates for individual sessions ranged from 4.9 per 1000 hours for rehearsal to 3.1 per 1000 hours for performance. Dancers in the low TL percentile group had a greater injury rate at 2.7 per 1000 hours for medical-attention injuries and the smallest injury incidence rate of 0.0 per 1000 hours in the medium TL group as highlighted in Figure 3. For time-loss injuries, performance had the greatest incidence rate for all three categories of TL at 0.7 per 1000 hours. The medical-attention incidence rate (4.6 per 1000 hours) was similar to that reported in a prospective epidemiologic study of professional ballet dancers (4.44 per 1000 hours) (Allen et al., 2012). However, the time-loss injury incidence rate was higher (1.4 per 1000 hours) than in several evaluations of similar contemporary dancers (0.16–0.22 per 1000 hours) (Bronner & Wood, 2017) possibly attributed to differences in repertoire, demographics, and study durations (Jeffries et al., 2020).

Jeffries and colleagues (2020) were the first to examine illness in dancers and were the first to assess injury and training load with time loss and medical-attention injury definition longitudinally. No relation between TL and injury and illness could be demonstrated, however Jeffries and colleagues (2020) suggested potential associations warrant further exploration with appropriate statistical methods and greater sample sizes. It was reported that dancers missed very few performances, despite injury and illness and they continued training, albeit with modifications, even when affected by injury or illness. Collectively, these results suggest that dancers persist with training and performance despite injury and illness (Jeffries et al., 2020). Parallel concepts of persisting through pain and injury are further explored and discussed in the next section of this thesis (2.1.3 implications of dancing in pain). Nevertheless, the health of dancers should be a priority and the development of preventive interventions and educational initiatives ongoing is encouraged (Jeffries et al., 2020).

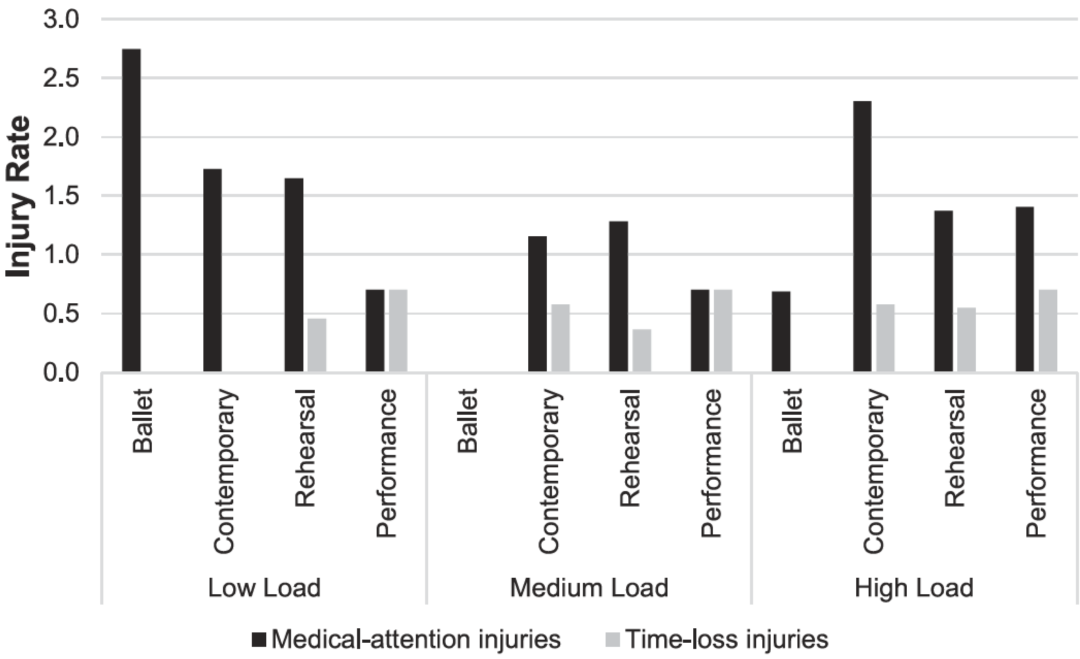

Figure 3. Injury incidence rate per 1000 exposure hours for training load percentiles for each dance session.

(Jeffries et al., 2020)

2.1.3 Implications of dancing in pain

Physical pain is considered to be expected in the dance profession, with dancing and performing with 'niggling injuries' the 'norm' (Aalten, 2007; Thomas & Tarr, 2009; Wainwright & Turner, 2004). Physical injury can have a devastating impact, potentially ending professional careers and impeding on the functioning and well-being of an athlete both short and longer term (Anderson & Hanrahan, 2008). The pain/ballet relationship has been identified and explored in the dance literature, with researchers investigating broader concerns related to dancer's pain, pain coping styles and pain tolerance (Anderson & Hanrahan, 2008; Dawson, 2000; Harrison & Ruddock-Hudson, 2017a; Rivera, 2012; Tajet-Foxell & Rose, 1995; Thomas & Tarr, 2009). In dance, pain tends to be centered on the quantity of, rather than quality of the pain (Rivera, 2012). Dancers may categorise pain as ‘good pain’ (associated with exerting effort and necessary for performance) and ‘bad pain’ (associated with injury experience) (Anderson & Hanrahan, 2008; Thomas & Tarr, 2009). The difference between the two terms may be obscured depending on occupational demands, personality, awareness, and culture, thus distorting dancers' appraisal of pain and inhibiting their subsequent reactions and behaviours to the experience of pain (Anderson & Hanrahan, 2008; Rivera, 2012).

An incapacity to dance presents a major threat to a dancer’s identity as their sense of self is strongly connected with their profession (Wainwright & Turner, 2004). The absent body theory illustrates how incidents of bodily absenteeism are an expression of the notion that the body and mind can be separated (Leder, 1990). Aalten (2007) extended Leder’s (1990) ‘absent body’ theory to explain the process of dancers actively ‘silencing’ their body until such a time as intense pain or physical damage brings the body into awareness. Dancers often actively attempt to embody an alternate dimension to become absorbed and aligned with their performance. As dancers train, their experiences of pain may alter their concentration from the choreography to their bodies (Singh, 2011). For example, it was identified via interviews that dancers systematically silenced their bodies, learning to assess pain as a sign of improvement and infrequently associating pain with the action to stop dancing (Aalten, 2007).

In an exploration of 51 professional dancer’s pain appraisal strategies from Australia, New Zealand, Hong Kong, Singapore and Korea, Anderson and Hanrahan (2008) found that the type of pain experienced did not influence the intellectual assessment or the coping strategies adopted by the dancers to manage the pain. Harrison and Ruddock-Hudson (2017) explored the perceptions of pain and injury interviewing 20 professional dancers (*n*=10 international, *n*=10 professional dancers from Australia) about their experiences of pain, injury, and career transition. Results from both international and Australian dancers revealed that professional dancers withstood, managed, and danced through persistent levels of pain and injury, consistent with previous research (Anderson & Hanrahan, 2008; Thomas & Tarr, 2009). Pain perceptions were consistent between Australian and international dancers as something to be anticipated, controlled, and pushed through and dancers consistently disregarded their pain experiences, risking injury and overlooking the potential implications of dancing through pain on their future health. It was suggested that dancers may have suffered injuries as a result of overlooking their pain experiences, subsequently affecting their professional and post-professional dance careers and quality of life (Harrison & Ruddock-Hudson, 2017a).

To sustain and enhance performance quality, and avert consequences such as; injury, under recovery, overtraining syndrome (OTS) and burnout, it is imperative that professional dancers are able to cope with and recover from varying personal and occupational stressors (Kellmann, 2010b). Maladaptive coping behaviours such as normalising injury (Aalten, 2004), pushing through pain (Harrison & Ruddock-Hudson, 2017a, 2017b) and over-conformity to sociocultural norms are prevalent within dance training and performance conditions (Aalten, 2004; Harrison & Ruddock-Hudson, 2017a; McEwen & Young, 2011), consequently resulting in overtraining and burnout (Blevins, Erskine, Hopper, & Moyle, 2019; Koutedakis & Jamurtas, 2004). Intense workloads and work-related demands may impact on the health and well-being of dancers and the exploration of coping strategies, attitudes, and subsequent behaviours to these demands may provide valuable insight for ongoing support and intervention.

A culture of fear, avoidance and stigma related to injuries is entrenched within the dance and performing arts industry (Jacobs et al., 2017). Furthermore, injury attitudes, job security, and support resources substantially differ due to organisational differences and the influence of full- and part-time contracts, opportunities, and sustainability of work (Vassallo, Pappas, Stamatakis, & Hiller, 2018). For example, to explore injury reporting behaviours in dancers, Vassallo and colleagues (2019) sought to investigate the possible disparities between full- and part-time dancers (Vassallo, Pappas, Stamatakis, & Hiller, 2019). A total of 146 professional dancers reported on their dance training and practice, recent injury occurrence, and injury management behaviours via survey. Over half (63%) of the dancers described that they feared suffering a dance-related injury, believed a stigma regarding injuries in dance was prominent (62%), and reported delay in recording or seeking care for an injury (51%) as a consequence of this stigma. Injured full-time dancers (21.4%) were incapable of dancing in any capacity subsequent to their injury, more frequent than part-time dancers (5.7%) (Vassallo et al., 2018). It was suggested that specialised clinicians for part time dancers may be limited, and therefore part-time dancers may be dancing on injuries where dance practitioners would have offered tailored rehabilitative advice to full-time dancers. Additionally, for a part-time dancer to cease dancing there may be extensive impacts, such as not being able to audition for upcoming work, no paid sick leave and no understudies or multiple casts (Vassallo, Pappas, et al., 2019). Competition within the dance industry, fear of being substituted, and not being viable for roles were found to be ongoing concerns for dancers.

Thus, the dance industry as a whole requires extra guidance and support to provide improved employment stability, to ease some of the fears relating to injury reporting and seeking treatment (Vassallo, Pappas, et al., 2019). Vassallo and colleagues (2019) contend that efficient and customised injury prevention initiatives, secure conditions, and reliable specialist recommendations are required to capture precise injury data, which may be currently compromised by a reluctance to report injuries. To avoid and manage injuries in professional dance, it is essential for practitioners to recognise dance specific stressors that may lead to injuries and to implement strategies and supports to mitigate these risks (Russell, 2013; Vassallo et al., 2018).

2.1.4 Wellness in dance

Performing arts organisations are progressively delivering training programs that encourage health and well-being, combined with the advancement of aptitude and artistry essential for elite performance (Clark et al., 2014). Multi-faceted wellness programs for dancers are scarce, with companies limited in their capacity and resources to implement holistic approaches. Injury screening procedures are becoming progressively utilised in the performing arts industry at both student and elite levels to identify intrinsic factors that might pre-dispose a dancer to injury (Liederbach & Richardson, 2007). Longitudinal screening can help to establish workload requirements and adjustments by assessing the impact of training and performance on dancer's physical well-being (Bronner, Codman, Hash-Campbell, & Ojofeitimi, 2016). In addition to physical ailments and work-demands, performing artists are sensitive to a range of psychosocial factors that can increase injury risk (Adam, Brassington, Steiner, & Matheson, 2004; Noh & Morris, 2004; Noh, Morris & Andersen, 2009). Dancers may be financially stressed, isolated, lonely and limited in their social supports (Hamilton & Robson, 2006) and these elements can impact a dancer's ability to concentrate, self-doubt and critical thinking (Nordin-Bates, 2010). Therefore, encapsulating and examining the interrelationship of physical, psychological, and psychosocial components in the development of wellness programs is vital for recognising how dancers manage their responses to stressors in the dance setting, to ensure optimal performance and recovery.

Often training in front of mirrors, classically trained ballet dancers are exposed to internal and external judgement, that can lead to maladaptive cognitive, emotional and behavioural patterns (Rice & Ashby, 2007). The physical demands and stress of training and performance may combine with psychological and psychosocial factors, negatively influencing the physical and psychological health of dancers (Grove, Main, & Sharp, 2013) and consequently the adoption of maladaptive coping behaviours may ensue. For example, in gymnastics, to prevent rumination of negative thoughts around preparation for performance a “just go for it” thought-stopping strategy has been found to be adopted by gymnasts (Chase, Magyar, & Drake, 2005). Similarly, in a recent exploration of behavioural responses to stress with 12 current and ex-professional ballet and contemporary dancers, it was reported by dancers that they coped with stress by “getting on with it” and “pushing through.” It was recommended that monitoring routines that encourage dancers to track their recovery might also provide additional benefit in assisting dancers to identify coping strategies to maintain recovery–stress balance (Blevins et al., 2019). Thereby, consideration of wellness status for injury prevention, performance quality and overall well-being should be incorporated into monitoring systems in dance, as they have been in sport (Buchheit et al., 2013; Coutts & Reaburn, 2008; Gastin et al., 2013). In the dance literature, monitoring strategies to assess multiple wellness constructs collectively and training distress symptoms are scarce. It is therefore important to implement monitoring strategies to understand dancer’s well-being and work-related demands from both an individual and group perspective, as this allows for consideration of their reported wellness status in real-time and provides opportunity to tailor training and supports accordingly (Halson, 2014).

Manifestations of training distress may emerge if an appropriate balance between training and recovery does not exist, impacting stress, mood states and sleep quality (Grove, et al., 2013). To explore the relationship between psychosocial variables and physical injuries impeding on performance, 54 professional ballet dancers from Germany completed questionnaires relating to perceived stress, social support, mood, and sleep quality, in addition to participating in a structured interview discussing dance related-injuries that arose over a 10-month previous performance season (Adam, Brassington & Matheson, 2004). Injury incidence and duration of absence due to dance-related injuries was recorded using a definition of any medical problem resulting from dance participation that restricted subsequent participation for at least one day beyond the day the injury occurred (Garrick & Requa, 1993; Smith et al., 2015). Forty-seven participants (87% of the sample) reported sustaining at least one dance related injury during the 10-month performance season. On average, dancers were unable to fulfil their professional obligations due to injuries for 42.8 days out of a possible 286 rehearsal and performance days (Adam, Brassington & Matheson, 2004). A significant relationship between psychological distress and the percentage of time during the season that dancers were unable to perform was found (Adam et al., 2004). Further, sleep problems (e.g., trouble falling asleep and poor sleep quality) and daytime sleepiness were significantly related to dance injuries (Adam et al., 2004). Psychological problems such as depression, anxiety, and poor sleep may be associated with decreased concentration, daytime sleepiness, fatigue, unhealthy eating, and substance use (Adam et al., 2004). Given the high-performance demands of elite ballet dancers, small changes in concentration and health behaviors may account for associations between dance injuries and psychological distress, and warrant further exploration (Adam et al., 2004). Adam and colleagues (2004) recommended that interventions to prevent and treat injuries in elite ballet dancers should consider including the appraisal and treatment of psychological variables such as stress, negative mood states, and sleep problems in their programs. Further, longitudinal intervention studies are needed to explore the effect of reducing psychological distress, improving sleep, and increasing social support among elite dancers on the prevention of injuries and the treatment of injured dancers.

Professional dance companies may extensively travel during the year, and the impacts of diverse work periods (e.g., rehearsal, international touring, national touring, performing) on dancers' physical and psychological well-being requires further exploration (Bronner & Wood, 2017). It has been suggested that a lack of techniques to quantify performance readiness, other than injury may conceal effects of touring on dancer's well-being (Bronner & Wood, 2017) and further exploration of health and well-being across differing work-demands should be considered. For example, studies of national baseball, football and basketball leagues reported decreased performance output associated with travel across several time zones (Leatherwood & Dragoo, 2013). Training and performances during the week and weekends preclude a consistent and steady work routine for dancers (Fietze et al., 2009). Therefore, further supports and resources during extended work periods should be investigated to improve training and performance quality and recovery and for enhancing physical and psychological health during touring periods (Fietze et al., 2009). An array of organisational, personal, cultural and external factors, may impede dancers physical and psychological health and monitoring their wellness to identify their readiness to perform is highly recommended (Bronner & Wood, 2017). The use of validated instruments to provide invaluable data for the management of workloads and training demands/conditions, to help optimise performance capacity and protect and support performers' physical and mental health, is therefore warranted (Grove et al., 2013).

To further support dancers holistically, it has been recommended that dance companies adopt an integrated care model to support the health and well-being of dancers (Descoteaux, 2018). In an exploration of dancers' reflections on their healthcare experiences from Australia and the USA, 20 dancers participated in semi-structured interviews. It was highlighted that whilst there are medical professionals dedicated to the well-being of performers, dance medicine is typically absent until the dancer reaches a professional company (Descoteaux, 2018). An ideal collaboration to manage dancers' wellbeing should encompass physicians, physical therapists, mental health professionals, nutritionists and somatic practitioners for dance-specific treatment and care (Descoteaux, 2018). Furthermore, Descoteaux (2018) recommended that education about anatomy, injury prevention, and nutrition for example be implemented alongside clinical practice or in workshops to continue to support, educate and enhance the health and well-being of dancers. A more integrative and collaborative approach to support, manage and prevent sports injuries through communication and teamwork has been advocated (Ekstrand et al., 2018). This concept has also been supported in the dance literature, for further research to develop comprehensive injury prevention approaches that encompass collaborative care for health and well-being (Bolling et al., 2019).

Further exploration of wellness variables in dance research is presented in the subsequent chapter (Chapter 2.2) in relation to fatigue (2.2.3), stress (2.2.4), muscle soreness (2.2.5) and sleep (2.2.6).

2.1.5 Dance-health surveillance systems

Surveillance methods to record injuries, psychological health and illness are vital to detect health problems promptly and to gain understanding into the burden of these conditions and fluctuations for dancers (Karreman et al., 2019). To explore the practicality of an online dance-health surveillance system (Performing Artist and Athlete Health Monitor (PAHM), nine professional dancers completed biweekly questionnaires relating to health challenges, injuries, mental ailments, and illness. The PAHM also included the Oslo Sports Trauma Research Overuse (OSTRC) questionnaire and dancers participated in a focus group after 6-weeks (Karreman et al., 2019). Dancers indicated a willingness to continue using the PAHM and suggested extended investigations about mental health, workload, sleep, rest, and nutrition would be beneficial. It was suggested that the OSTRC questionnaire could be revised to be more dance-specific, and it was recommended that the OSTRC be carefully tailored to differentiate between class, rehearsal and performance to gain further insight into these work demands and subsequent injury and illness fluctuations (Karreman et al., 2019). The importance of dancers feeling comfortable to share self-reported data with staff was emphasised, to create opportunities for adjustments to load, recovery and supports to be adopted in response to the data recorded (Karreman et al., 2019), consistent with sport models (Clarsen, Myklebust, & Bahr, 2013).

To investigate characteristics and impacts of mental health issues in contemporary dance students, van Winden and colleagues (2019) monitored 130 dancers on a monthly basis for one academic year using the PAHM and OSTRC mental health questionnaire (consequences of mental health problems on participation, training volume and performance). It was found that 96.9% of dancers reported at least one physical/ mental health complaint, with an incidence proportion of 44.6% for mental health issues (van Winden et al., 2019). The most reported mental health issues were anxiety (20%), stress due to external factors (18.3%), and constant tiredness (16.7%). The PAHM and OSTRC mental health questionnaire were incorporated as part of the dance educational program which assisted with response rate (79.9%) (van Winden et al., 2019). The depth of data obtained through the OSTRC was limited however as only one mental health issue could be recorded per entry and consequently, dancers had to choose which issue they perceived as most severe to enter into the monitoring system (van Winden et al., 2019). Consequently, the results could actually depict an underrepresentation of the mental health issues experienced. Furthermore, mental health issues were recorded via self-report, with no diagnostic information obtained to support the subjective data. Therefore, van Winden and colleagues (2019) recommend medical staff members follow-up with dancers in relation to their subjective recordings, to refer to treaters such as clinical and sport psychologists to gain further insight into the specific mental health issues of dancers and to enhance the psychological well-being of performers.

Further research exploring health and well-being with contemporary dance students has been recently published (Hopper et al., 2020). Hopper and colleagues (2020) investigated how dancers engaged with monitoring practices, adopted from scientific and medical literature. In one component of the research, dancers were required to complete daily monitoring questionnaires to determine energy levels, emotional state and motivation throughout a rehearsal and performance season (Hopper et al., 2020). Co3's (West Australian contemporary dance company) Artistic Director reviewed the data and used the information to guide the day's work and how she engaged with the dancers. An exploration of the dancers' experiences and perceptions of this monitoring approach however, revealed that dancers felt there was a level of judgment and hesitated being completely honest if they were feeling tired, run down or unmotivated in fear these responses would adversely affect their role in the company performances. This example highlights challenges and opportunities for effective implementation of dancer monitoring strategies to benefit both dancers and the company. It was therefore recommended that open lines of communication, feedback and transparency are incorporated into the implementation design, essential for future work in conducting dancer monitoring within a company. Further, it was suggested that dancer engagement with the monitoring process would likely be enhanced if the dancers shared the perceived value of the monitoring process as expressed by the Artistic Director (Hopper et al., 2020).

2.2.1 Athlete Self-Report Measures

Monitoring athlete wellness and responses to training and performance is of increasing interest to coaching and medical staff for optimal performance and recovery (Saw, Main, & Gastin, 2015a). Incorporating monitoring strategies into busy athlete training schedules presents challenges with concerns relating to compliance, self-report bias and questionnaire fatigue (Taylor, 2012). Accordingly, sporting organisations have sought to incorporate psychometric monitoring methods that are efficient to reduce the burden on the athlete (Meeusen et al., 2013a).

The development and utilisation of AMS to record and monitor athlete data is a growing trend (Gastin et al., 2013; Saw et al., 2015a). AMS facilitate collaboration between the athlete, coaching, medical, and strength and conditioning team in an attempt to further support athletes and enhance training and performance quality (Hiller et al., 2004). The value of an AMS is dependent on all key parties being actively involved in the ongoing development of the monitoring system (Saw et al., 2015a). Saw and colleagues (2015) contended that Athlete Self-Report Measure (ASRM) add value to athletic preparation by improving communication that prompts staff to initiate targeted conversations with athletes and other support staff. Further ASRM also encourage athletes to become more involved and informed in their athletic preparation, and such measures promote the importance of supporting athlete well-being holistically to maximise training quality and performance (Saw et al., 2015a).

AMS are intended to function as a proactive early warning system, highlighting potential issues from fluctuations and changes in wellness (Saw et al., 2015a). AMS can also guide decision support processes in team sport where colour is used to signify a performance status of an athlete (Robertson, Bartlett, & Gastin, 2017). Often used to also monitor student capability, traffic light systems operate by flagging red, amber, or green, subsequently exhibiting how dissimilar a daily score is from baseline (Given, Hannigan, & McGrath, 2016). The determination of a 'red flag' is often established from baseline thresholds (Taylor, 2012), with a significant drop below an athlete's baseline score (typically ±1 SD from the mean) flagged as important to initiate a conversation between the athlete and medical support staff. For example, green may be interpreted as things should remain as normal, amber alerts caution that if left unaddressed could pose a risk to the athlete, whereas red raises an alarm and signifies action is required (refer to Figure 4 as an example). Traffic light systems have been adopted into AMS and monitoring techniques that include self-reported athlete wellness (Gastin et al., 2013), musculoskeletal screening (Halson, 2014a), training load (Williams et al., 2016), fitness and fatigue (Gabbett & Domrow, 2007) and physiological testing and benchmarking (Gastin, Meyer, Huntsman, & Cook, 2015). The traffic light system therefore acts as an early warning sign to potentially mitigate the risk of an undesirable outcome, such as injury, if left unattended (Robertson et al., 2017).

An improved sense of responsibility and subsequently increased self-management behaviors may result from athlete monitoring, such as athletes taking the initiative to seek advice and assistance from staff, and being less likely to persist through pain and injury (Saw et al., 2015a). For instance, the act of entering data into an AMS has been proposed to enhance athlete self-awareness and accountability of their preparation to perform/ compete, which may result in the athlete adopting improved training, performance-related behaviours and recovery strategies (Saw, Main, & Gastin, 2015c), as illustrated by a quote from an elite athlete: "an athlete self-report measure lets you reflect on yourself at that moment. You actually have to think about what you're doing, and all your plans, and how you're actually treating your body"(Saw et al., 2015c).

Figure 4. Example of a traffic light wellness scoring App.

In the implementation phases of ASRM it is recommended that time is taken to effectively promote the rationale and benefits of the self-report data entry task to incentivise participants to respond accurately, thus potentially decreasing conscious bias (Brener, Billy, & Grady, 2003). Conscious bias occurs when individuals respond in socially desirable ways, commonly over-reporting positive responses and under-reporting unfavourable responses. For example, athletes may ‘fake good’ to appear to be coping or to achieve selection (Ekegren et al., 2014), or ‘fake bad’ to have their training decreased (Meeusen et al., 2013a). Therefore, it is imperative to not only contemplate the design of a self-report measure, but also the personal and situational factors which may influence the capability to obtain significant, precise and reliable data from athletes (Saw, Main, & Gastin, 2015b).

2.2.2 Monitoring athlete wellness

Perceptual wellness scales attempt to measure how individuals perceive particular physical and psychological states, and a survey exploring current trends of monitoring with high-performance sport clinicians in Australia and New Zealand revealed 80% of self-report questionnaires were custom designs with 4-12 items (Taylor, 2012). Wellness parameters such as sleep quality, fatigue, stress and muscle soreness (stiffness) (Brink, Visscher, Coutts, & Lemmink, 2012b; Gastin et al., 2013; Halson, 2014a; McLellan et al., 2011; Nunes et al., 2014) have received increasing attention in sport literature (refer to Table 2 for a summary of key wellness monitoring studies). For example, in rugby league, a trend toward higher injury incidence was identified when players recorded more positive psychological scores, suggesting that when players felt healthier, they may have trained at higher intensities which consequently may have increased injury risk (Killen et al., 2010). It has also been identified that pre-training perceived wellness in AFL players influenced exercise output measured by rate of perceived exertion (Thorpe et al., 2016), implying that as wellness decreased, output within a session might also decrease (Gallo, Cormack, Gabbett, & Lorenzen, 2016) (Table 2). These findings suggest that a low pre-training wellness score may influence players to modify their external load in order to maintain RPE. It was concluded that monitoring pre-training perceived wellness for both individual athletes and the entire team may offer further insight into external output potential and provide coaches with the ability to make modifications if warranted (Gallo et al., 2016).

Consistent elevated wellness states may influence the subsequent occurrence of an injury (Gastin et al., 2013). For instance, in a study of AFL players (*n*=27), players completed ratings for nine wellness items (fatigue, general muscle, hamstring, quadriceps, pain/stiffness, power, sleep quality, stress and well-being) on a 1-5 visual analogue scale daily via an AMS (Gastin et al., 2013) (Table 2). Subjective ratings of physical and psychological wellness were found to be sensitive to weekly training manipulations and periods of unloading during the season. It was also found that pain/stiffness and sleep quality had the highest average scores (over the entire season) with quadriceps strain, stress and well-being having the lowest scores. A case study provided raw data for a single player and showed that the player suffered a hamstring strain during the game in week six and a groin strain in week 17, missing two and three games, respectively. In the weeks leading up to both injuries, fatigue and pain/stiffness appeared elevated and stress experiences were observed in the weeks after the hamstring strain and continued on for a number of weeks despite the player returning to competition. It was established that self-reported wellness averages provide a valuable tool for coaches and practitioners to monitor athlete responses to the rigorous demands of training and competition (Gastin et al., 2013). These findings have practical implications for self-report measures and the interpretation of data by players and coaches for reactive responses to monitoring and performance data. Gastin and co-authors (2013) recommended that to be useful, the ASRM needs to be valued by players and coaches and administered in a supportive environment to protect player welfare and team performance.

Furthermore, wellness monitoring can provide valuable information relating to the recovery status of athletes for load scheduling post-competition/ match/ performance periods. For example, it has been identified that self-reported perceptions of fatigue, well-being and muscle soreness were impacted for 48 hours following a match, recovering to baseline within four days in professional rugby (McLean, Coutts, Kelly, McGuigan, & Cormack, 2010) (Table 2). A similar trend was also identified in AFL players, whereby perceptions of wellness returned to a positive score at three days post-match for a 6-7 day micro-cycle and four days post-match for an 8-day micro-cycle (Gallo, Cormack, Gabbett, & Lorenzen, 2017) (Table 2).

Gallo and colleagues (2017) examined 33 male AFL players over a 23-week competitive season, where daily wellness and RPE were entered daily into an AMS. The wellness items included sleep quality, stress, fatigue, mood, and muscle soreness rated on a 7-point Likert scale. The study explored the weekly wellness profiles of the participants finding that days-post-match was the strongest predictor of wellness, with perceptions of wellness returning to a positive score at three days post-match (Gallo et al., 2017). Red flags were monitored, and TL manipulated in response to these alerts. In essence the results did not reveal an interaction effect between load on wellness scores due to the interventions that occurred in response to the red flags (Gallo et al., 2017). In applied sport, adjustment to training loads in response to red flags is accepted practice and presents as a possible limitation to study designs. Caution should therefore be exercised when interpreting the results from studies that intervene in response to wellness red flags (Gallo et al., 2017). These findings suggest that wellness monitoring provides insight into the perceptual recovery status of an athlete to guide post-match load and inform athlete and coach expectations to reduce injury risk.

Investigations into the predictive ability of wellness data on injury and illness have previously been reported as accumulated or aggregated weekly or monthly averages (Drew & Finch, 2016) however, the identification of injury or illness risk on a daily basis may allow for a more-timely intervention to promote athlete's health, and identify specific trends and risks to injury (Watson et al., 2017). Watson and colleagues (2017) subsequently sought to determine whether TL and/or subjective well-being were independent predictors of injury and illness in 75 female youth soccer athletes. The athletes recorded wellness (mood, fatigue, soreness, stress and sleep quality) each morning on a 3-point likert scale and provided duration (minutes) and intensity (1-10) for all physical activity. Throughout the season, injuries and illnesses were self-reported by the participants, adopting a time-loss injury definition. It was found that acute TL and mood were independent predictors of injury, with higher TL from the previous day an independent effect on the risk of injury (Table 2). Watson and colleagues (2017) concluded that daily measurement of well-being and TL may provide a more precise measurement of the relationships between wellness variables and injury incidence, and consideration previous day TL may guide modifications to upcoming TL schedules to reduce the risk of injury (Watson et al., 2017). Furthermore, it was found that higher chronic TL was predictive of illness, specifically an increase in weekly and monthly TL (Watson et al., 2017). Whilst these findings provide valuable insights and practical implications, additional risk factors for injury and/or illness such as anatomic differences, body composition or fitness level were not accounted for and the study was conducted among a group of elite, adolescent female soccer players and may not be generalisable to other populations. Watson and colleagues (2017) findings and research design have important implications for wellness monitoring designs however and suggest that daily recording of wellness and TL may highlight consecutive days of high internal TL and identify timely changes and fluctuations in wellness, which may impair well-being and increase risk of injury. Furthermore, it appears that illness may be impacted by an accumulation of higher TL over weeks and months, and this has important considerations for coaches and medical staff in the development of TL schedules and for the formation of interventions to reduce the burden of injury and illness in athletes and dancers (Watson et al., 2017).

Table 2. Summary of key athlete wellness monitoring studies

Athlete group and author	Study design	Study duration	Sample size	Wellness variables	Key findings
Professional Rugby League. (Killen, Gabbett & Jenkins, 2010)	Prospective experimental study	14-weeks	*n*=36 males	Sleep Energy Mood Stress 10-point likert scale	Twenty injuries were recorded during the preseason training period. the majority of injuries sustained were categorised as minor, resulting in no time loss in training and no required modifications to the training program. Lower body injuries were most common. There was no significant relationship between players' training loads and psychological wellness data. A trend toward higher injury rates with greater psychological scores was identified. This may suggest that when players feel healthier, they train at higher intensities, which may increase the incidence of injury consequently.
Professional Rugby League. (McLean, Coutts, Kelly, McGuigan & Cormack, 2010)	Cross sectional study	26-weeks	*n*=12 males	Fatigue Sleep quality Muscle soreness Stress Mood 5-point likert scale	Fatigue, well-being and muscle soreness self-report ratings were significantly reduced in the 48 hours following match and recovered to baseline levels within 4 days. These findings suggest that with appropriate training, it is possible to recover neuromuscular and perceptual measures within 4 days after a rugby league match.

Athlete group and author	Study design	Study duration	Sample size	Wellness variables	Key findings
AFL. (Gastin, Meyer & Robinson, 2013)	Cross sectional study	183 days	*n*=27 males	Fatigue Muscle pain/stiffness Sleep quality Stress Well-being 5-point likert scale	Improvement in wellness items were identified as game day approached. Individual ratings for fatigue, muscle strain and well-being improved over the course of the season. Variability between players declined significantly in all items as game day approached. Player self-reported ratings of wellness were sensitive to daily and weekly variations in recovery status.
AFL. (Buchheit, Racinais, Bilsborough, Bourdon, Voss et al., 2013)	Observational design	Off-season 2-week training camp	*n* = 8 males	Fatigue Sleep quality Muscle soreness Stress levels Mood Overall wellness 5- point likert scale	Day-to-day changes in individual wellness measures were related to training load. Players coped with increased training demands supported by increased physical performance, absence of injury, and steady wellness scores throughout the camp.

Athlete group and author	Study design	Study duration	Sample size	Wellness variables	Key findings
AFL. (Gallo, Cormack, Gabbett & Lorenzen, 2015)	Cross sectional study	10-week pre-season	*n* =36 males	Sleep quality Stress Fatigue Muscle soreness 7- point likert scale	Reductions in wellness scores corresponded to reductions in player load.
Youth soccer players. (Watson, Brickson, Brooks & Dunn, 2016)	Cross sectional study	20-week soccer season	*n* =75 females	Fatigue Mood Soreness Stress Sleep quality	Thirty-six injuries were identified. Compared with days without a reported injury, days in which an injury had occurred were found to have significantly lower daily mood, as well as significantly higher training load from the same day. No significant differences were identified in other measures of well-being from the prior day, week or month.
Rugby League. (Fowler, Duffield, Lu, Hickmans & Scott, 2016)	Cross sectional study	Pretravel + 2, 6, and 8 days after travel	*n*=18 males	Sleep quantity Sleep quality Overall wellness Muscle soreness 10-point likert scale	Compared with pretravel, no significant differences in wellness were observed on post-2, post-6, or post-8 days. No significant differences were detected for muscle strength or soreness measures. Compared with the week before travel, total training load and duration was significantly reduced during the week after travel. No incidences of injury were recorded after travel

Athlete group and author	Study design	Study duration	Sample size	Wellness variables	Key findings
AFL. (Gallo, Cormack, Gabbett & Lorenzen, 2017)	Cross sectional study	23-week competitive season	*n*=33 males	Sleep quality Stress Fatigue Muscle soreness 7-point likert scale	No interaction effect between days post-match and load on wellness score. Days post-match was the best predictor of wellness scores. Perceptions of wellness returned to a positive score at 3 days post-match for a 6 and 7-day micro-cycle but not until 4 days post-match for an 8-day micro-cycle.

Fatigue, stress, muscle soreness and sleep research in athletes and dancers is briefly summarised in the subsequent paragraphs, highlighting the key impacts of reduced wellness on well-being and injury risk.

2.2.3 Fatigue

Fatigue is an acute and ongoing state of exhaustion that can lead to physical, mental or emotional exhaustion and may prevent people from functioning safely and within normal boundaries (Victoria, 2020). Physical fatigue is defined by pronounced physical exhaustion and reduced ability to engage in physical activities, whereas mental fatigue is identified through pronounced mental debilitation and reduced ability to engage in cognitive activities, such as making decisions. Furthermore, emotional fatigue is categorised by emotional enervation and the reduced ability to engage in emotional activities, such as empathising with or caring for others (Victoria, 2020).

Athlete fatigue is difficult to define, impacting measurement feasibility and validity (Abbiss & Laursen, 2006; Taylor, 2012). Fatigue is most frequently described as a reduced capacity for maximal performance in exercise science research (Coutts & Reaburn, 2008; Knicker, Renshaw, Oldham, & Cairns, 2011). Self-report questionnaires appear to be the most popular methods of monitoring fatigue (84%) due to the simplicity of the approach, and are most commonly reported daily (55%), followed by numerous times per week (24%), weekly (18%), or monthly (2%) in athlete populations (Taylor, 2012).

An accumulation of fatigue can result in overtraining, negatively impacting performance (Meeusen et al., 2013a). Fatigue regularly ensues when performance or training loads are not complemented by sufficient rest periods, and can be preceded by a period of time where greater effort is required to maintain the optimal level of performance (Liederbach et al., 2013). Generally, OTS symptoms can include feelings of general fatigue and illness, depression, anger, irritability, and anxiety, with potential consequences to energy and vigour levels, experience of heaviness in the limbs, and changes in sleep patterns and appetite (Liederbach et al., 2013). Fatigue may accumulate when athletes do not receive sufficient time to recover between training and competition, compromising key aspects of performance and increasing injury and illness risk (Halson, 2014a; Johnston, Gabbett, & Jenkins, 2013; Meeusen et al., 2013a). For example, in rugby league, physiological responses to an intensified period of competition were investigated over a 5-day period, and it was identified that high-intensity running, maximal accelerations and defensive performance in the final game were significantly compromised by cumulative fatigue (Johnston et al., 2013).

Similar to professional athlete occupational demands, dance training and performance comprises intense, repetitive and high-impact components (Liederbach et al., 2008). Muscular strength and endurance are pivotal in joint and postural stability, motor control, and performance endurance (Koutedakis & Jamurtas, 2004). Relative imbalances and deficits in strength as a consequence of fatigue may pose significant risks for injury (Liederbach et al., 2008). It has been reported that dancers tend to have a robust awareness of their bodies and a high pain tolerance (Rivera, 2012). Fatigue, muscle soreness and pain are recognised as concepts that require multi-method assessment in sport and ballet due to the complexities involved in measuring concepts that are subjective experiences (Anderson & Hanrahan, 2008). To meet professional expectations, dancers subject their bodies to prolonged hours of intense physical training often combined with tight rehearsal and performance schedules, which over time can lead to fatigue, constant muscle soreness, psychological stress, decline in performance quality, and injury (Grove et al., 2013). Muscles under high-intensity eccentric loading conditions can become strained during jumping, leaping and repetition of return from relevé movements (Liederbach et al., 2008). Under loading conditions muscles absorb energy, distributing control and regulation of limb movement; however, fatigued muscles are unable to absorb as much energy before reaching the point of stretch that results in muscle strain injuries (Grove et al., 2013; Liederbach et al., 2008). In a fatigue-induced state, adaptability to force load is compromised leaving the ligaments and joints at risk for torsion force, dislocation or subluxation and associated nerve entrapment, impingement, and contusion (Grove et al., 2013; Liederbach et al., 2008). In addition to the physical presentations of fatigue through muscle soreness, reduced output and injury (Grove et al., 2013), fatigue in dance can also present as a consequence of low caloric intake (Twitchett, 2010), mood disturbance and training distress (Adam et al., 2004; Downs, 2013; Grove et al., 2013; Raglin, 2006) and sleep disturbances (Fietze et al., 2009). Therefore, the perception and experience of fatigue in dancers and athletes can encompass both physical and psychological consequences.

The distinction between cognitive and physical fatigue appears under researched in sport and dance literature, and future research therefore would benefit from attempting to investigate both concepts in exploring the contributing factors to a dancer and athlete's fatigue state.

2.2.4 Stress

Psychological stress can arise when the relationship between an individual and the environment exceeds the person's available coping resources (Lazarus, 1984). The interpretation and appraisal of an event as threatening, challenging or harmful is highlighted by the cognitive transactional model of stress-appraisal-coping (Lazarus, 1984). The model focuses on cognitive assessment of stressors from the viewpoint of the person experiencing it, and how the person copes within the stressful situation to make sense of the experience. The fundamental hypothesis of this theory is that any event is potentially stressful (Lazarus, 1984). Thereby, psychological stress presents as a state of perceived threat to homeostasis (Pacák & Palkovits, 2001). In humans, perceived stress stimulates the central nervous system, triggering the discharge of corticotropin releasing hormone from the hypothalamus, adrenal corticotropic hormone from the anterior pituitary, and cortisol from the adrenal cortex (Burke, Davis, Otte, & Mohr, 2005). Subsequently, elevations in cortisol levels predictably impede the hypothalamic-pituitary-adrenal system via negative feedback processes in the hippocampus (Burke et al., 2005).

A sustained disparity between stress and recovery in athletes can result in athletes being unable to endure training (Brink, Visscher, Coutts, & Lemmink, 2012a). Performance and training periods expose athletes to differing physical and mental stressors, with individuals often differing in their abilities to cope (McCloughan, Hanrahan, Anderson, & Halson, 2016). During stress, it has been found that elite performers encounter a divergence from the homeostasis state, necessitating the adoption of recovery and self-care strategies for training and performance conditions to be maintained (Beckmann & Kellmann, 2004).

In addition to the physical and mental health issues associated with stress, judgement competency and rational decision making can be interrupted (Savage & Torgler, 2012). For instance, Savage and colleagues (2012) explored penalty shoot-out kicks taken in the FIFA World Cup and UEFA Euro Cup competitions (16 events) in their investigation of the interactions between work stressors and performance. It was reported that less predictable stressors appeared to impact performance, highlighting opportunities to develop strategies that help reduce the consequences of stress on performance. Further, it was identified that positive stress appeared to promote performance, however as anticipated negative stress reduced performance and had a stronger negative impact on performance quality (Savage & Torgler, 2012). Thus, in elite athletes, the impact of high stress on performance is evident, and poor decisions, as a consequence of stress can have widespread impact to athletes, coaches, and organisations.

In professional ballet, dancers continually strive for perfection, which can often lead to high levels of stress that persist and can affect performance, motivation, impact injury and illness susceptibility, and diminish overall physical and psychological well-being

(Grove et al., 2013; Noh, et al., 2009). In a study involving ballet dancers (*n*=16), modern dancers (*n*=19) and gymnasts (*n*=30), the relationship between stress and perfectionism was examined via a modified version of the Life Experience Survey, which assesses stressors and the Multidimensional Perfectionism Scale (Dawson, 2000). It was found that ballet and modern dancers had higher levels of total stress compared to gymnasts and it was recommended that researchers identify the sources of stress that dancers' experience and the coping strategies adopted to manage stress for the development of interventions to reduce stress (Dawson, 2000).

Noh and colleagues (2009) explored occupational stress and coping strategies with 20 professional ballet dancers in Korea via interview. Four general dimensions of stress including physical, psychological, interpersonal and situational factors were identified with desire to achieve high levels of practice and performance, and the experience of physical fatigue and subsequently fear of injury or re-injury, associated with psychological stress responses (Noh et al., 2009). Dancers reported that their coping strategies to manage stress involved physical relaxation and cognitive techniques to focus on positive thoughts, however also reported avoidance as a coping strategy and adopted dysfunctional behaviour such as eating behaviour and substance use (Noh et al., 2009). Through this research, it was suggested that researchers and practitioners seek to understand the types of stress dancers experience and how they cope with stress associated with the dance environment and their personal lives. Further it was recommended that quantitative measures to assess stress and coping in dance specifically be developed to guide training strategies and coping resources to mitigate injury and moderate the stress-injury relationship (Noh et al., 2009).

2.2.5 Muscle soreness

Muscle soreness can be defined as soreness to a body region, restricting the capacity to participate (Drew & Finch, 2016) and is relatively common in elite athletes undertaking their normal training and competing regime (Cooke, Nix, Greenwood, & Greenwood, 2018). Discomfort from the onset of delayed muscle soreness intensifies within the first 24 hours of activity cessation and tends to dissipate within 5–7 days post-exercise (Cheung, Hume, & Maxwell, 2003; Cleak & Eston, 1992). Structural harm to the muscle and connective tissue can also arise and result in alterations to muscle function and joint mechanics (Proske & Morgan, 2001). For an elite athlete, these modifications, combined with other compensatory processes to alleviate soreness, can lead to substantial adjustments to, and a decrease in, training intensity and performance output (Cheung et al., 2003).

Self-report muscle soreness measures can be used to provide coaches with instant and invaluable data regarding the health and wellness status of players (Drew & Finch, 2016). For example, to establish the effects of game and TL on muscle soreness and soreness dissipation time, 64 elite AFL players recorded perceptions of muscle soreness, game and training intensity on scales of 1-10, in the morning, across three competition seasons (Montgomery & Hopkins, 2013). In the three days after high-load games, a small increase in general muscle soreness (0.22 ± 0.07-0.50 ± 0.13 units), was identified comparative to low-load games (Montgomery & Hopkins, 2013). Montgomery and colleagues (2013) suggested that when planning weekly training and recovery programs practitioners should be informed of soreness responses. Game-related soreness was found to dissipate after three days irrespective of game load and heightened TLs in the following week (Montgomery & Hopkins, 2013). These findings have important implications for load scheduling and management in consideration of the recovery status and well-being of athletes.

Training and competition/ match periods for athletes is often periodised, whereas dancers typically do not have defined nor predictable seasons and dancers are at risk of muscle damage given the extensive demands and limited rest in training and performance (Twitchett, 2010). It has been identified that 1-2 minutes of maximal dance exercise (such as a jump section in dance class) can lead to declines in muscle force production (Wyon & Koutedakis, 2013). To investigate muscle damage response following dance activity, Rodrigues-Krause and colleagues (2014) sought to examine and compare highly trained ballet dancers' cardiorespiratory, muscle damage and oxidative stress responses in ballet and class. It was reported that creatine kinase was elevated for 48 hours following class and rehearsal and it was suggested that dance activity appears to induce muscle damage and oxidative stress (Rodrigues-Krause et al., 2014). Investigation of muscle soreness and muscle function were not included, therefore the potential effects on subsequent performance were not substantiated and require further exploration.

Brown and colleagues (2015) randomly assigned 29 female recreational dancers to one of two groups, either a dance-specific exercise bout or a sport-specific repeated-sprint protocol. A sequence of commonly applied muscle damage indices were administered pre, immediately post (0 h), and 24-, 48-, and 72 hours post muscle damage. Low perceived soreness levels were recorded, and it was suggested that this may be attributed to dancers' high pain tolerance threshold (Thomas & Tarr, 2009). Increases in delayed onset muscle soreness, circulating creatine kinase and limb girth, and reductions in muscle function were identified post-exercise, and persisted for several days (Brown, Howatson, Keane, & Stevenson, 2015). Dance activity appears to increase indices of muscle damage associated with increases in muscle soreness, and reductions in muscle function (Brown et al., 2015). These findings have implications for dancers, coaches, practitioners and treaters, such as Exercise Physiologists, for management of muscle soreness, as associated symptoms following strenuous and potentially damaging dance-type activity may appear for several days and impact subsequent injury risk if left unaddressed.

2.2.6 Sleep

Sleep is crucial for cognitive and physiological functioning and is an essential component in the preparation for, and recovery from training and competition (Simpson, Gibbs, & Matheson, 2017). A reduction in sleep to fewer than six hours per night for four or more consecutive nights has been proven to impair cognitive mood and performance (Belenky et al., 2003) and appetite regulation (Karine, Esra, Plamen, & Eve Van, 2004). It is recommended that adults should obtain eight hours of sleep per night to preclude neurobehavioral deficits (Van Dongen, Maislin, Mullington, & Dinges, 2003).

Features of sleep quality include sleep initiation, maintenance, quantity, and refreshment upon awakening and poor sleep quality across numerous days/weeks may predispose athletes to injury as chronic fatigue concentrations remain elevated (Schlarb, 2015). Sleep quality and quantity are deemed to be the important aspects that impact an athlete's ability to train, recover, and perform (Juliff, Halson, & Peiffer, 2015; Lastella, Lovell, & Sargent, 2014; Sargent, Halson, & Roach, 2014). Periods of increased training coupled with reduced and inadequate sleep can have adverse implications for pain sensitivity, memory, cognition, immunity, inflammation and metabolism in athletes (Halson, 2014b; Killer, Svendsen, Jeukendrup, & Gleeson, 2017). Further, sleep loss or deprivation can have substantial effects on performance, enthusiasm and perception of effort (Halson, 2014a). For example, Reilly and Edwards (2007) reported that swimmers who experienced an acute partial (2.5 hours) sleep deprivation suffered decreased vigour, negative mood and increased depression, fatigue, confusion, tension and anger (Reilly & Edwards, 2007). Recognising the effect of sleep and circadian rhythms on athletic performance, recovery and restoration is therefore important for athlete health and well-being (Leatherwood & Dragoo, 2013).

Monitoring sleep quality can be valuable for early recognition and intervention prior to the experience of significant performance, injury and health decrements (Halson, 2014a). Alterations in ratings of sleep quality have been detected in athletes after a game in heavy training (Gastin et al., 2013) and after prolonged vigorous exercise (Bahr, 2016). A bi-directional relationship has been observed between chronic pain and the experience of poor quality sleep (Dzierzewski et al., 2010) with evidence suggesting that poor sleep has a greater influence on negative perceptions of pain, rather than the other way around (Nijs et al., 2018). For instance, Raymond and colleagues (2001) examined inpatients with burn injuries and found that the subjective quality of night sleep was a significant predictor for pain intensity on the subsequent day. Interestingly, the perceived pain intensity of the day prior did not predict the sleep quality of the subsequent night. Higher pain intensities were found to be strong predictors of pre-existing sleep disturbances and this relationship may reflect a chronic effect of non-restorative sleep on pain sensitivity. These findings indicate that non-restorative sleep has an instant and chronic impact on pain perception (Raymond, Nielsen, Lavigne, Manzini, & Choiniere, 2001). This direction of implied causation has significant implications for sleep, as a modifiable behaviour, and for interventions that aim to reduce pain intensity (Whibley et al., 2019).

The sequence of wakefulness and sleep, activity, and rest plays an important role for professional dancers, comparable to that described for other athletes (Leger, Metlaine, & Choudat, 2005). Fietze and colleagues (2009) explored ballet dancers sleep-wake pattern, sleep efficiency, and sleep duration over 3-months of training, preceding the premiere of a new ballet. Actigraphy, a validated quantitative technique was utilised to explore duration, efficiency, and movement patterns during sleep over 67 days by 24 professional ballet dancers. In the months preliminary to the ballet premiere, work schedules of ballet dancers were extended and variations in sleep parameters during this time indicated that the specific intensified schedules impacted dancer's sleep-wake schedule (Fietze et al., 2009). Injury incidence reportedly did not increase over the training and rehearsal periods leading into performance, however the sleep figures reflected persistent stress in ballet dancers that increased before the premiere performance (Fietze et al., 2009). It was therefore recommended that ballet dancers concentrate their attention on relaxation, including their sleep-wake behaviour for improved performance outcomes and holistic well-being in addition to focusing on their physical health and nutrition (Fietze et al., 2009).

2.2.7 Overreaching

Monitoring athlete wellness and responses to training and competition can be advantageous in the assessment of an athlete's capacity to cope with the physical challenges of training and competition and the persistent sport performance demands (Gastin et al., 2013). Overreaching (OR) is characterised by symptoms such as increased fatigue, deficient concentration, disrupted mood and sleeping patterns and a short-term decrease in performance output (Brink et al., 2012a). Functional OR also incorporates a short-term performance decrement (i.e., days to weeks) however includes a planned recovery period. Non-functional OR is a serious ailment with more severe symptoms where performance decrement is extended (weeks or months) and can lead to OTS with recovery periods continuing from months to years. The extent and severity of performance decline and symptoms are difficult to define and distinguish, however Figure 5 provides a continuum of overtraining components.

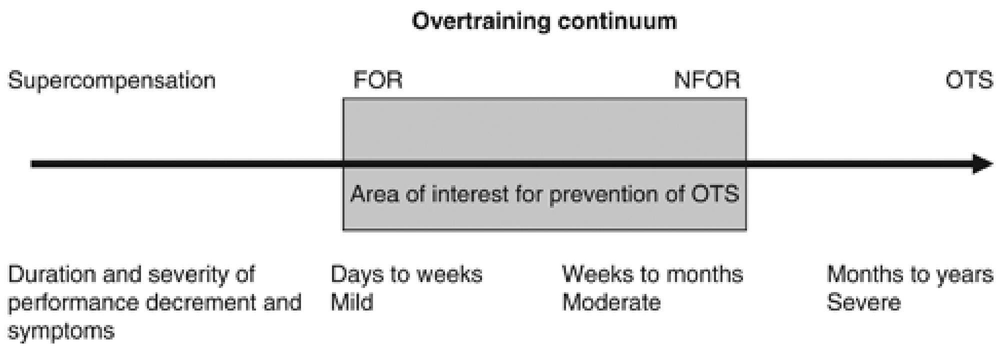

Figure 5. The overtraining continuum.
(Brink et al., 2012a)

To minimise the threat of OR, it has been suggested that the stress associated with training demands be complemented with adequate recovery practices (Brink et al., 2012a; Dodson, 2007; Kenttä, Hassmén, & Raglin, 2006). To identify athletes who may be at risk of OR, frequent monitoring for changes in stress and recovery might useful (Kellmann, Altenburg, Lormes, & Steinacker, 2001). The Recovery-Stress Questionnaire (RESTQ-Sport) was created to measure the multi-dimensional elements of stress and recovery in athletes, to identify athletes at different stages on the "overtraining continuum" (Figure 5) and to empower coaches and athletes to identify specific intervention strategies to avoid unplanned OR. For example, to detect acute changes in athlete's stress–recovery status in the weeks leading into major championships (Kellmann et al., 2001; King, Clark, & Kellmann, 2010) and during periods of intensified training (Coutts & Reaburn, 2008; Coutts, Reaburn, Piva, & Rowsell, 2007), the RESTQ-Sport has been applied. It was found that the RESTQ-Sport was able to detect changes in stress and recovery over short and longer periods (~6 months) (Filaire, Bernain, Sagnol, & Lac, 2001). Elite sport comprises periods of high TL in the pre-season period and periods of increased competition during the season, and these variants can influence the recovery and stress balance (Coutts & Reaburn, 2008; Coutts et al., 2007). Monitoring the TL of an athlete is therefore important to determine if an athlete is adapting to the training schedule and to provide emphasis on recovery practices (e.g. sleep, social connection, general well-being) during the season to help minimise the risk of non-functional OR, injury and illness (Halson, 2014a) (Brink et al., 2012a).

To investigate whether changes in wellness and fluctuations in load help to identify OR in athletes, Campbell and colleagues (2020) explored the responsiveness of perceptual wellness to changes in load with 13 amateur AFL players. Load was quantified using global positioning system devices, HR and sRPE and wellness was recorded daily via physical performance measures and psychological questionnaires (Profile of Mood States and

RESTQ-S) assessed fortnightly. Variations in perceived TL, accompanied by anticipated changes in performance markers and disturbances in mood and stress/recovery states were identified (Campbell, Stewart, Sirotic, & Minett, 2020). These findings indicate that a state of OR was achieved by the athletes during the intensified training load phase, with subsequent restorations to baseline (or improvements) observed after a taper training phase (Campbell et al., 2020). Campbell and co-authors (2020) established that disturbances in mood, increases in stress, and decreases in recovery states appear to be sensitive to periodised training within AFL players. An average perceptual wellness score was the only variable to demonstrate significant effects between normal training and intensified training, indicating that wellness monitoring may effectively identify OR in athletes (Campbell et al., 2020). Accordingly, the role of perceptual wellness measures within an overall monitoring system may be more appropriate to provide a concise insight into the perceptual state of the athlete and to assist in practitioner decision-making during specified training periods (Campbell et al., 2020). It was recommended that further research, to better understand interactions between different monitoring methods to optimise performance with athletes is conducted with a larger sample size (Campbell et al., 2020).

2.2.8 The Oslo Sports Trauma Research Centre (OSTRC) Overuse Injury Questionnaire

Overuse injuries are caused by repeated micro-trauma rather than a single injury event and are usually advanced by a period of unsustainable tissue loading, such as an excessive volume of load, or insufficient recovery between sessions of loading (van Wilgen, Kaptein, & Brink, 2010).

Overuse injuries are a problem in many sports especially where athletes are exposed to consistent high loads, rigid competition schedules and have limited recovery time between training and competition/ performance demands (Clarsen et al., 2013). Overuse injuries can have substantial consequences for individuals, families, and organisations, and are a common cause of premature retirement from sports (Kettunen, Kvist, Alanen, & Kujala, 2002). In the sport literature, systematic prevention research had focussed predominantly on acute, traumatic sports injuries (van Wilgen et al., 2010). Subsequently, Claresen and colleagues (2013) sought to develop a method to record overuse injuries in sport and to establish the validity for application to a number of different research settings. The OSTRC questionnaire was successively developed in consultation with sports physiotherapists, medical practitioners, sports injury epidemiologists and athletes. The OSTRC questionnaire comprises four questions for the assessment of any given anatomical area (refer to Figure 6). The questionnaire was developed to be regularly administered to large groups of athletes with the intention for online access. Via the OSTRC questionnaire, an athlete is considered to have an overuse problem if anything other than the lowest response for all four questions for the atomical area is recorded. A severity score is calculated for each anatomical area based on the questionnaire responses by allocating a numerical value between 0 and 25 and adding these together to give a score from 0 to 100 (Clarsen et al., 2013).

The application of the questionnaire has been found to be feasible across various athlete groups. For example, Clarsen, Myklebust & Bahr (2013) recruited 313 athletes from five sports to use the OSTRC for 13 weeks including: cross-country skiers (*n*=46), road cyclists (*n*=98), floorball players (*n*=50), handball players (*n*=55) and volleyball players (*n*=65). Four-hundred and nineteen problems in the shoulder, lower back and knee were identified, affecting 236 athletes (75% of the cohort) (Clarsen et al., 2013). Mild pain was reported by 17% of the cohort, with no correlated reductions in sport participation or performance. Substantial overuse problems that led to moderate or severe reductions in sports participation or performance, or a total inability to participate were classified as 34% of the cohort. The authors concluded that the OSTRC questionnaire was found to be feasible, with good face, content and construct validity, capturing a greater magnitude of overuse injuries than traditional methods (Clarsen et al., 2013).

Subsequent to the previous study, a further application of the OSTRC questionnaire with athletes from differing sports was investigated by Clarsen and colleagues (2014). To document the trends of acute injuries, overuse injuries and illnesses in athletes preparing for the Olympic and Paralympic Games, 142 athletes, which included Olympic (*n*=116) and Paralympic (*n*=26) candidates participated in the study (Clarsen, Rønsen, Myklebust, Flørenes, & Bahr, 2014). During the 40-weeks prior to the Olympic Games, athletes reported 617 health problems. The average weekly prevalence of health problems was 36%, with a total of 329 illnesses reported by 106 athletes (76% of the cohort) and a total of 288 injuries reported by 115 athletes during the study (80% of the cohort). The average prevalence of overuse injury was 20% with an average duration of 5-weeks and the average prevalence of acute injury was 4% with an average duration of 3-weeks (Clarsen et al., 2014). It was found that overuse injuries represented the greatest burden on athletes' participation and performance (49%), followed by illness (36%) and acute injury (13%) (Clarsen et al., 2013; Clarsen et al., 2014). Clarsen and colleagues (2014) suggested that the success of the method of data collection is dependent on true responses from the athletes, as well as thorough follow-up from medical teams to record diagnoses. These recommendations are important for consideration in further research designs for sustained implementation and utilisation of the OSTRC questionnaire.

The OSTRC questionnaire appears to provide a more accurate indication of the health status of an athlete than time loss definitions, with overuse problems identified 6.5 times more than those registered by a team practitioner (Weiss, McGuigan, Besier, & Whatman, 2017). For example, Weiss and colleagues (2017) sought to assess the prevalence and severity of overuse injuries in a men's basketball team (*n*=13) and determine the efficacy of the OSTRC questionnaire compared to a Physiotherapist detection of these injuries. OSTRC questionnaire responses were compared against time-loss injury registration procedures to record overuse conditions by a Physiotherapist (Weiss et al., 2017). The OSTRC questionnaire captured 183 overuse conditions, compared to 28 overuse conditions identified by the Physiotherapist. The team's average weekly prevalence of overuse problems 63%, with the highest prevalence of injury affecting the lower back (Weiss et al., 2017). Weiss and colleagues (2017) concluded that the OSTRC questionnaire method of overuse injury surveillance may be more accurate in quantifying overuse problems to aid earlier intervention and management of these conditions.

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Question 1

Have you had any difficulties participating in normal training and competition due to injury, illness or other health problems during the past week?

☐ Full participation without health problems

☐ Full participation, but with injury/illness

☐ Reduced participation due to injury/illness

☐ Cannot participate due to injury/illness

Question 2

To what extent have you reduced you training volume due to injury, illness or other health problems during the past week?

☐ No reduction

☐ To a minor extent

☐ To a moderate extent

☐ To a major extent

☐ Cannot participate at all

Question 3

To what extent has injury, illness or other health problems affected your performance during the past week?

☐ No effect

☐ To a minor extent

☐ To a moderate extent

☐ To a major extent

☐ Cannot participate at all

Question 4

To what extent have you experienced symptoms/health complaints during the past week?

☐ No symptoms/health complaints

☐ To a mild extent

☐ To a moderate extent

☐ To a severe extent

Figure 6. The OSTRC questionnaire.

(Clarsen et al., 2013)

It has been suggested that 90.5% of overuse injuries in sport were not recorded via standard injury surveillance recording previously (Clarsen et al., 2013). A high prevalence of overuse problems in dance has been reported (Allen et al., 2012; Bronner & Wood, 2017; Gamboa et al., 2008), and adopting the OSTRC questionnaire method for injury monitoring and recording may therefore be suitable in dance populations, to capture overuse injuries that may be underreported via time loss and medical attention definitions. Accordingly, the OSTRC questionnaire was incorporated into dance research studies with pre-professional and contemporary dancers (Kenny et al., 2018), professional dancers (Karreman et al., 2019) and contemporary dance students (van Winden et al., 2019). For example, the OSTRC questionnaire was administered to full time pre-professional ballet (*n*=85) and contemporary (*n*= 60) dancers to explore injury prevalence and severity (Kenny et al., 2018). It was found that injury definitions of medical-attention and time-loss underestimated the onus of injury in preprofessional dancers and the inclusion of a dance-specific version of the OSTRC questionnaire may assist in capturing self-reported physical complaints and early signs of overuse injury (Kenny et al., 2018). The OSTRC questionnaire was also included in a 12-month injury epidemiology review of contemporary dancers, where dancers recorded health problems monthly (van Winden et al., 2019). Six hundred and twenty health problems recorded via the OSTRC questionnaire, of these, 321 were injuries, 67 mental problems and 232 other health problems including illness (van Winden et al., 2019). No further insight into the OSTRC questionnaire or overuse injuries was recorded in this study, however. Future research studies should therefore seek to further explore the applicability of the OSTRC questionnaire with dancers, and the perceptions and experiences of dancers completing the questionnaire.

To address the limited qualitative feedback to guide further application of the OSTRC questionnaire with dancers, Karreman and colleagues (2019) incorporated a qualitative design in their administration of the OSTRC questionnaire. Professional dancers entered physical and psychological data into the PAHM and OSTRC questionnaire bi-weekly. In this publication, no quantitative data relating to the OSTRC was reported however, with the emphasis of the manuscript on the focus group interview findings. Dancers suggested that the OSTRC questionnaire could be revised to be more dance-specific, and it was recommended that the OSTRC be carefully tailored to differentiate between class, rehearsal and performance to gain further insight into these work demands and subsequent injury and illness fluctuations (Karreman et al., 2019). It appears that the OSTRC questionnaire may be suitable, as a validated injury register to monitor health problems in dancers and potentially better record overuse injury, that may have been previously underreported. Possible adjustment to the questionnaire to tailor it to be dance-specific may be warranted, however caution is recommended as changes to the questions might influence the validity of the questionnaire (Karreman et al., 2019).

2.3 Mindfulness

It has been identified that psychosocial factors may contribute to injury occurrence however, interventions to mitigate these factors for the prevention of injury have been limited (Birrer & Morgan, 2010; Gardner & Moore, 2012; Johnson, 2007; McCloughan et al., 2016; Mohr et al., 2009). In sport, a common technique to support athletes experiencing lack of confidence, negative moods and distressing thoughts is psychological skills training (PST) (Vealey, 1994). These techniques are largely drawn from cognitive behavioural traditions, where changing thoughts and feelings is a key approach to changing behaviour and improving well-being (Friborg & Johnsen, 2017). PST aims to change the content of internal experiences, for example by swapping a negative thought "You cannot do it" for a positive one "You can do it" (Johnson & Ivarsson, 2011). The four psychological techniques that have been most extensively researched in PST are: i) goal setting, ii) imagery, iii) self-talk, and iv) relaxation (Birrer & Morgan, 2010; Vealey, 1994).

Emerging advances to psychological interventions have incorporated mindful, awareness and acceptance strategies focused on enhancing cognitive, affective and sensory experiences, rather than focusing on trying to control or reduce internal experiences (Gardner, 2007). Mindfulness can be described as the awareness that develops through paying attention on purpose and nonjudgmentally, in the present moment (Kabat-Zinn, 2003). Enhanced awareness, affiliated with a non-judgmental attitude, allows for optimal self-regulation for attention and behaviour (Gardner, 2007; Gardner & Moore, 2004, 2017). Therefore, it has been suggested that mindfulness is helpful to disengage from automatic thoughts, habits, and unhealthy behaviour patterns and could play a key role in promoting informed and self-endorsed behavioural regulation, associated with enhanced well-being (Brown & Ryan, 2003).

Mindfulness training for managing stress has been founded in both clinical and health populations (Grossman, Niemann, Schmidt, & Walach, 2004; Khoury et al., 2013). Neuroscientific research suggests that mindfulness training enhances aptitude of self-regulatory process; to reappraise stressors and downregulate psychophysiological stress responses (Rosenzweig et al., 2007; Tang, Hölzel, & Posner, 2015). In addition, stress management mindfulness training has been associated with numerous health advances including enhanced cognition (Tang et al., 2015), awareness (Vidic, St Martin, & Oxhandler, 2017), and sleep quality (Garland, Campbell, Samuels, & Carlson, 2013), as well as reduced symptoms of depression and anxiety (Hofmann, Sawyer, Witt, & Oh, 2010).

As a specific attentional strategy for athletes, mindfulness has become a practice of interest in sport to capture a quality of consciousness for task focus and performance enhancement (Gardner, 2007). The performance-oriented essence of sport requires prolonged focus of attention on goal-related cues, while disengaging from disruptive inducements (Gardner, 2007). When athletes adopt mindfulness qualities, they are better able to acknowledge and accept the presence of external stimuli, bodily sensations, emotional reactions, and cognitions, without overreacting to them, and are capable of redirecting their focus of attention toward thoughts and behaviours that benefit performance subsequently (Gardner, 2007; Gardner & Moore, 2004).

To assess the effectiveness of mindfulness and acceptance approaches with young elite golfers, Bernier and colleagues (2009) compared the effects of a mindfulness program with a traditional psychological skills program (goal setting, imagery, concentration, and arousal). Mindfulness and acceptance skills were integrated into the pre-performance routines of the seven elite golfers, adapted from the structure and principles of Mindfulness-based Cognitive Therapy (Bernier et al., 2009; Segal, 2002). It was found that mindfulness and acceptance approaches enhanced the golfer's activation of skills significantly more than those who followed the traditional psychological skills program (Bernier et al., 2009). It was suggested that additional research is needed to gain a better understanding of mindfulness-acceptance approaches and to further validate applicability and efficacy in sport psychology. Further, Bernier and colleagues (2009) recommended that mindfulness and acceptance approaches should continue to be investigated in a variety of sports, as distinct applications and specificity of the program, according to athlete needs, may be identified and could subsequently enhance uptake of mindfulness practice across a variety of sports (Bernier et al., 2009).

MacDonald and Minahan (2018) examined whether mindfulness training may have comparable benefits in para-athletes, wheelchair basketball players, by investigating the effects of mindfulness training on salivary cortisol during a competition period. It was identified that mindfulness training may help athletes better-manage stress during competition, as a correlation was found between mindfulness training and a reduction in the competition-related increase in salivary-cortisol (Macdonald & Minahan, 2018). It was suggested that mindfulness training positively influenced para-athletes physiological stress response, however, an understanding of how athletes see the impact of mindfulness training from their own perspective is limited. To address this gap in literature, Macdonald, Oprescu and Kean (2018) investigated the impacts of a mindfulness training intervention on wheelchair basketball players utilising a qualitative design. Eight wheelchair basketball players participated in an eight-week mindfulness training intervention and interview. It was found that mindfulness training enhanced concentration in at least one facet of day to day activity, training and/or game settings and improved sleep and stress management (Macdonald, Oprescu, & Kean, 2018). Similar findings were detected in female collegiate basketball players who participated in a mindfulness training based intervention and reported improved focus from the intervention (Vidic et al., 2017). Wheelchair basketball players are subjected to competition and noncompetition sources of stress including pre-match, on-court and post-match concerns, team-cohesion issues, coaches, personal stressors and lack of disability awareness (Macdonald et al., 2018). Therefore, strategies to assist players to cope with the onset of a multitude of stressors is important for sporting performance and quality of life.

2.3.1 The Mindfulness-Acceptance-Commitment (MAC) approach

In addition to the utility of mindfulness-based practice in clinical populations, mindfulness has become increasing applied in sport to enhance performance (Gardner & Moore, 2004). Athletic research has indicated that mindfulness is correlated with lower levels of burnout and is beneficial for performance enhancement and well-being in athletes (Bernier et al., 2009; Gardner & Moore, 2012; Jouper & Gustafsson, 2013; Moore, 2009; Walker, 2013). One of the most common programs utilised with athletes is the Mindfulness-Acceptance-Commitment-based approach (MAC) (Gardner, 2007).

The MAC approach to performance enrichment is an assimilation of Acceptance and Commitment Therapy and Mindfulness-Based Cognitive Therapy for specific use in an athletic population (Gardner, 2007), for the purpose of improving performance and psychological well-being of athletes (Moore, 2009). The manualised MAC guidelines encompass a number of techniques and experiential exercises to assist athletes to develop a willingness to engage in behaviours consistent with their personal values. MAC incorporates strategies such as cognitive defusion, promotion of experiential acceptance and values classification (Gardner, 2007). Furthermore, the MAC approach was developed on the theory that athletes are better able to make decisions in practice and competition that lead to improved performance when they are able to adopt non-judgemental awareness, and focus their attention on task-relevant stimuli (Moore, 2009). Evaluations by soccer players who completed MAC training showed that majority of the players (76%) had started to think more about their abilities to select what behaviors they should perform in order to achieve their goals (e.g., to perform well in soccer) (Ivarsson et al., 2015). Furthermore, players recorded that they had learned how to relax (24%) and had increased their abilities to focus during longer periods than they did before the MAC program (81%) (Ivarsson et al., 2015) (Table 3). These responses add further insight into the potential benefits and application of MAC for ongoing research and implementation with athletes to potentially enhance well-being and performance (Ivarsson et al., 2015).

To explore MAC as a performance enhancement strategy, coach ratings of athlete performance have been incorporated into MAC intervention designs. For example, Wolanin (2004) found that an increase in coaches' rating of athletic performance was reported in MAC compared to a control group, suggesting MAC may be a viable performance enhancement strategy for utilisation with college athletes (Table 3). Coaches rating of performance was based on subjective performance measurement. It was recommended therefore that future research incorporate athlete's ratings of performance for a more robust evaluation of performance (Wolanin, 2004). To partially address this limitation and recommendation for future research, Hasker (2010) included an athlete self-report rating of performance in addition to the coaches rating in an evaluation of MAC for performance enhancement also with college athletes. No statistically significant athletic performance findings were found by the coaches or athletes, however generally, the athletic performance ratings were higher at the end of the MAC program over time (Table 3). It was suggested that the rating forms did not accurately measure the construct, hence decreasing the likelihood of finding significant results. This research however provides directions for the development of further mindfulness research studies exploring athletic performance (Hasker, 2010).

Table 3. Summary of athlete MAC intervention research.

Sample population and author	Objectives	Sample size	Measures	Number of sessions and duration	Key findings
Division I university athletes. (Women's field hockey and volleyball) (Wolanin, 2004)	Compare MAC with non-intervention control	MAC (*n*=13) No active component (*n*=7)	Coaches rating of performance Metacognitions Questionnaire Sport Anxiety Scale Generalised Anxiety Disorder Scale Quality of Athletic Life Inventory	7 sessions 30- 60 minutes (average 40 minutes)	A 37% increase in coach ratings of competitive performance in the MAC group were found compared to 14% increase in the control.
NCAA division 1 athletic team. (Hasker, 2010)	Compare MAC with PST	MAC (*n*=9) PST (*n*=10)	Coach's Rating of Athlete's Performance Athlete's Self-Rating Acceptance and Action Questionnaire Five Facet Mindfulness Questionnaire Flow State Questionnaire White Bear Suppression Inventory	7 sessions 60 minutes	MAC athletes demonstrated increased ability to describe and be nonreactive to internal experiences, experiential acceptance and increased ability to commit to behaviours directly related to achieving goals compared to PST. No statistically significant improvements in performance by coach and self-ratings of athletic performance. Athletic performance ratings were higher at the end of the MAC program over time.

Sample population and author	Objectives	Sample size	Measures	Number of sessions and duration	Key findings
NCAA division 1 athletic team. (Goodman, Kashdan, Mallard, & Schumann, 2014)	Compare MAC with non-intervention control	MAC (*n*=13) + 60-min yoga classes after each session. No active component (*n*=13)	Mindful Attention and Awareness Scale Acceptance and Action Questionnaire-II (AAQ-II) The Adult Hope Scale The Perceived Stress Scale The Values Living Questionnaire The Short Grit Questionnaire The Drexel Defusion Scale Depression Anxiety Stress Scale Written evaluation	8 sessions 90 minutes	MAC participants reported greater mindfulness, greater goal-directed energy, and less perceived stress than before the intervention. Compared with control group MAC participants reported greater goal-directed energy and mindfulness.

Sample population and author	Objectives	Sample size	Measures	Number of sessions and duration	Key findings
Elite junior soccer players. (Ivarsson et al., 2015)	Compare MAC with sport psychology education to reduce injury risk	MAC (*n*=21) Sport Psychology education (*n*=20)	Physiotherapists recorded injury Evaluation form	7 sessions 45 minutes	No statistically significant differences in injury rates between the two groups. 67% players in the MAC group remained injury free compared to 40% in the control group. Results imply that the attentional/mindful-like components of PST interventions (e.g., autogenic training) may account for a significant amount of variance in injury outcomes. Mindfulness practice could be a viable alternative when designing injury prevention programs for a group of athletes.
Recreational athletes – dart throwers. (Zhang et al., 2016)	Compare MAC with sport psychology education	MAC (*n*=22) Sport Psychology education (*n*=21)	Five Facet Mindfulness Questionnaire AAQ-II Short Dispositional Flow Scale Performance: self-report	6 sessions 80-90 minutes	MAC group had significant improvements in mindfulness, experiential acceptance, and flow at post-intervention and follow-up. Both groups improved dart throwing performance however the improvement of the mindfulness group was statistically higher in comparison to that of the control group.

Sample population and author	**Objectives**	**Sample size**	**Measures**	**Number of sessions and duration**	**Key findings**
NCAA Division III Uni – women's basketball. (Gross et al., 2018)	Compare MAC with PST	MAC (*n*=11) PST (*n*=11)	Counselling Centre Assessment of Psychological symptoms-62 AAQ-II Difficulties with Emotion Regulation Scale Mindful Awareness Attention Scale Sport Performance Questionnaire Marlowe-Crowne Social Desirability Scale – short form Working Alliance Inventory- short version	7 sessions 60 minutes	MAC is effective in reducing psychological symptoms, behavioural difficulties, and emotional distress. Sport performance in the MAC group also improved. MAC participants became more emotionally regulated across time compared to PST participants. Increases in psychological flexibility in the MAC group and decreased psychological distress found 1-month post intervention.

Sample population and author	Objectives	Sample size			Key findings
Female Basketball University Athletes. (Dehghani, Saf, Vosoughi, Tebbenouri, & Zarnagh, 2018)	Compare MAC with non-intervention control	MAC (*n*=15) No active component (*n*=16)	Charbonneau Sports Performance Questionnaire Action and Acceptance Questionnaire Sports Competition Anxiety Test Questionnaire	8 sessions 60 minutes	MAC improved athletic performance and reduced experiential avoidance and athletic anxiety.
Competitive elite athletes. (Josefsson et al., 2019)	Compare MAC with PST	MAC (*n*=36) PST (*n*=32)	The Athlete Mindfulness Questionnaire Difficulties in Emotion Regulation Scale	7 sessions 50 minutes	MAC intervention had an indirect effect on self-rated athletic training performance through changes in dispositional mindfulness and emotion regulation respectively. MAC group had greater post-test improvements in athletic mindfulness, emotion regulation abilities, and perceived performance compared to the PST group.

To explore whether mindfulness and acceptance-based skills taught through sport could improve overall psychological well-being of student athletes, Gross and colleagues (2018) via RCT compared MAC with PST (Table 3). Twenty-two women's basketball players recruited from a university athletic department participated in seven 60-minute sessions and completed pre- and post-intervention questionnaires. Findings suggested that the MAC was effective in reducing psychological symptoms, behavioural difficulties, and emotional distress, whilst improving sport performance (Gross, et al., 2018). Participants in the MAC group demonstrated statistically significant increases in overall sport performance from pre-intervention to post-intervention, however the pre-score of the MAC group was lower than the PST pre-intervention (Gross, et al., 2018). Additionally, no-between differences emerged based upon coach's ratings of athletic performance, indicating there was more variability in scores in the MAC group (Gross, et al., 2018). These findings suggest that mindfulness interventions may be effective in improving athletic performance while also decreasing psychological, emotional, and behavioural concerns of the athlete (Gross, et al., 2018). Thus, it was concluded that MAC appears to influence fundamental principles associated with a wide range of psychopathology, suggesting MAC warrants ongoing investigation and implementation as an intervention to simultaneously address mental health and performance needs of athletes.

A further exploration of MAC compared to PST was recently investigated with 69 elite athletes including: floorball (*n*=38), golf (*n*=27), football (soccer) (*n*=2), cycling (*n*=1) and wrestling (*n*=1) (Josefsson et al., 2019). Findings revealed that through changes in dispositional mindfulness and emotion regulation the MAC intervention had an indirect effect on self-rated athletic training performance. Further, the MAC- group achieved better post-test improvements in athletic mindfulness, emotion regulation abilities, and perceived performance compared to the PST group. Overall, findings suggested that dispositional athletic mindfulness and emotion regulation are central mechanisms in MAC, and that the

MAC approach is a more effective intervention compared to PST in reducing emotion regulation difficulties, as well as improving sport-relevant mindfulness skills and perceived athletic training performance (Josefsson et al., 2019) (Table 3).

2.3.2 Mindfulness and injury prevention

Psychologically based intervention programs have been suggested to potentially reduce injury risk among athletes (Gardner & Moore, 2004; Williams & Andersen, 1998). It has been suggested that participation in mindfulness could lessen the burden of injury, offering substantial potential positive effects for athletes and their teams (Gardner & Moore, 2012, 2017). Accordingly, Johnson and colleagues (2005) sought to investigate the effectiveness of a prevention intervention program to reduce the incidence of injury for soccer players with at-risk psychosocial profiles. Thirty-two high injury-risk players were detected and randomly assigned to treatment and control groups. The intervention program comprised mental health skills training delivered in 6-8 sessions during 19-weeks of the competitive season. The results indicated that the brief intervention program significantly lowered the number of injuries in the treatment group compared with the control group (Johnson, Ekengren, & Andersen, 2005). To advance research in mindfulness and injury, it was recommended that future research design an intervention with the foundations of the stress-injury model (Williams & Andersen, 1998) for predicting and preventing injury.

To investigate the extent to which a mindfulness-based program could reduce the number of sport injuries, Ivarsson and colleagues (2015) recruited 41 elite junior soccer players and randomly assigned them to a MAC treatment or attentional control group. The treatment group participated in a 7-session program based on the MAC approach. The attentional control group was offered 7-sessions of sport psychology presentations with a specific focus on soccer. Injury was defined by two criteria: a) it occurred as a result of participation in a soccer practice or game, and b) it resulted in 4-days or more of restricted or no practice including the day of injury reported (Ivarsson et al., 2015). Twenty-three injuries were recorded in total during the 6-month study period. It was reported that 67% of the players in the mindfulness group maintained an injury free status in comparison to 40% in the control group (Ivarsson et al., 2015). These findings indicate that an intervention program centering on strategies for increasing attention could reduce injury risk. It appears that the results of the Ivarsson et al., (2015) study and the neurological components of mindfulness align with the Williams and Andersen (1998) athlete stress-injury model. In the model, stress responses present as cognitive disruptions (e.g., distractibility, intrusive worrisome cognitions), perceptual changes (e.g., peripheral vision narrowing), and physiological reactions (increased generalised muscle tension) and are hypothesised to influence injury risk (Andersen & Williams, 1988), consistent with Ivarsson and colleagues (2015) findings.

Attentional disruption/distractibility is one of the fundamental variables in the model of stress and athletic injury (Andersen & Williams, 1988), therefore further exploration of a mindfulness-based program focussing on attentional processes may help to ascertain if focusing specifically on enhancing attention/concentration may reduce injury risk. Mindfulness practice has been found to positively influence both individuals' appraisals of stressful situations and their stress responses (Weinstein, Brown, & Ryan, 2009). Cognitive appraisals and stress reactions (e.g., disrupted attentional processes) are the foundation of the stress and athletic injury model, and it is predicted that mindfulness practice could decrease injury risk in professional ballet, likely through changes in appraisals and improved attentional processes. The athlete stress-injury model (Andersen & Williams, 1988) is further explored in section 2.4 (theoretical framework: the stress-injury model) of this thesis.

2.3.3 Mindfulness and dance

Comparable to sport, the performing arts are focused on human performance, and parallels are frequently illustrated between the two, especially the physical-based pursuits of sport and dance (Moyle, 2016). Dancers continuously work with and on their bodies throughout the duration of their careers, both as students and professionals (Aalten, 2004). Dancers are required to maintain strong body-mind connections with maintained focus through self-regulated attention and awareness considered as inherent in the practice of dance, regardless of genre (Moyle, 2016). Although parallels exist between mindfulness and the practice of dance, research exploring mindfulness in dance specifically and solely related to performance enhancement has not been published (Moyle, 2016).

Mindfulness in the dance literature although scarce, has been explored. A nine-week mindfulness-meditation ACT-based program was presented to all dance students enrolled in a full-time University dance training course (*n*=106), with an objective to support students in the further advancement of their performance psychology skills. Tai chi as a 'moving' method of mindfulness was incorporated alongside mindfulness meditation to engage both physical/ somatic and psychological skill development (Moyle, 2016). An acceptance-commitment-therapy mindfulness medication-based program was introduced in dancers weekly scheduled class, initially administered over a 9-week period. The Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003) was administered pre- and post-the mindfulness training period. Furthermore, dancers were required to maintain a reflective journal and complete a self-report questionnaire post-program. An upward trend in levels of mindfulness awareness was identified, however, the results were not significant. Qualitative feedback indicated that involvement in the mindfulness program had resulted in positive performance and personal outcomes (Moyle, 2016).

A debriefing process was included into the mindfulness training design in a subsequent year (part 2 of this research) with an increase in walking meditations, increase in classes run outside (from five to nine) and shortening the classes from 1-hour to 45 minutes. A subsequent 9-week program was delivered to 96 dance students covering key principles such as mindfulness breathing, feelings, emotions, thoughts and beliefs. Reflective journals and completion of the MAAS pre-and post- intervention consistent with part one transpired. A slight downward trend in levels of mindfulness awareness were identified, although inconclusive possibly due to decreases in the duration of classes, timing of the sessions (7.30am) and reduced attendance rates (Moyle, 2016). Qualitative feedback however indicated positive personal performance outcomes. Scheduling constraints were experienced in part one and part two of the study and highlight practical implications for incorporating mindfulness into dancer schedules and for committed attendance by dancers. Moyle and colleagues (2016) contended that successful integration of mindfulness into dance education and training requires an organisational and systems-theory approach. It was also recommended that further exploration of mindfulness in dance is required to investigate the proposed benefits for performance enhancement and general health and well-being for dancers, and to assist in expanding the literature in performance settings. To the researcher’s knowledge, literature examining mindfulness in professional ballet has not been published and warrants exploration.

2.4 Theoretical framework: the stress-injury model

Sport injuries vary across a spectrum of structural damage, and can range from microtrauma (over-use, cumulative trauma over time) to macro-trauma (acute, specific traumatic event) (Wiese-Bjornstal, 2010). Prevention of sport injuries is a complex process due to the multi-factorial nature of injury causality and risk factors (Bahr, 2009; Meeuwisse, Tyreman, Hagel, & Emery, 2007). To identify sport injury risk, multidisciplinary efforts should be adopted by health teams working with high-intensity athletes (Wiese-Bjornstal, 2010).

In exploring the vulnerability and resiliency of psychosocial variables related to athletic injury, Andersen and Williams developed the stress-injury model (1988; revised 1998), the most cited model in the area of psychology and injury prediction/prevention (Urban, Ulrika, & Andreas, 2014). The model was developed to consider physical, psychological, and psychosocial factors that may impact injury occurrence, identified as a stress-injury relationship. The model proposes that a potentially stressful situation will create a stress response and the strength of the stress response will be affected by the interaction among various psychosocial factors, separated into three categories: personality factors (e.g., anxiety, Type-A behaviour, and attentional style), history of stressors (e.g., life event stress, and previous injuries) and coping strategies/resources (e.g., social support, acceptance, and positive reappraisal).

In response to stressful situations such as competition, practice, and selection periods, athletes appraise the pressures of the environment and their capability to address the stressors and challenges (Williams & Andersen, 1998). If the perceived demands exceed perceived resources, the stress response may be pronounced and consequently influence the behavioural and cognitive response to the stressor. Maladaptive and negative responses to a stressor if excessive, may predispose an athlete to heightened risk of injury due to the attentional and physiological changes that accompany negative cognitive appraisals (Andersen & Williams, 1988). Numerous physiological changes occur during stress including muscle tension which can disrupt motor coordination and reduce flexibility, consequently contributing to sprains, strains and other musculoskeletal injuries (Andersen & Williams, 1988; Ford, Eklund, & Gordon, 2000; Rogers & Landers, 2005). Further, a change in attention during stress can result in the narrowing of visual focus, increasing the risk of injury, due to an inability to acknowledge crucial cues in the periphery (Ivarsson et al., 2015). It has also been suggested that continuous stressors such as daily hassles may impede the association between distinct stressors (e.g., major life changes) and health and well-being (Pillow, Zautra, & Sandler, 1996). Accordingly, further research exploring the stress response in athletes is warranted to identify whether persistent stressors (e.g., daily life hassles) influence the relationship with injury frequency for the development of further interventions to mitigate injury risk and enhance health and well-being.

Fundamentally, the stress-injury model suggests that a history of stressors, personality characteristics (that may intensify stress responses), and limited coping skills will impede an athlete's appraisal of a stressor and the subsequent response. When experiencing a stressful situation, athletes with the aforementioned issues will appraise a situation as more stressful and display greater physiological stimulation and attentional disturbances compared to athletes with the contradictory psychosocial profile (Williams & Andersen, 1998). Consequently, attentional and somatic changes associated with the stress response such as; enhanced distractibility, peripheral narrowing, muscle tension, fatigue, and reduced timing/coordination increase injury risk and incidence. For example, it was reported that a professional soccer player concerned about contractual obligations (i.e., a major life stressor) and suffering relationship problems (i.e., a chronic stressor) may, when placed in a potentially stressful situation (e.g., a league final), experience intensified attentional and physical deficits that prohibit them from noticing or responding to a blindside tackle (Johnson & Ivarsson, 2011). Under such conditions, according to the model, this player would be at a heightened risk of injury (Johnson & Ivarsson, 2011).

Stress vulnerability (Johnson & Ivarsson, 2011), competitive anxiety (Ford et al., 2000), type A behaviours (Nigorikawa et al., 2003) and mood disturbances (van Wilgen et al., 2010) have been found to influence a larger stress response (e.g. generalised muscle tension and distractibility) and subsequently contribute to a higher risk of injury (Maddison & Prapavessis, 2005). Petrie and Perna (2004) extended the Andersen and Williams' (1988) model of the stress response describing it as a bidirectional relationship (see Figure 7) between cognitive appraisals and physiological and attentional changes. It was recommended that the assessment of an individual's stress response consider individual effects of affective (e.g., anxiety and depression), cognitive (e.g., disruptions in attention and concentration), behavioural (e.g., interference with self-regulatory behaviour), and physiological (e.g., autonomic nervous system) systems. Further, it was suggested that stress responses are impacted by intense and sustained exercise, and incorporate adverse health consequences (e.g., viral infection and physical symptoms) in athletes (Hiller et al., 2004). Exploring the stress-injury relationship and mitigating factors may therefore offer greater insight for the identification of coping resources, and which coping strategies are adaptive or maladaptive relative to specific stressors in dance.

2.4.1 Personality

Athletes with differing personality characteristics may be predisposed to identify circumstances and experiences as more or less stressful, affecting their sensitivity to stressors (Andersen & Williams, 1988). According to Williams and Andersen's (1998) stress–injury model, personality factors that intensify the stress response can produce greater physiological activation and attentional disruptions for the athlete, increasing the possibility of injury. Andersen and Williams (1988) proposed that personality factors identified in the stress-injury model are preliminary recommendations rather than an extensive list of possible factors. Desirable personality characteristics and/or coping resources may protect individuals from stress and injury interactions, perceiving fewer circumstances as stressful or by reducing their vulnerability to the impacts of their history of stressors. Conversely, the absence of desirable personality characteristics and coping resources, or the existence of undesirable characteristics (e.g., high competitive trait anxiety), may impact susceptibility to heightened stress (acute and chronic) and, likely, greater injury risk (Williams & Andersen, 1998).

There are a number of personality traits that have been linked to dancers including high achievement motivation, introversion, neuroticism (i.e., high anxiety and poor emotion stability) and perfectionism (Bakker, 1991; Hamilton et al., 1989). A personality factor that has been identified to impact injury risk in the stress-injury model is perfectionism (Williams & Andersen, 1998) supported by retrospective research in gymnasts and dancers (dancers (Cumming & Duda, 2012; Dawson, 2000; Nordin-Bates et al., 2011). Perfectionism may also be considered contextually relevant to the study of mindfulness-performance relationships (Van Dyke, 2019). For the purpose of this thesis and this chapter, perfectionism as a sole personality trait will be briefly discussed as this trait has been linked to chronic stress and injury risk, aligning to a key component of the stress-injury model (Williams & Andersen1998).

An integral aspect of the perfectionism construct is performance standards, a primary focus in elite dance and sport (Krasnow, Mainwaring, & Kerr, 1999). Perfectionism has been found to be relatively common with athletes and in the performing arts as success is based on the achievement of near perfect or flawless performance (Hall & Hill, 2012). As a multidimensional personality characteristic, perfectionism incorporates a propensity for setting unrealistically high personal goals or standards and for overly critical evaluation of self and one's mistakes (Flett & Hewitt, 2002; Nordin-Bates, Raedeke

& Madigan, 2017). A preoccupation with strict self-critical appraisal is associated with psychological maladjustment, and such vulnerabilities further impact risk of chronic stress. Maladaptive perfectionists maintain extreme concerns about their mistakes, constantly feel inadequate, produce relentless and intense self-criticism, and often feel incompetent to reach their goals or required standards (Rice & Ashby, 2007). Strong perfectionistic qualities may exacerbate intense stress experiences and consequently, perfectionistic concerns may impact stress and injury risk (Gordon & Paul, 2005) (Figure 7). Within dance-specific research, positive correlations between stress, maladaptive coping behaviours and injury have been reported (Adam et al., 2004; Noh & Morris, 2004). However, limited data has been published exploring how professional ballet dancers cope with stressors longitudinally in dance-specific contexts.

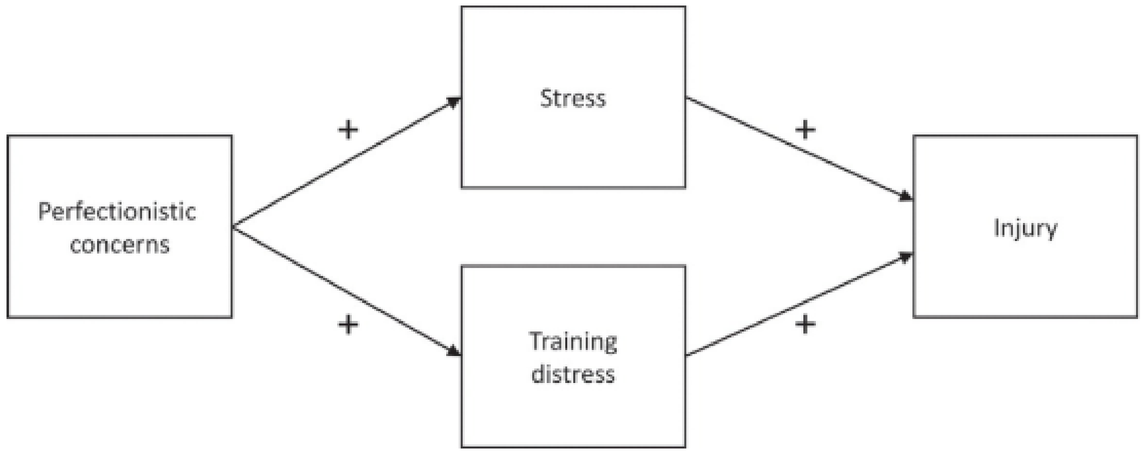

Figure 7. Theoretical model of the relationship between perfectionistic concerns and injury.

(Madigan et al., 2018).

Madigan and colleagues (2018) suggested two courses by which perfectionistic concerns may predispose athletes to injury as highlighted in Figure 7. The first direction is based on the stress–injury model (Williams & Andersen, 1998). According to this model, the probability of injury is increased when athletes are subjected to stress moderated by personality factors (i.e., personal factors that predispose athletes to increased stress responses). Research adopting the diathesis–stress model of perfectionism (Flett & Hewitt, 2002; Gordon & Paul, 2005) has validated that perfectionism is correlated with chronic stress, and this stress may result in increased injury risk and is associated with maladaptive stress coping strategies (Hill, Hall, & Appleton, 2010). The second direction links training distress from perfectionistic concerns and injury (a proxy of OTS). Perfectionistic concerns have been found to predict increases in training distress over time (Madigan et al., 2018). Consequently, perfectionistic athletes may overtrain, adopting intense durations of training compared to non-perfectionistic athletes, making them more susceptible to an increased risk of injury (Hägglund et al., 2013). Further research is warranted to assess the mediational pathways in the theoretical model (Figure 7) and explore if stress and/or overtraining are accountable for the interactions and risks to athlete injury.

2.4.2 History of stressors

Stress has been shown to enhance susceptibility to injury, either as a consequence of major life events and/or negative situations that athletes are unable to cope with potentially due to their absence of coping skills and social support (Wiese-Bjornstal, 2010). Athletes who self-report suffering higher levels of stress correlated with major life events are more likely to sustain a sport injury than those who report lower levels (Maddison & Prapavessis, 2005). Furthermore, it has been found that athletes with high life stress are two to five times more likely to sustain an injury than athletes with low life stress (Maddison & Prapavessis, 2005). For example, in a study of NCAA Division I intercollegiate athletes, athletes who self-reported major life event stress levels at the beginning of the season sustained a sport injury twice the frequency of their uninjured teammates (Wiese-Bjornstal, 2010). Injured athletes experienced greater negative mood states before, during, and after the injury compared to their uninjured counterparts on the same teams (Wiese-Bjornstal, 2010). It was therefore proposed that injury interventions should focus on modifying the cognitive appraisal of potentially stressful events and address the physiological and attentional aspects of the stress response to identify injury susceptibility and prevention of injuries caused by stress.

If an athlete is physically, but not psychologically ready to return to sport participation following injury, complications may arise due to anxiety and negative cognitive appraisals. In dance, Adam and colleagues (2004) found that dancers who missed more rehearsal and performance days during the past season reported higher levels of perceived stress, anxiety, depression, anger, fatigue, and confusion than less injured dancers. Elite ballet dancers are under considerable pressure to perform consistently at a high level and are at risk of losing their position in the dance company for missing rehearsals and performances. Hence, it is possible that the relationship between dance injuries and psychological distress may be the result of how dancers "feel" about the consequences of being injured (Adam, Brassington & Matheson, 2004) and therefore further exploration is warranted.

2.4.3 Coping resources

The stress-injury model includes coping resources consisting of social support, stress management, psychological coping skills, general coping behaviors and medication (self or prescribed) (Figure 8). Coping resources are comprised of a variety of multifaceted behaviours and social networks (Andersen & Williams, 1988). General coping behaviour might contain several diverse behaviours such as sleep, nutritional habits, time management and general self-esteem that may influence an athlete's overall stress level.

Social support involves resources and interactions with others that might aid a person cope with a challenge. Stress management skills include one's ability to monitor arousal and focus under stress conditions. The stress-injury model proposes that coping resources indirectly impinge on sport injuries through the stress response (Williams & Andersen, 1998). Specifically, it is anticipated that the accessibility of coping resources impacts the perception of a stressful situation as less threatening, hence reducing the stress response and decreasing the possibility of sport injury. A negative relationship between adaptive coping strategies, such as the use of social support, and injury frequency has been found (Rogers & Landers, 2005).

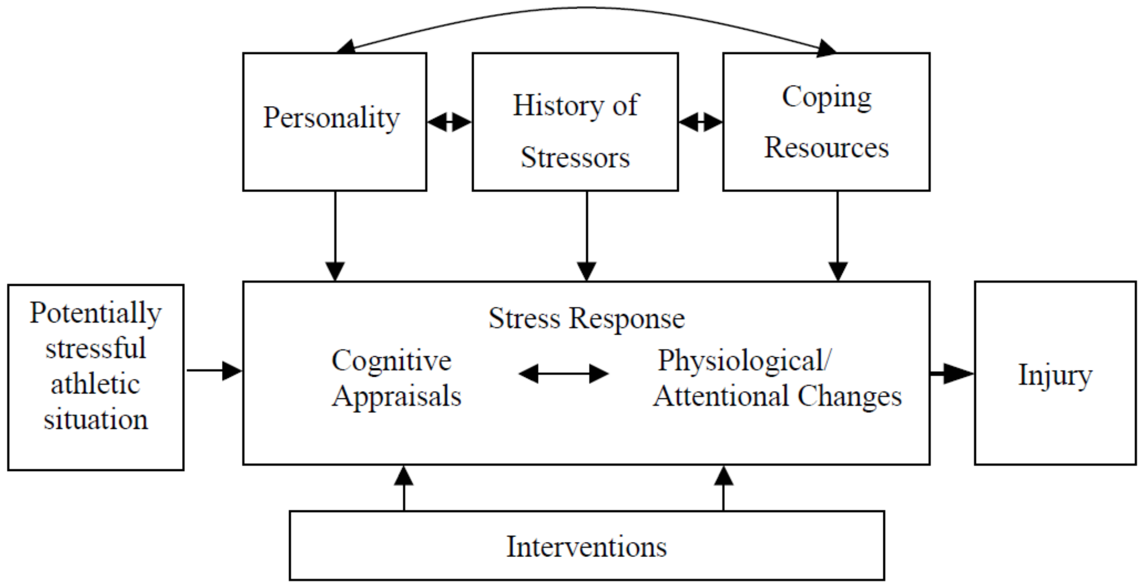

Figure 8. The stress-injury model.

(Williams & Andersen, 1998).

2.4.4 Interventions

Although the model of stress and athletic injury is the most frequently adopted framework in injury prediction and prevention research, the implicit limitations of the model are related to the model not entirely addressing emotional (e.g., mood states) and environmental factors (e.g., motivational climate, training venue conditions) that may have influences on injury risk (Hackfort & Kleinert, 2007; Steffen, Pensgaard, & Bahr, 2009).

Additionally, the model does not clearly identify how overt behaviors (e.g., motor behaviour) may impact the stress–injury relationship (Hackfort & Kleinert, 2007). Williams and Andersen (1998) suggested that future research implement and assess the effectiveness of interventions targeted at modifying psychosocial risk factors and decreasing stress reactivity. Psychological interventions could reduce the magnitude of the stress response, which in turn, could diminish the injury risk that athletes are exposed to (Johnson, 2007).

Adopting the stress-injury model (Williams & Andersen, 1998) as a theoretical framework, dance researchers have explored stress and coping in ballet, identifying that dancers have low levels of coping skills and reported experiencing distress from multiple foundations (Noh & Morris, 2004; Noh et al., 2005). Accordingly, it was suggested that the development of coping skills could be an important area for intervention and intervention-based research was recommended (Noh & Morris, 2004; Noh et al., 2005). To address these recommendations, Noh and colleagues (2007) sought to explore psychological intervention programs for reduction of injury in ballet dancers. Thirty-five ballet dancers were assigned to three conditions: control (n=12), autogenic training (n=12) and a broad-based coping skills condition (n=11). The intervention occurred over a 12-week period and dancers were required to practice their respective interventions three times a week for a further 12-weeks following the intervention (Noh, Morris, & Andersen, 2007). Injuries were recorded over the total 24-weeks by training staff at the dance academies recording injury frequency and duration. The overall results of this research indicated that the combination of imagery, self-talk and relaxation was effective in enhancing coping skills and reducing injuries (Noh et al., 2007). Specifically, it was found that dancers in the broad-based coping skills condition spent less time injured than dancers in the control condition (Noh et al., 2007). The results of the study therefore supported the proposal in Williams and Andersen's (1998) model that interventions that reduce stress or increase coping resources will reduce the likelihood of injury (Noh et al., 2007). Noh and co-authors (2007) concluded that although the effects of intervention programs on the development of psychological skills appears valuable, the inclusion of coping skill training is warranted to better prepare dancers to manage practice and performance stressors. Additionally, further research should also consider the effects of programs on subsequent behaviors and on the impacts on dancers personal and professional coping strategies for enhanced holistic well-being and quality of life (Noh et al., 2007).

Picture 3: The Australian Ballet.

CHAPTER THREE:

THESIS AIMS

The overall aim of this thesis was to explore the use and feasibility of a wellness App designed to monitor wellness, activity and participation status in professional ballet and explore an intervention designed to enhance awareness of well-being in professional dancers at TAB.

It was anticipated that the findings from this research may positively contribute to a greater understanding of the patterns and fluctuations in wellness according to work-related activity in professional ballet. Further, it was thought that performance periods may be associated with increased stress, fatigue and muscle soreness, and decreased sleep quality and quantity, potentially heightening risk factors for injury incidence. It was anticipated that findings may guide the development of interventions in professional dance companies nationally to promote and enhance awareness of holistic well-being, and to minimise the experience of preventable physical and psychological injury and illness in professional ballet companies.

3.1 Research objectives and aim(s)

To achieve the overall research aim, four studies were conducted. Primarily, it was necessary to pilot the wellness App with a small group of dancers to explore the feasibility, experiences, and perceptions of the App prior to administering the App with a greater number of dancers. Given the extensive work-demands of dancers in the company, identification of whether the App may be viable was the primary focus of the pilot study. Subsequently, for Study 2 it was anticipated that the App would be used by a greater number of dancers from the company, and it was most important to TAB for dancer’s wellness to be explored in the context of elite-sport. Therefore, a comparison group of professional athletes were incorporated into the research design. Furthermore, given the self-report design of data recording through the App, the exploration of dancer's experiences and perceptions was incorporated as Study 3 to provide further depth and insight into the applicability of the App and to potentially inform the development of the proposed mindfulness intervention. The mindfulness intervention, Study 4 was developed as a pilot study via a RCT to explore the potential practicality of mindfulness practice in dance to enhance awareness and holistic well-being.

Four specific research objectives and aims were developed, found in Table 4.

3.2 Significance

Athlete self-report measures are widely adopted in professional sport and have the potential to proceed as a valuable tool in athletic preparation (Saw et al., 2015a) . Currently, there is limited use of subjective wellness monitoring in professional ballet and a lack of evidence to support and guide the development, implementation, and ongoing use of wellness Apps in dance companies. If the value of a wellness App and mindfulness intervention in ballet can be demonstrated, dance companies may be motivated to invest resources, supports and time to these initiatives with greater confidence. Comprehension of wellness monitoring and mindfulness use, feasibility, practicality and implementation considerations will provide guidance for further development and utilisation to potentially enhance dancer awareness of holistic well-being, and ultimately improve performance quality and overall physical and psychological health.

Table 4. Research objectives and aim(s)

Objective	Aim(s) of study	Chapter
Explore the use of a wellness App within a professional ballet company.	To increase feasibility of tracking in professional ballet, study 1 aimed to expand upon dancer wellness monitoring initiatives using a ballet-specific wellness App.	Chapter 5 (Study 1)
Quantitatively compare wellness and activity in professional ballet dancers and athletes.	1) To compare wellness scores of professional ballet dancers and athletes over 4-months in season. 2) To compare wellness scores between training and performance in both dancers and athletes. 3) To report frequency of self-reported modified participation during training and performance. 4) To report frequency of self-reported inability to participate due to pain and illness in dancers and athletes.	Chapter 6 (Study 2)
Qualitatively explore the perceptions and experiences of professional dancers using a wellness App.	To explore the experiences of professional ballet dancers using a wellness App and to investigate the applicability of a wellness App for the dance industry.	Chapter 7 (Study 3)
Explore the applicability of an intervention aimed at improving well-being in professional ballet.	To explore the practicality of a mindfulness intervention via a RCT with a MAC group and a control group (who were provided with meaningful education sessions).	Chapter 9 (Study 4)

CHAPTER FOUR:

THE DEVELOPMENT OF A WELLNESS APPLICATION

This chapter summarises how the wellness App was developed by the doctoral student and the key elements and stakeholders involved in the development.

Following extensive planning and discussions with TAB medical team management, a research proposal developed by the doctoral student was presented to TAB board and company Artistic Director for review and approval. The doctoral student also presented the App to the Human Resource team at TAB for review and endorsement.

The development of the wellness App for TAB was adopted from sporting organisation AMS frameworks. After a lengthy process seeking to identify a comparison group, an agreement with a professional athlete organisation to use de-identified data was finalised. The professional athlete group used the FairPlay AMS App, therefore TAB sought to use the same App for the current research. The doctoral student was able to adopt a ballet-specific model with FairPlay, from the template of the AMS used by the professional athlete group. Throughout the development process, regular interaction and communication with TAB occurred to ensure the App was in accordance with ballet terminology for specificity.

The wellness App included fatigue, sleep quality, sleep quantity, stress, and overall wellness scores (Figure 9), consistent with the constructs measured by the professional athlete group (Figure 4). These variables were also consistent with self-report athlete monitoring literature (for example see (Gastin et al., 2013). The App was developed so that work-related activity could be entered via a prepopulated list of activities including coaching class, technique class, rehearsal, and strength and conditioning. Performance was also recorded, and dancers indicated on tour and if it was a double show day. Figure 9 provides an example of the screen layout in the App and the handbook (Appendix G) depicts the multiple screens dancers became familiar with in completing their wellness, activity, and participation status.

The wellness questionnaire took 1-2 minutes to complete. During the study period, no feedback was given back to the dancers around their scores, however the dancers had access to a ‘history’ tab in the App where they could review their previous days and previous week wellness scores for each variable (sleep quality, sleep quantity, stress, fatigue). Automated alerts were sent to the researched and medical staff member through the App if for 3 consecutive days the following were recorded: low wellness scores (between 0 and 3), high muscle severity scores (between 7 and 10), and inability to participate due to injury. In addition, alerts were sent to the participant and the principal researcher if wellness or activity or injury data was missing for 2 consecutive days.

Dancers gave consent for the researcher and medical staff member to be alerted if 3 consecutive days of poor wellness, inability to participate or high muscle severity scores were recorded. Dancers at TAB appear to have a very good relationship with the medical staff, however sharing this information may have influenced the dancer’s wellness scores and reporting accuracy if they were apprehensive to have the medical staff member alerted. In applied sport, adjustment to training loads in response to alerts and red flags is accepted practice. By closely monitoring each dancer’s wellness via alerts a more specialised plan may be devised. Specialised care plans to support and assist dancers through challenging times, could incorporate the possibility of adjusting training schedules, referral to specialists and ongoing coordinated care, which may build trust in the dancers when recording wellness scores.

The OSTRC was developed as per OSTRC guidelines (Clarsen et al., 2014), with the questionnaire ending if full participation was entered and with continued questions for all other pre-designed responses (Figure 6). The doctoral student also met with an OSTRC specialist at La Trobe University to ensure the App was appropriately developed and to review the OSTRC analysis guidelines. The OSTRC was not altered for this research. Although previous dance research recommended adjustments for the application in the dance population (see Karreman et al., 2019; Kenny et al., 2018) due to the comparison with the athlete group in Study 2, adjustments were not made to ensure consistency in the measures across the groups was maintained for statistical comparison.

Once the wellness App template for the ballet was developed, the doctoral student trialled the App for a two-week period to test the App for functionality and to identify further adjustments that may have been required, in addition to testing for technological issues. This step was important to ensure that the App was “user friendly” and easy to navigate for the dancers. Data was also extracted from the App to an excel spreadsheet for additional appraisal. The doctoral student wanted to be confident that the App was accurately reflecting the data recorded and that the data could be extracted successfully for analysis of trends with dancers. Dancers in the company were consulted during the development process and their feedback sought and addressed, where possible, for App specificity and to enhance future adherence to the App. It was anticipated that following this research study the App might be implemented companywide therefore efforts to include the dancers in the development and to test and trial the functionality was vital in gathering rich data and for the potential ongoing adoption of wellness monitoring in the TAB.

Following the trial period (by the doctoral student) and minor adjustments, a handbook was created for the participants in Studies 1-3 (see Appendix G). Furthermore, an education session was conducted by the doctoral student and provided to all participants. Information about how to use the App and rationale for use was provided. The session also incorporated a demonstration to visually guide the dancers through the App features, including how to set reminders through the App, for consistent and daily reporting and for optimal data entry efforts. The participants were provided with a summary of the doctoral student’s skills/qualifications and work history to encourage trustworthiness when reviewing their wellness data.

FairPlay provided a username and password for the initial log in to the App. Participants were prompted to change their password monthly. In studies 1-3, the participants completed a 1-week familiarisation period where they practiced using the App prior to official data collection commencement. A check in meeting between the doctoral student and the participants at TAB after the first week of data entry across all studies occurred, to identify any concerns, and action any queries where possible. This step was important to identify early if there were any technical difficulties using the App and to address and clarify any questions relating to the rating of wellness, activity and participation through the App. Dancers were reminded in this meeting to record their wellness holistically considering both personal and professional factors in their assessment of the numerical value aligned to the wellness construct. Overall, in the catch-up meetings, the dancers reported finding the App easy to use and were consistently entering data.

Following the focus group interview in Study 1, adjustments to the App were made to include a calendar on the home screen for dancers to visualise if they had entered their wellness and activity data for each day, and contact details for the medical GP and Employee Assistance Program were included. For this research, feedback regarding the feasibility and use of the App was only sought from the dancers. No other stakeholders, for example medical staff or artistic staff were enrolled in the study to provide feedback on the App due to limited availability at the time of data collection, and this is a limitation. Future research should incorporate the exploration of other stakeholder's perspectives of the practicality of the App as well. It is important to consider the dance companies organisational structure and the attitudes, opinions, and behaviors of those close to the dancer to ensure that a facilitating environment is provided to encourage dancers to seek help as required for the enhancement of their health and well-being.

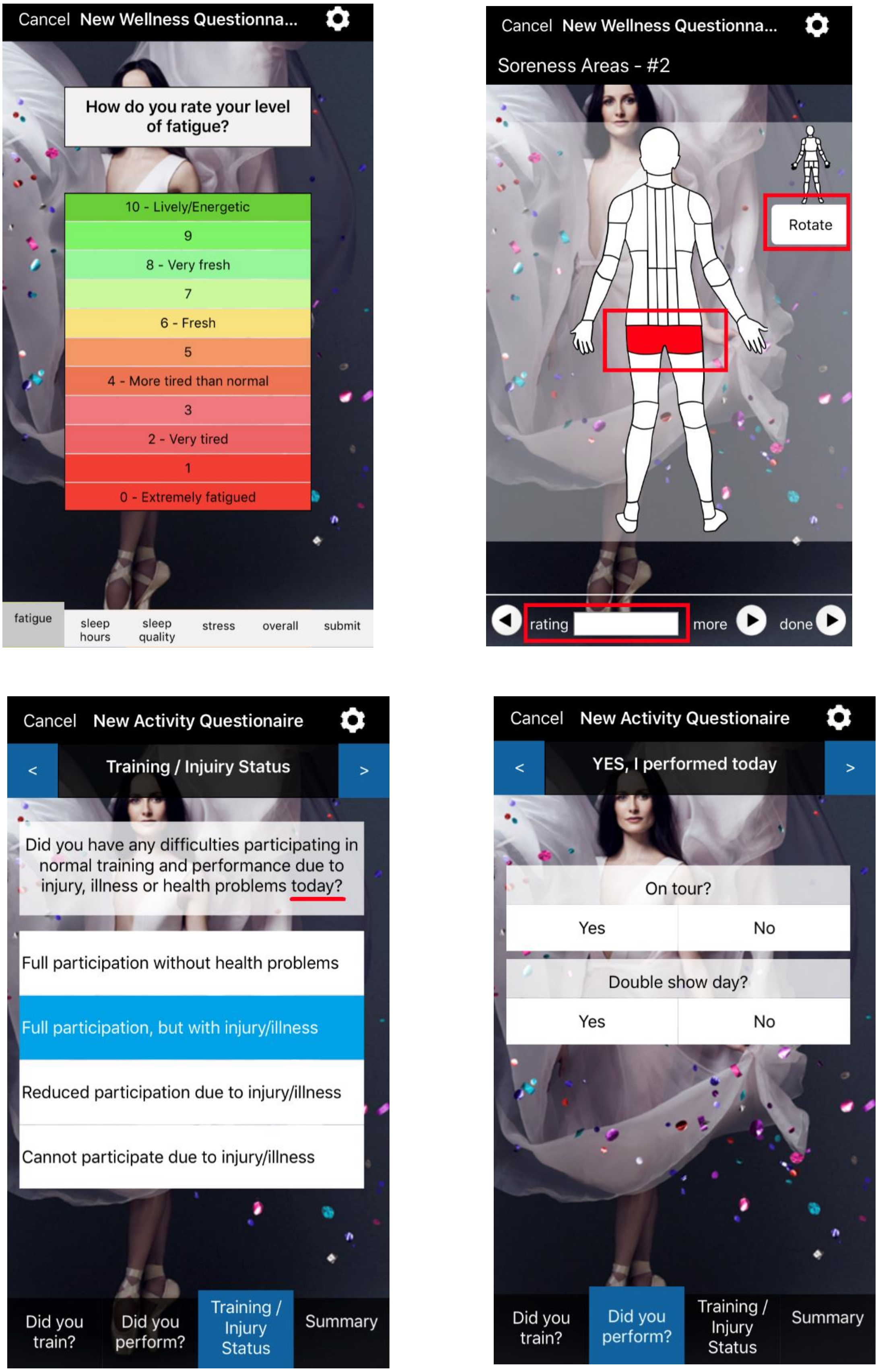

Figure 9. Sample wellness App questionnaire screens (see Appendix 12.7 for full handbook).

CHAPTER FIVE:

WELLNESS MONITORING FOR PROFESSIONAL BALLET DANCERS:

A PILOT STUDY (STUDY 1)

5.1 Preamble

Ballet dancers are repeatedly exposed to intense and extensive training and performance demands, and their holistic well-being has not been consistently monitored throughout work-demands. This chapter of the thesis explores the use of a wellness App as to identify the feasibility of use in a professional ballet company. Specifically, the pilot study aimed to discover whether the App could successfully capture wellness, work-related activity, and performance participation. Further, qualitative research was utilised to explore dancers' experiences using the App to gain insight for possible future use and company implementation. It was anticipated that the dancers would acknowledge the potential benefits of utilising an App and further encourage other dancers to participate in future studies investigating trends and fluctuations in wellness via the dance-specific wellness App.

5.2 Abstract

Self-report wellness measures are used extensively in elite sport as valid indicators of the adaptive responses to training and performance of an athlete. Wellness parameters such as quality and quantity of sleep, muscle soreness, fatigue, and stress are monitored in professional sport via Athlete Management Systems (AMS) and self-report monitoring applications (App). However, the use of a monitoring App specifically for professional classical ballet dancers has not been tested. This study piloted a self-report App to measure wellness constructs in a professional ballet company. Three male and two female dancers volunteered to take part in the mixed-method study, entering daily wellness data, frequency of work-related activities, and injury status into an App on their smart phones. Via a focus

group interview session, perceptions of wellness and experiences using the App were found to be favourable, with dancers reporting that the App enhanced awareness of their well-being. To further develop monitoring tools in professional ballet companies, it is recommended that the App be made specific to the wellness needs of dancers.

5.3 Introduction

Training imposes stress on athletes, often shifting their physical and psychological well-being along a continuum that progresses from acute fatigue to overreaching, and ultimately overtraining syndrome (Saw et al., 2015c). Such disturbances may also be reflected in an increased risk of injury (Andersen & Williams, 1988; Galambos, Terry, Moyle, Locke, & Lane, 2005; Johnson & Ivarsson, 2011). In the dance-specific research, positive correlations have been reported between stress, maladaptive coping behaviours, and injury (Liederbach et al., 2013; Noh & Morris, 2004; Patterson, Smith, Everett, & Ptacek, 1998; Rip, 2006). At any given point in time, strain on the body from the physical stress of training may combine with other psychosocial stressors to exert a negative influence on physical state, mental state, and as a consequence, ability to perform (Grove et al., 2013). Exhaustion is the central symptom related to stress and associated with intense training and competitive demands (Gustafsson, Kenttä, & Hassmén, 2011; Raedeke & Smith, 2001). Many dancers have perceived fatigue and overwork to be a major contributing factor to their injuries (Laws, 2005). Once fatigued, the ability to perform movements requiring complex skill is compromised. This can lead to poor technique, faulty alignment, inefficient biomechanics, and resultant stress placed on the muscles and joints that can only be tolerated to a limited extent before injury occurs (Twitchett, 2010).

An Athlete Self-Report Measure (ASRM) that records daily wellness can provide valuable insight into the adaptive responses of athletes when training and competing (Gastin et al., 2013). The use of self-report measures in wellness research is widespread, with 84% of surveyed high-performance sports in Australia and New Zealand incorporating a wellness self-report measure as part of their monitoring strategy (Halson, 2014a; McLellan et al., 2011; Taylor, 2012). The act of completing a self-report data form has been suggested to increase athletes self-awareness and ownership of their training, such as taking the initiative to seek information and assistance from staff, forming better habits, and being "less likely to sit on pain and injury, which may, in turn, lead to better training and performance-related behaviors (Kellmann, 2010a; Kenttä et al., 2006; Saw et al., 2015c).

Athlete monitoring Apps have been implemented in many professional sports (Gastin et al., 2013; Halson, 2014a; Nunes et al., 2014) and have provided coaches and medical staff with data that may assist with prescribing and adjusting training load, optimizing adaptation and performance while reducing the risk of overtraining, injury, and illness(Halson, 2014a; Taylor, 2012). While there is a growing body of research around dancer wellness programs and monitoring (Clark et al., 2014; Hopper et al.), the use of a monitoring App specifically for professional classical ballet dancers has not been tried. To increase feasibility of tracking in professional ballet, the current study aimed to expand upon dancer wellness monitoring initiatives using a ballet-specific wellness App.

5.4 Methods

Participants

Five professional ballet dancers (three male) employed at a national ballet company participated in a 1-month pilot study using a wellness App. Participants were aged between 24 and 30 years, and the length of their professional careers ranged from 4 to 10 years. Ranks in the company included senior artist (one), Soloist (two), coryphee (one), and corps de ballet (one).

Measurement Instruments

Participants completed a wellness questionnaire and an activity questionnaire (ballet specific work-related activities such as coaching class, technique class, rehearsal, and strength and conditioning) daily through the wellness App. They were instructed to complete the questionnaires consecutively, wellness in the morning before class and activity at the end of day.

Wellness questionnaire

Similar to sporting AMS structure, participants identified areas of soreness on a visual body map and scored their pain on a 10-point Likert scale where 1= no pain, 5 = quite sore, and 10 = extremely sore. They entered wellness scores for fatigue, sleep quality, stress, and overall wellness from a visual "traffic light" colored scale between 0 and 10, where 10 indicated a higher quality of wellness. Wellness variables were selected in accordance with the Hooper Index for well-being variables (Hooper, Mackinnon, Howard, Gordon, & Bachmann, 1995). The wellness questionnaire took 1-2 minutes to complete.

Activity questionnaire

Participants recorded their activities each evening via the App, which included the type of training activity, such as coaching class (a ballet class designed for dancers who are rehabilitating from injury), technique class, rehearsal, and strength and conditioning. More than one activity could be selected. If no activity was recorded, a reason could be selected from a list including day off, injured or rehabilitating, or sick leave. Participants recorded if they performed during the day, if they were on tour, and if it was a double show day. Finally, they were required to complete the Oslo Sports Trauma Research Centre (OSTRC) questionnaire (Clarsen et al., 2013), which measures the severity of a physical complaint, reflects athletes' self-assessment of their pain, and summarizes the impact that the problem has had on their participation, training volume, and sports performance (Table 5). Body areas were selected from a body map to represent areas that most limit training. The OSTRC was in no way altered to make it specific to ballet or dance. Previous studies have administered the OSTRC weekly to review symptom progression (Clarsen et al., 2013); this study, on the other hand, required participants to complete it daily.

Procedures

Ethics approval was granted by the authors' university ethics committee, and participants provided written consent. A tutorial and handbook for using the App on a smart phone or i-pad device was provided to all participants.

Throughout the 1-month pilot period, automated alerts of low wellness scores (between 0 and 3), high muscle severity scores (between 7 and 10), and inability to participate due to injury were sent for 3 consecutive days to the researcher and medical staff member through the App. In addition, alerts were sent to the participant and the principal researcher if wellness or activity or injury data was missing for 2 consecutive days.

Following the 1-month data entry period, a focus group was conducted by the principal researcher that provided the dancers an opportunity to describe their experiences and to hear the experiences of co-participants. A semi-structured interview format was adopted for the focus group exploring App use and experiences, completion of daily data entries, self-awareness, areas of improvement, and suggestions for further development of the App. The focus group data were transcribed verbatim by the primary researcher and the interview data were analysed via thematic analysis and condensed to information summaries. Due to the small sample group and the importance of maintaining confidentiality, the principal researcher chose not to denote participants as "Dancer A," "Dancer B," or to use other pseudonyms that might identify participants. Following the focus group, dancers were presented with a brief summary of the results of the pilot study.

Statistical analysis

Data analyses were performed in IBM SPSS Statistics software version 25 (IBM, Armonk, New York, USA). Data were reported using descriptive statistics. OSTRC findings were reported as frequencies (Table 5, Table 8).

5.5 Results

Quantitative data

Over the 1-month period, a 97% adherence rating was recorded, with participants scheduling alarm reminders through the App. They detected technical difficulties on three occasions when data were not entered. One participant entered two consecutive days of low fatigue ratings (0 to 3).

Table 5. Training impacts: Thoracic spine recording through the OSTRC.

Participation	Number of Times Recorded
Unable to participate	0
Reduced participation	2
Fully participating with physical complaint	3
Extent of Reduced Training Volume	**Number of Times Recorded**
Cannot participate	0
To a major extent	2
To a moderate extent	1
To a minor extent	1
No reduction	1
Extent Affected Performance	**Number of Times Recorded**
Cannot participate	0
To a major extent	2
To a moderate extent	1
To a minor extent	1
No effect	1

Symptoms	Number of Times Recorded
Severe pain	1
Moderate pain	2
Mild pain	1
No pain	0

Average wellness scores ranged from 6 to 7.92, which corresponded to reports of being "slightly stressed or fatigued," and the frequency of alerts for low wellness (0 to 3) were highest for fatigue and lowest for sleep quantity (Table 6). Dancers' participation in training activities included: technique class (36%), coaching class (1.5%), rehearsal (31%), performance (24%), strength and conditioning (32%), and double shows (4.4%).

Table 6. Average Wellness Scores Recorded over the 4-week period.

Wellness parameter	Mean	Standard Deviation	Number of alerts for low wellness
Fatigue	6.00	0.54	6
Stress	7.10	0.73	3
Sleep Quality	6.76	1.18	5
Sleep Quantity (hours)	7.92	1.03	0
Overall wellness	6.98	0.51	2

Foot pain was reported most frequently, and the highest severity of pain was recorded in the neck (Table 7).

Table 7. Muscle Soreness Areas Recorded Over the 4-week period.

Body area	Number of Times Body Area Recorded as Sore	Average Severity Rating	Highest Rating Severity Score Recorded on a scale of 1 to 10
Foot	30	0.80	2
Ankle	16	1.80	4
Pelvis	7	0.80	2
Neck	6	2.40	5
Thoracic Spine	5	1.80	4
Lower Leg	5	0.40	2
Thigh	5	0.60	3
Knee	4	0.80	4
Shoulder	2	0.60	3

Over a cumulative 118 days of recorded activity data, dancers reported full participation (N = 96), full participation with physical complaint (N = 9), reduced participation due to physical complaint (N = 4), and unable to participate due to physical complaint (N = 2). Seven illness events were recorded that impacted participation and performance.

Thoracic spine pain limited training most often and resulted in modification of training participation and performance (Table 8).

Table 8. Number of Times over 4 Weeks an Area of the Body Was Recorded as Limiting Performance.

Body area	Impact on Performance
Thoracic Spine	5
Lower leg	4
Knee	2
Ankle	2
Neck	1
Shoulder	1

Qualitative data

Qualitative thematic analysis of the focus group was conducted. Themes were refined into a summary that revealed two main concepts: enhanced self-awareness (effectiveness and ease of use of the wellness App), and further development (considerations for a wellness App explicitly for professional ballet.

Enhanced Self-Awareness: Effectiveness and Ease of Use of the Wellness App

Dancers reported that the App was simple to use; each section flowed with ease and could be completed quickly. All five dancers reported the App "enhanced" their self-awareness and provided an opportunity for reflection on their health. Two dancers found that they regularly checked the history component of the App. In particular, two of the five dancers reported that they regularly reviewed their fatigue and self-reported sleep quality and quantity over the week. Dancers acknowledged that psychological awareness and consideration of holistic well-being was "not always at the forefront" of their mind. They said that their physical and psychological awareness was enhanced in preparing for and recovering from training and performance demands, and using the App encouraged them to be more aware of their holistic well-being; for example: “In terms of how many hours I’ve slept and my level of fatigue in the morning, using the App I’ve actually stopped and thought wait, have I had enough sleep, am I actually tired. That’s kind of good in making me aware.” Dancers summarized their experiences using the wellness App as positive, beneficial, and practical for use in professional ballet. As a final component of this theme, dancers supported this trial of the App.

Further Development: Considerations for a Wellness App Explicitly for Professional Ballet

Dancers reported that they experienced difficulty in identifying if they had entered daily wellness and activity data and suggested that a tracking option via a visual calendar in the App may assist in tracing data entries and avoiding the potential for missed or duplicated data being entered. Dancers also discussed their experience of entering data in the morning and noticing that their wellness and muscle soreness varied throughout the day. For example, dancers reported that in the morning before class, when they entered their wellness data, they were feeling fresh, not stressed, and had limited muscle soreness. However, by the end of the day, if tested, they may have scored lower wellness and higher muscle soreness. One participant suggested entering whether dancers were on analgesic medications, as that might impact their wellness scores. A final recommendation was to provide medical points of contact and contact details through the App.

5.6 Discussion

A self-report wellness monitoring App was tested with a small sample of dancers in a professional ballet company and found to be useful. The App captured self-reported wellness, frequency of work-related activity, and injury status data, with dancers reporting that the App enhanced awareness of their well-being. Five wellness parameters based on the Hooper Index self-assessment questionnaire were included in the current App, involving well-being ratings relative to sleep, stress, fatigue, and muscle soreness (Clemente et al., 2017; Haddad et al., 2013; Hooper et al., 1995).The small number of wellness variables was chosen to enhance adherence to entering data, and participants found that the App was easy to use, data entry was efficient, and the questions succinct. Consistent with previous research (Saw et al., 2015c), participants in this study discussed the benefits of recording and reviewing their own data, acknowledging that wellness is often “not at the forefront of their mind.’’

Monitoring wellness can be useful for early detection and intervention before performance, injury, and health decrements are observed. Increased awareness and acknowledgement of wellness status on a daily basis can provide a greater depth of understanding of an individual’s holistic well-being, for both dancers and the medical team, to reduce the risk of injury. Wellness data collected in this study was limited to the five variables mentioned above, but exploration of other states such as mood, energy level, and motivation may provide greater insights into professional ballet dancers’ wellness. Further, wellness data was collected only in the morning, before any work-related activity had begun. Regular wellness reporting throughout the day, after each type of activity is completed, may promote greater insight for the development of interventions to maintain and improve health and well-being.

Access to the App via their smart phones facilitated the completion of wellness recording in real-time and thus allowed for immediate personal reflection of wellness scores. Confidentiality was a priority for dancers testing the App; therefore, it was agreed that only the researcher and a medical team staff member would be privy to the daily data entries and alerts for low wellness or injury and participation issues throughout this pilot study. The App successfully alerted the researcher and medical staff member to a participant’s data entry of low fatigue scores over 2 consecutive days, encouraging conversations between the dancer and the medical staff member. The medical staff member met with the dancer as part of the protocol for alerts through the App. Further access, analysis, and interpretation of individual and group wellness data by medical professionals within the company may be beneficial for rehabilitation program development and adjustment, intervention, and injury management.

In parallel with the research into athletes' overuse injuries (Clarsen et al., 2013), the current study collected daily OSTRC recordings to identify how symptoms progress from day to day. The OSTRC daily reporting may provide greater insight into the progression and development of overuse injuries. Further research in this area with a larger sample size, recording daily OSTRC scores and comparing with daily wellness scores, may assist in identifying patterns, trends, and possible injury risk factors. As a result of the limited sample size and pilot-study design, evaluating the relationship between injury and participation status and wellness fluctuations was not possible. Comparing wellness data in each of the work-related activities was also beyond the scope of this pilot. However, it is recommended that this be investigated in future research to identify possible patterns and fluctuations in wellness relative to work-related activity.

Future directions to expand on the findings of this pilot study are recommended. First, a study with a larger sample size and over a longer period of time is required to provide meaningful data on the incidence of injury and its impact on performance and training in dance. Second, it is recommended that further research be conducted to compare wellness profiles between touring and non-touring periods and to investigate the relationship between wellness scores and injury incidence resulting from work-related activities. Third, we suggest that dancers should be educated about the potentially injurious effects of poor wellness habits on holistic well-being and performance.

5.7 Conclusions

The experimental App utilized in this study captured self-reported wellness, participation in work-related activities, and injury status data. It also provided alerts to missing data entry points and poor wellness and injury reporting, enabling a timely and proactive approach to holistic well-being. To further develop monitoring tools for professional ballet companies, it is recommended that the App be made increasingly specific to the wellness needs of dancers.

5.8 Additional content: expansion of the focus group responses

This section was submitted as supplementary material and was not published in the Journal of Dance Medicine and Science.

Qualitative thematic analysis of the focus group revealed two overarching main themes: 1) Enhanced self-awareness: The effectiveness and ease of the wellness App and 2) Recommended improvements for further development of a wellness App for the ballet profession.

Enhanced self-awareness: The effectiveness and ease of the App

Via a collaborative conversational focus group, dancers reflected on their experiences using a ballet specific self-report wellness App. Of note, dancers reported that the App was "simple to use." Each section reportedly flowed with ease and was quick to complete. The dancers appreciated the short time duration to complete both the wellness and activity questionnaires due to their busy schedules and other occupational demands.

> I thought it was really easy to use, it makes you really check in with yourself, which I found really fascinating. I really enjoyed the whole process of it all. We get stuck in a rut sometimes, the industry can be very old fashioned, especially in the ballet world it's very traditional, and we need to modernise it and keep the ball rolling in that regard and adapt… It is a good initiative.

All five dancers reported the App "enhanced" their self-awareness and provided an opportunity to reflect on a day, set of days or week over the four weeks. Two dancers reported that they regularly checked the history component of the App. "The App provided a visual representation of previous wellness scores in graphs which made it really easy to track our own data." In particular, two of the five dancers reported that they regularly reviewed their fatigue and self-reported sleep quality and quantity over the week. For example: “I looked at it a bit, especially fatigue… I tracked my sleep too and would look at the last 8 days of sleep and I was like that’s really cool.” “In terms of how many hours I’ve slept and my level of fatigue in the morning, using the App I’ve actually stopped and thought wait have I had enough sleep, am I actually tired. That’s kind of good in making me aware.”

Another dancer stated:

> Being a dancer is a chunk of who we are and usually our wellness comes second, so a lot of dancers feel sick but you just come in, come in, come in until you just have a day where you’re like I’m so sick I need to stop.

Dancers discussed their naturally heightened self-awareness of their bodies with regards to muscle soreness/ stiffness, pain and injury due to their profession. For example: “I’m normally generally hyper aware (muscle soreness). As soon as you start class that’s when you consider how you are feeling muscle wise.” Dancers however, acknowledged psychological awareness and consideration of holistic well-being as “not always at the forefront” of their mind. Piloting the self-report wellness App, dancers reported that their psychological awareness was enhanced and using the App encouraged them to be more self-aware of their holistic well-being, preparation and recovery for example, “The wellness stuff is probably more relevant and made me more aware. We generally put wellness on the back burner as we are focused on achieving what we are wanting to achieve with our bodies and are generally more aware of our physical health.”

As a final component of this theme, dancers supported the trial of the App and whilst they provided recommendations and suggestions for further improvements, highlighted in the next theme, all participants were supportive of the trial and confirmed that should a further study occur they would be interested in further participating, responding “yeah definitely.” In response to a question: “Do you think the Application is feasible for a ballet company?” a dancer reported:

> Totally and I think it's a great App, I think less physically beneficial as I'm already aware of that myself but in terms of how much I've been sleeping and how I've been feeling such as fatigue and stress, it is good to monitor yourself and see times where your ratings decrease.

In conclusion, dancers summarised their experiences using the wellness App as positive, beneficial and practical for the professional ballet industry. One dancer concluded:

> "It's a great tool not only for athletes but in performing and the toll it takes touring, it's a very unique environment and I think it's enabling us to get the data that we need to be sustainable. To be quite honest with you, I feel like there is a lot of turnover in the performing arts not necessarily because of the work, I think it's because of the lifestyle and not always having the outlets that you need to be able to deal with normal life situations – the lifestyle becomes too difficult, it's not that they don't love it at all, it's just too difficult in the end and it's at an expense and the more we can, the more knowledge we can gain from it, hopefully in turn we can help support one another."

Recommended improvements for further development of a self-report wellness monitoring App for the ballet profession

Discussions regarding recommendations and opportunities for improvement were strongly encouraged throughout the discussion group. Dancers reported that they experienced difficulties in identifying if they had entered wellness and activity data daily and suggested a tracking option via a visual calendar in the App may assist in tracking data entry and avoiding the potential for missed data or retrospective data being entered. For example, one dancer suggested:

> I found it really hard to remember if I had done a certain activity or wellness questionnaire, and until you said that you can go into the settings, I couldn't

> remember if I had done it or not as the days melt into one. I feel like if there was a calendar set out so that you could see what that you have entered your data that would make it even easier to use and to keep up to date with.

Dancers also discussed their experiences entering data in the morning and noticed that their wellness and muscle soreness varied throughout the day. For example, dancers reported that in the morning before class when they entered their wellness data, most were feeling fresh, not stressed and had limited muscle soreness. However, "then I would start class or get to the end of class and I'm just like oh my god my back is actually really sore." Another dancer supported this comment by adding "I don't notice it (muscle soreness) until I start doing ballet or movement such as a rotation or something where I'm then like oh that's sore, so then you're like actually I am sore." A suggestion that arose from discussions around the experience of muscle soreness and the variations throughout a day was in relation to the possibility of entering medication data. Dancers reported that "If you are taking anti-inflammatories or pain relief this may impact swelling and muscle soreness recording and severity of pain ratings. "I don't know if it's possible to include, with the full participation option could you add are you on anti-inflammatories?"

Via collaborative discussion, the principal researcher explained to the dancers that the App template was designed from the sporting model and entering data in the morning was consistent with other AMS and self-report wellness monitoring guidelines. The dancers acknowledged this however queried the potential benefit of entering wellness data pre and post activity to monitor whether a particular class, rehearsal or performance had impacted wellness and holistic well-being. For example: one dancer suggested: "Even if there were a few questions on there like how you felt at the beginning of the day compared to the end of the day," for preparation and recovery monitoring. For example:

> Recording wellness in the morning, it seems if you are recording how well you are in that very moment, just one part of the day when you have woken

> up, it's not very indicative of our entire day, I don't know if that's something to consider.

With regards to entering activity data, dancers provided suggestions and recommendations for additional components to the App for them to reflect on at the end of a day, couple of days or week. Dancers reflected on their workloads and differing schedules and queried the impact load may have on their wellness scores. For example, one dancer suggested an option to select medium, heavy or light after each activity entered may be a good way to track load in terms of physical demands on the body and mind. Another dancer stated that "If you do a double show and then you do a single show and no rehearsal, that can wreck you more…" therefore having an opportunity to enter self-report physical demand data and reflect on the demands of the day, this may assist dancers with both preparation and recovery techniques. Entering such data may also assist in enhancing holistic awareness and connecting possible impacts on wellness, depending on work activity and demands.

> I think the degree of difficulty for rehearsal performances would be another key element to add in terms of breaking down fatigue and like what's actually sore the next day, I don't know if you could tick rehearsal for example and then another think folded down and you tick minor, moderate or heavy load.

A final recommendation was provided by a dancer who queried if medical points of contact and contact details could be made available to dancers through the App. For example: "Having these details readily available instead of having another point of contact with say the physio to gain the details, I thought it would be really good to have all of it there, such as the GP and Psychologist contact numbers and email. It can really help when you need the support especially when it's not something you are prepared for and interstate."

CHAPTER SIX:

SELF-REPORTED WELLNESS IN TRAINING AND PERFORMANCE: A COMPARISON OF PROFESSIONAL BALLET DANCERS AND PROFESSIONAL ATHLETES (STUDY 2)

6.1 Preamble

Wellness profiles of professional dancers utilising a wellness App were compared with elite professional athletes to identify how dancers compare, with similar athletic expectations and work demands. In the previous chapter a wellness App was developed, trialled and found to be feasible with dancers. This chapter of the thesis compares wellness scores between professional ballet dancers and athletes in training and performance and includes frequency of modified participation and inability to participate due to pain and illness. Age- and sex- matched wellness, activity and participation data for the comparison were provided from the professional athlete group. The findings from this study provide valuable information to guide future intervention and recovery strategies, especially during performance periods.

6.2 Abstract

Objective: In high-performance sport, the use of self-report measures is expanding. The exploration of wellness states in response to training and performance requires further investigation for professional ballet dancers and athletes. This study therefore aimed to: compare wellness scores between professional ballet dancers and athletes in training and performance; report frequency of self-reported modified participation during training and performance and; report frequency of self-reported inability to participate due to pain and illness in dancers and athletes. Methods: Fourteen professional ballet dancers (mean 26 yrs, SD 2.6) and 14 sex- and age-matched professional athletes (mean 27.7 yrs, SD 2.9) recorded daily wellness (fatigue, stress, sleep quality and quantity), participation (full, rest, modified, or unable to participate) and activity (performance, training) into a wellness application on their smart phone over a 4-month period. Mixed factorial Analysis of Variance (ANOVAs) were conducted to assess the interaction between group (ballet dancers and athletes) and activity (performance and training) on the dependent variables (stress, fatigue, sleep quality and sleep quantity). Results: Stress and fatigue levels were higher for both dancers and athletes during performance compared to training periods. Dancers recorded lower sleep quantity than athletes, with no difference in sleep quality. Modified participation appears more common in dancers compared to athletes. Dancers and athletes were rarely unable to train or perform/compete over the 4 months. Conclusion: Self-reported wellness scores appear sensitive to activity type and can provide valuable information to guide intervention and recovery strategies. Further research on the impact of poor wellness on performance, illness, and injury in professional ballet is warranted.

6.3 Introduction

In dancers, physical and mental health problems can lead to discomfort, require treatment, inhibit artistic development due to absence from dance activities (i.e. classes, rehearsals and performances) and can be career-threatening (Allen et al., 2012; Kenny, Whittaker, & Emery, 2015; Roncaglia, 2006). The physical stress of training combined with other psychosocial stressors can add strain on the body and as a consequence impact the readiness to perform (Grove et al., 2013). An association between maladaptive coping and high levels of stress among professional dancers (Noh et al., 2009) and a relationship between coping styles and injury frequency has been reported (Noh et al., 2005). Elite performers must be able to cope with and recover from stressors to maintain and improve performance (Kellmann, 2010b). When athletes do not receive adequate time to recover between training and competition, fatigue can accumulate which can compromise performance and increase the risk of injury or illness (Gleeson, 2007; Halson, 2014a; Johnston et al., 2013; Meeusen et al., 2013b). Similarly, an imbalance between training-specific stressors, psychosocial stressors and recovery activities can negatively affect physical and mental states and readiness to perform in dance (Grove et al., 2013).

Poor sleep quantity and quality can considerably impact health and well-being (Chin Moi, 2020). Several studies indicate that elite athletes and dancers sleep less and have poorer sleep quality than members of the general population (Fietze et al., 2009; Sargent, Halson, et al., 2014; Sargent, Lastella, Halson, & Roach, 2014). This is important given that sleep is suggested to be the best recovery strategy available (Halson, 2014a; Sargent, Lastella, Halson, & Roach, 2016). As with other markers of wellness, the quantity and quality of sleep reported in dance and its impact on training and performance requires further exploration.

Poor athlete well-being can increase the risk of injury and impact performance (Dennis, Dawson, Heasman, Rogalski, & Robey, 2016; Gastin et al., 2013; Taylor, 2012), and monitoring athlete well-being is (Gastin et al., 2013) common practice in high-performance sport (Gastin et al., 2013; McNamara, Gabbett, Naughton, Farhart, & Chapman, 2013; Wehbe, Gabbett, Hartwig, & McLellan, 2015). Monitoring of responses to training and competition via wellness scoring is important for athlete load management and could be applied to dance (Gastin et al., 2013). Dancer's perceptions and experiences using an online dance-health surveillance system have been explored, providing insights into the possible association between scheduling and injury prevalence (Karreman et al., 2019). Minimal studies in the dance literature have used an online health surveillance system to monitor health problems and injuries in preprofessional (Kenny et al., 2018), and preprofessional contemporary dancers (van Winden et al., 2019). Wellness programs are being increasingly employed with performing artists. Evaluation of a site-specific dancer wellness program within a professional ballet company highlighted potential interactions between repertoire programming, fitness and injury patterns for ongoing review of training and support for artists (Clark et al., 2014). Further exploration of well-being profiles and the relationship to training and performance readiness in professional ballet is required.

It is important to evaluate if wellness scores vary between training and performance periods, as wellness status may guide training schedules (Halson, 2014a) and be essential in protecting dancers' health and in developing preventive measures (Ekegren et al., 2014). There appear to be similarities in the physical and psychological work demands of professional ballet dancers and athletes (Koutedakis & Jamurtas, 2004), but further exploration of wellness scoring in a dance population is required to determine if the procedure and results from athletic populations can be generalised to dance. A self-reported wellness app has been recently piloted in a professional ballet company, successfully capturing self-reported wellness, activity and participation/injury status (Harrison et al., 2019). If well-being is found to be poorer in dancers compared to other high performing individuals, or if meaningful fluctuations in well-being are apparent, interventions to improve overall well-being and targeted interventions related to load (training or performance) could be implemented.

This study aimed to:

1) compare wellness scores of professional ballet dancers and athletes over 4-months;

2) compare wellness scores between training and performance in both dancers and athletes;

3) report frequency of self-reported modified participation during training and performance and;

4) report frequency of self-reported inability to participate due to pain and illness in dancers and athletes.

6.4 Methods

Participants

Participants comprised two groups: i) 14 professional ballet dancers (female *n*= 8, male *n*=6), over 18 years old and employed full time in a national ballet company (mean 26 yrs, SD 2.6); and ii) 14 sex-, age- and experience-matched (years practice as a paid professional) professional athletes (mean 27.7 yrs, SD 2.9). The athlete comparison group was chosen as both male and female participants commonly participate for a similar duration of years to ballet. An agreement was made with the professional athlete group not to specify the type of sport they are professional aligned to in publications.

Procedure

Ethics approval was granted by a La Trobe University Ethics Committee (approval no. S17-224). Dancers and athletes provided informed consent. Athlete data had been collected, and athlete participants consented to their de-identified data being shared for research purposes. Data recording commenced following a break period for both groups, for athletes data recording commenced at the start of a new year and ballet after mid-year break. The data recording period for dancers and athletes included intensive performance demands, with training and performance load comparable between both groups. A tutorial and handbook that explained how to record and enter data into the app on a portable electronic device was provided to all participants.

All participants recorded daily wellness (fatigue, stress, sleep quality and quantity) and activity (training or performance (performing on stage for ballet dancers or a tournament/match for athletes)) into an Athlete Management System (AMS) application on their electronic device over a 4-month period. All participants entered wellness data into the AMS app in the morning prior to training, while activity data were entered into the

AMS app at the end of the day. Each questionnaire took approximately 2 minutes to complete.

Adherence was defined as entering both wellness and activity data on any given day. For each participant they were assigned a yes (1) if they entered both data on a given day and if they entered only one type of data on a given day, they received a no (0). Failure to enter either type of data was recorded as a non-adherent day (0).

Measurement Instruments

Wellness questionnaire:

Participants recorded wellness scores everyday during the 4-month study period from a visual 'traffic light' coloured scale between 0 and 10 where higher numbers represent increased wellness and lower numbers represent decreased wellness for each variable.

Fatigue (0= extremely fatigued, 2= very tired, 4= more tired than normal, 6= fresh, 8= very fresh, 10 = lively/energetic), sleep quality (0= unable to sleep, 2= very difficult falling asleep/ restless, 4= difficult falling asleep/slight restless, 6= good, 8= very restful, 10 = no disturbances) and stress (0= extremely worried, 2= very worried, 4= quite worried, 6= slightly worried, 8= not really stressed, 10 = not stressed). Sleep (in hours) was selected from a drop-down list (half-hour intervals). Wellness variables were selected in line with the Hooper Index for well-being variables (Hooper et al., 1995).

Activity questionnaire:

Ballet dancers and athletes entered participation level such as: full, rest/day off, modified or unable to participate. If the participants selected unable to participate, they were required to select the reason as either i) illness or ii) pain. Activity was categorised into performance and training for both groups. On days where no performance was scheduled, dancers and athletes selected 'no' to the performance prompt. Performance was defined as performing on stage (for ballet dancers) or a tournament/match (for athletes). Ballet dancers reported specific training activities in an AMS app that included class, rehearsal, and strength and conditioning. Athlete participants reported specific training activities in an AMS app that included strength and conditioning, practice match, group training and private training.

Statistical analysis

Data were transposed into statistical software (SPSS ver. 25, IBM, Armonk, NY, USA). The mean score for each participant was aggregated across the group to provide an average score for each wellness variable (stress, fatigue, sleep quality and sleep quantity).

Mixed factorial ANOVAs were conducted to assess the interaction between group (ballet dancers and athletes) and activity (performance and training) on the dependent variables (stress, fatigue, sleep quality and sleep quantity).

The magnitude of group differences was interpreted using partial η^2 effect size and 95% confidence intervals (CI) (Thompson, 2007). Participation frequencies were categorised into the following criteria: full, rest, modified and unable to participate. These were converted into percentages based on a total of 3,416 participation data entries (122 days (in the 4 months) x 28 participants).

6.5 Results

Over the 4-month period, a 90% adherence was recorded for ballet dancers and an 86% adherence for athletes.

Wellness

Stress. Ballet dancers and athletes reported feeling more stressed during performance compared to training activity (Wilks' Λ=0.6, F(1, 26) = 17.5, p =0.001, partial η^2=0 .4 CI [0.1, 0.6]) (Figure 10). Overall, ballet dancers were significantly more stressed than athletes (F(1, 26) = 5.9, p=0.02, partial η^2 =0.19, CI [0.01, 0.4], p=0.02) (Table 9).

Table 9. Mean Wellness Scores for Professional Ballet Dancers and Professional Athletes.

Mean score	Ballet dancers (n=14)	Athletes (n=14)	Ballet dancer performance	Athlete performance	Ballet dancer training	Athlete training
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Fatigue	6.6 (0.8)	6.8 (1.1)	6.3 (0.7)	6.6 (1.4)	6.7 (0.8)	6.9 (1.1)
Stress	7.2 (0.6)	7.9 (0.9)	6.8 (0.7)	7.6 (1.1)	7.3 (0.6)	8.1 (1.1)
Sleep quality	7.1 (0.8)	7.7 (0.7)	7.0 (0.7)	7.6 (0.9)	7.2 (0.8)	7.8 (0.7)
Sleep quantity (hours)	7.9 (0.4)	8.3 (0.4)	7.8 (0.4)	8.4 (0.5)	7.9 (0.4)	8.3 (0.5)

Data given as mean (Standard Deviation)

Fatigue. Ballet dancers and athletes were more fatigued during performance compared to training activity (Wilks' Λ=0.7, F(1, 26)=8.2, p=0.008, partial η^2 =0.24, CI [0.02, 0.4]) (Figure 1). Mean fatigue scores were not significantly different between ballet dancers and athletes, and there was no difference in mean fatigue during training and performance between the two groups (main effect for group F(1, 26)=0.3, p=0.54 partial η^2 =0.02, CI [0.00, 0.1] p>0.05), or the group by activity (performance and training) interaction, p=0.95, partial η^2 <0.001, p>0.05 (Table 9).

Sleep quantity. Ballet dancers reported that they slept significantly less hours than athletes (F(1, 26)=9.7, p=0.004, partial η^2 =0.2, CI [0.03, 0.4]) (Figure 10). There were no differences in sleep quantity between training and performance (Wilks' Λ=0.10, F(1, 26)=0.06, p=0.8, partial η^2 =0.002, CI [0.00, 0.8], p>0.05) and sleep quantity during training and performance were similar for ballet dancers and athletes (p=0.30, partial η^2=0.041) (Table 9).

Sleep quality. No difference between ballet dancer and athlete quality of sleep was found. Quality of sleep in performance and training was no different between ballet dancers and athletes.

Participation

Over the 4-month period, dancers reported: full participation (68%), rest (17%), modified participation (14.5%) and unable to participate (0.5%). Of the 247 recordings of modified participation across all ballet participants for the 4-months, 25% were in performance and 75% were in training. Dancers were unable to participate due to illness (n=6 days) and due to pain (n=12 days).

Athletes reported: full participation (80%), rest (11%), modified participation (7%) and unable to participate (2%). Of the 119 recordings of modified participation across all athlete participants for the 4 months, 13% were in performance and 87% were in training. Athletes were unable to participate due to illness (n=2 days) and due to pain (n=23 days).

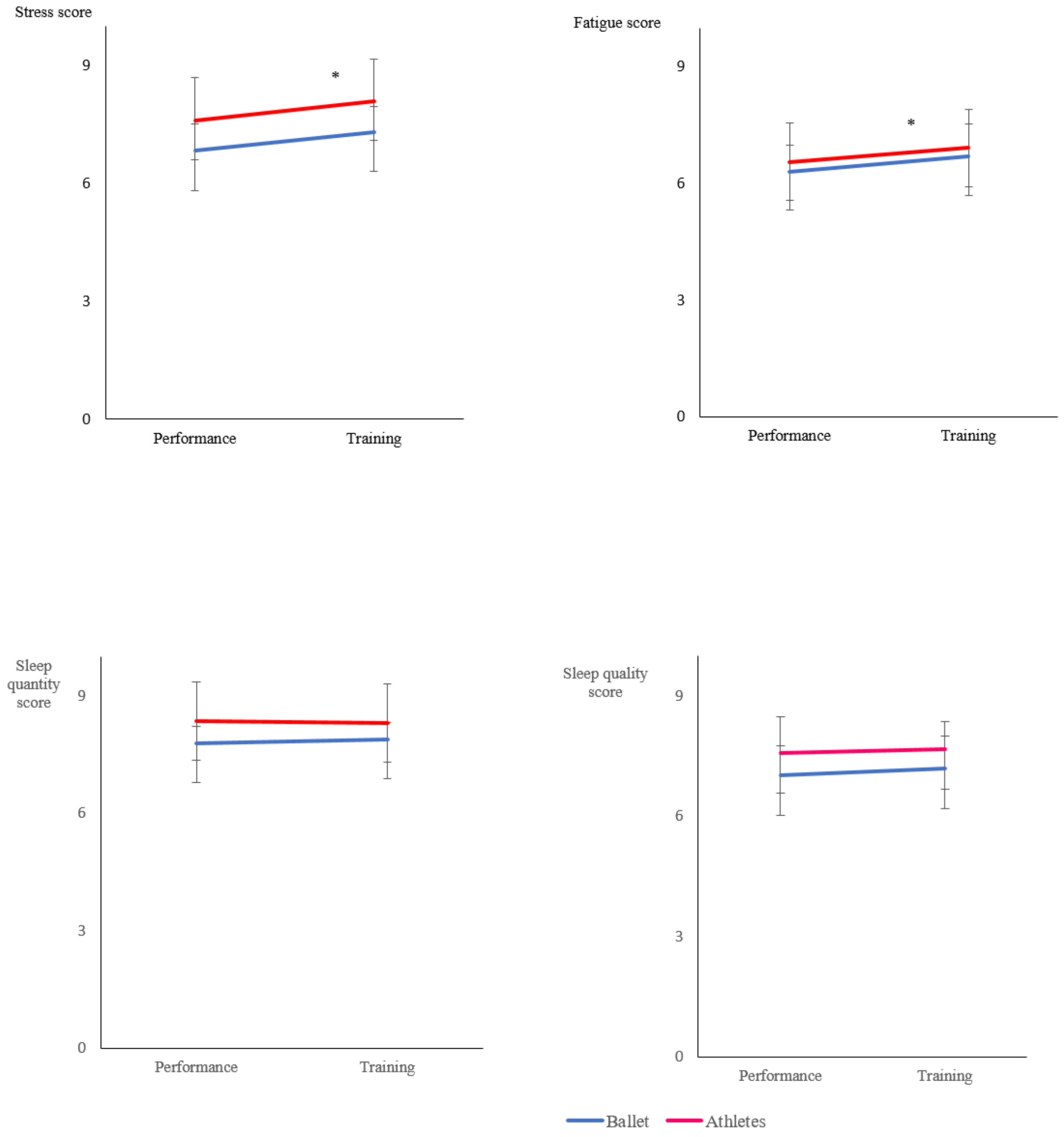

Figure 10. Mean (SD) fatigue, stress, sleep quality and quantity for professional ballet dancers and professional athletes in training and performance.

Professional ballet dancers (blue lines).

Professional athletes (red lines).

Lower scores represent poorer wellness (10=highest degree of wellness, 0=lowest).

6.6 Discussion

Ballet dancers reported lower wellness, with poorer sleep quantity and higher stress levels compared to athletes. Performance periods for both groups (dancers and athletes) were related to lower wellness levels for stress and fatigue. Modified participation appears more common in dancers and when they do modify, dancers appear to modify performance more often than athletes. Dancers and athletes were rarely unable to train or perform/compete.

The findings of this study are aligned with previous research that demonstrated higher levels of stress and fatigue during performance in dancers (Chavarria-Soto & Salazar-Rojas, 2011; Liederbach et al., 2013; Noh et al., 2009). Overtraining is an underexplored issue in dance, despite dancers perceiving fatigue and overload as influential injury risk factors (Liederbach et al., 2013). In the final days before performance, there is a tendency for workloads to increase further in an effort to ensure attainment of the required standard (Grove et al., 2013), potentially heightening stress and fatigue states. During performance periods artists tend to be highly critical of themselves and can experience persistent anxiety about their performance and the feedback from choreographers and audience observers. If stress and fatigue are not managed appropriately, dancers like athletes may be at risk of underperformance (McLean et al., 2010). It is unclear whether self-reported fatigue in this study was cognitive (Smith et al., 2016) or physically driven (Kempton, Sirotic, Cameron, & Coutts, 2013), and future research should explore both physical and cognitive fatigue and the impact on dance performance.

Dancers and athletes participate in physically and mentally demanding occupational roles (Koutedakis & Jamurtas, 2004) and report fewer rest periods in a day and between days than the typical worker (average 5 day/wk worker is approximately 30% rest). A lack of rest may lead to overtraining and burnout within the high-performance demands in professional dancing (Liederbach et al., 2013). In the current study, ballet dancers appeared to modify their training and performance more frequently than athletes. Depending on the choreography, dancers may be able to more effectively modify their movements, enabling them to continue performing with symptoms. Athletes conversely may not have the flexibility or opportunity to modify their movements to the same degree. Encouragement of supportive and proactive responses to reduced wellness is essential for developing adaptive responses to stress and fatigue and the use of monitoring tools such as wellness applications may encourage dancers to review and understand their individual responses to training and performance, optimising holistic health and well-being.

Professional ballet dancers in this study reported less sleep quantity than professional athletes, but only by approximately 30 minutes each night, and their sleep quantity was consistent with documented adequate sleep duration ranges (Sargent, Lastella, et al., 2014). The sleep duration of professional ballet dancers leading up to opening night was researched by Fietze and colleagues (Fietze et al., 2009) who postulated late mental and physical stress occasioned by evening performances, missed recovery between an "end of work" session and usual bedtime, and the absence of free days (regular weekends) as variables that markedly influenced sleep (Fietze et al., 2009). In contrast to these findings, there were no reported changes to sleep quality or sleep quantity between training and performance periods in this study. Sleep quality and quantity data were collected via self-report recordings and not via actigraphy or other validated quantitative techniques to study sleep quantity, sleep quality, and movement patterns during sleep. The influence of disturbed or shortened sleep on dancers' performance and well-being is unclear and requires further exploration with validated technology.

Consolidating wellness subscales is a common approach in athlete monitoring practice and has been investigated in several prior studies, however a systematic review has suggested that combining subscales into an overall wellness score reduces the sensitivity of the measure (Saw et al., 2015c). This study was rigorous in its approach and explored wellness variables separately during training and performance periods over 4-months with good participant adherence. The small number of wellness variables were included to enhance willingness and adherence in entering data, and for interest, ease and applicability to both groups (athletes and ballet dancers). A ballet specific self-report wellness monitoring application was developed, consistent with professional sport formats and trailed with a small sample of dancers (Harrison et al., 2019) prior to this 4-month study. Dancers summarised their experiences using the wellness application as positive, beneficial and practical for the professional ballet industry (Harrison et al., 2019).

The small sample size limits the interpretation of a relationship between activity (performance and training) and wellness scores and comparisons between dancers and athletes and a power analysis was not conducted. The wellness data were self-reported, thus susceptible to individual interpretation and deliberate bias. Deliberate response distortion may result from participants wanting to present themselves in a uniformly positive light (Meeusen et al., 2013b). To minimise the risk of bias, all participants were given clear instruction, assured anonymity and reassured their data would not be reviewed by coaches or staff. Finally, a limited number of well-being variables were included, and load measurement was not collected. Load variables such as session-rating of perceived exertion [sRPE], would have added further depth to activity distinctions, to better reflect the psychophysiological load experienced by participants. Further, wellness data was collected only in the morning before any work-related activity had commenced. Regular wellness reporting throughout the day, after each activity type plus an entry of sRPE may provide greater insight into the well-being of the dancer in multiple work demands and across performance contexts for the development of interventions to maintain and improve health and well-being. To be more broadly effective and utilised, wellness scoring, and monitoring questionnaires should undergo further validity and test–retest reliability assessments.

Further research with larger sample sizes that explore the relationship between wellness scores, activity, illness and injury incidence in professional ballet is warranted. Wellness patterns in training and performance may help guide early intervention strategies to prevent illness and injury. Further in-depth investigation into the perceptions of professional ballet dancers using a wellness application is recommended to explore experiences, ‘buy in’ and possible self-report data bias for continued use and further development in a professional ballet company.

6.7 Conclusions

Fluctuations in wellness scores were apparent between training and performance periods, and between dancers and athletes. Further research with a larger dance population is warranted to evaluate the relationship between wellness scores, activity and pain or illness.

CHAPTER SEVEN:

AN EXPLORATION OF THE PERCEPTIONS AND EXPERIENCES OF PROFESSIONAL BALLET DANCERS USING A WELLNESS MONITORING APPLICATION (STUDY 3)

7.1 Preamble

The previous chapters of this thesis explored the use and implementation of a wellness App with professional ballet dancers and compared wellness, activity and participation with professional athletes. Although findings indicated support for the App, partial qualitative data was collected in the pilot study. Furthermore, in the sport literature, the exploration of dancer's perceptions and experiences using self-report wellness Apps is limited. This study therefore sought to gain further insight to help guide wellness App implementation. The findings of this chapter highlight the importance of education and support when implementing self-monitoring Apps for dancers and athletes and have important practical implications for the promotion of positive adaptive behavioural responses to enhance optimal well-being in training and performance.

7.2 Abstract

Athlete injury and illness surveillance methods have been explored; however, dance-health monitoring systems are scarce. This study aimed to explore the experiences of professional ballet dancers using a wellness application and the applicability of a wellness application for the dance industry. Fourteen professional ballet dancers (female *n*= 8, male *n*=6), over the age of 18-years (*M*=26.0 years, *SD*=2.60) and employed full time in a national ballet company participated in one semi-structured interview, approximately 60 minutes in duration, reflecting on their perceptions and experiences using a wellness application. The interview material was analysed via thematic analysis. Three overarching

main themes emerged: 1) Applicability of a wellness application in the professional ballet industry: experiences entering wellness scores; 2) Dancers conceptualisation of wellness: perceptions and difficulties; and 3) Psychological impact of entering wellness scores. Findings indicated that a wellness application enhances dancer’s self-awareness of wellness, specifically psychological well-being which is often ‘not at the forefront’ of dancers’ minds and focused attention. Further, dancers explained difficulties in processing and acknowledging wellness scores and subsequent avoidance as a coping mechanism from ‘confronting’ experiences of consecutive poor wellness scores. Monitoring wellness may assist companies in developing interventions that promote positive adaptive behavioural responses to changes in wellness scores for optimal well-being in training and performance. However, further education, support structures and strategies for acknowledging and coping with fluctuating wellness are required.

7.3 Introduction

Ballet dancers participate in long hours of training (Kenny, Whittaker & Emery, 2015) consisting of repetitive movements (Gamboa et al. 2008) often exceeding anatomical limitations (Kenny, Whittaker & Emery, 2015) and competing for performance roles (Jacobs et al. 2017). Dancers are also exposed to numerous psychosocial stressors such as environmental conditions, personal stressors and intensive performing and touring schedules (Grove et al., 2013). As a result of the physical and psychological demands of their profession, dancers are at high risk of compromised physical and mental health (Grove et al., 2013 2013; Kenny, Whittaker & Emery, 2015; Laws, 2005) that require treatment, may inhibit artistic development (Kenny, Whittaker and Emery, 2015) and in extreme cases, can lead to the end of a professional career (Roncaglia, 2006).

To monitor athlete perceived physical and psychological well-being, Athlete Self-Report Measures (ASRM) have been implemented in numerous sporting organisations

(Halson, 2014). The use of self-report measures in wellness research is widespread, with 84% of surveyed high-performance sports in Australia and New Zealand incorporating a wellness self-report measure as part of their monitoring strategy (Halson, 2014; Taylor et al. 2012). Monitoring of responses to training and competition via wellness scoring appears to be important for athlete load management and could be applied to dance (Gastin, Meyer & Robinson, 2013). Athletes have suggested that completing an Athlete Self-Report Measure (ASRM) increased their self-awareness and ownership of their preparation (Saw, Main & Gastin, 2015a). Increased sense of accountability and subsequently improved self-management behaviours have been found to result from athlete monitoring, leading to better training and performance-related behaviours, athletes taking the initiative to seek further information about their health and well-being and seeking assistance from staff (Saw, Main and Gastin, 2015b).

Prior to implementation, it is important to determine the perceived role and importance of the ASRM for athletes or group of athletes (Saw, Main & Gastin, 2015c). Encouraging and engaging athletes to use an ASRM consistently across a training period is a key determinant of successful ASRM implementation and uptake (Saw, Main & Gastin, 2015c). Self-report measures are susceptible to inherent limitations such as measurement error and conscious bias by athletes when recording and reviewing data (Saw, Main & Gastin, 2015a). Athletes may want to present themselves in a consistently positive light and deliberate response distortion or 'faking good' may result (Meeusen et al. 2013). It is therefore important to recognise self-report data limitations in the design of the self-report measure, in addition to considering individual and situational factors which may influence the ability of an ASRM to collect consistent, meaningful, and accurate data from athletes (Saw, Main and Gastin, 2015d).

Athlete injury and illness surveillance methods have been published (for example: Clarsen, Myklebust and Bahr, 2013; Gastin, Meyer & Robinson, 2013), however online dance-health surveillance systems are scarce (Karreman, Keizer-Hulsebosch, & Stubbe, 2019). Two studies in the dance literature have used an online health surveillance system to monitor health problems and injuries in preprofessional dancers (Kenny et al. 2008) and preprofessional contemporary dancers (van Winden, van Rijn, Savelsbergh, Oudejans, & Stubbe, 2020). Data collected from the Dance OSTRC questionnaire in these studies were reliant on dancers' honesty and accuracy however an exploration of the dancers' perceptions, expectations and honest reporting using the system were not explored.

In a study that did explore the experiences of professional dancers using an online surveillance system, nine professional ballet dancers from the Dutch National Ballet participated in a focus group interview to investigate dancer's perceptions and experiences (Performing artist and Athlete Health Monitor, PAHM) (Karreman, Keizer-Hulsebosch, & Stubbe, 2019). Dancers reported wellness bi-weekly, specified they were willing to continue using the PAHM and stated that they became more aware of their own physical and mental health. Dancers indicated that extended questions about mental health over the 6-week period, such as workload, sleep, rest and nutrition would be beneficial to monitor their associated health problems. Karremen and colleagues (2019) provided valuable insight into the perceptions of professional ballet dancers using an online health surveillance system by conducting a focus group interview to start a discussion and enable dancers to learn from each other. Further exploration of online wellness reporting, more frequently than bi-weekly and over a longer period of time, may provide further insights into the experiences of dancers for further development of wellness monitoring systems.

A tailor-made, online self-reported wellness application has been recently piloted and trailed in an Australian professional ballet company, successfully capturing self-reported wellness, activity and participation/injury status (Harrison et al., 2020a; Harrison et al. 2021). The self-report wellness application was developed to capture wellness scores for sleep duration, sleep quality, fatigue and stress over a 4-month period, capturing different aspects of a professional ballet dancers experience in rehearsal, performing, challenging repertoire and prolonged periods of touring. Harrison and colleagues (2021) recommended further in-depth investigation into the perceptions of professional ballet dancers using a wellness application to explore possible response distortions and to more thoroughly identify possible associations between poor wellness and injury incidence, for injury prevention and early intervention strategies.

It is debatable whether self-report measures accurately reflect changes in athlete well-being, and how they can be effectively integrated into applied practice varies (Meeusen et al. 2013). It is important to seek the perspectives of end-users to identify and address factors influencing the implementation and uptake of ASRM (Donaldson & Finch, 2012). The increased accessibility of ASRM means that they may be potentially utilised by dancers and athletes on their own accord without support measures and, implementation strategies and considerations. Therefore, the aim of this study was to explore the experiences of professional ballet dancers using a wellness application daily over 4-months to better understand and seek in-depth insight into their perceptions entering wellness data. The purpose of the present study was to improve understanding of the implementation process of a wellness monitoring application for the potential implementation in professional ballet companies. Specifically, we sought to explore the dancer's self-awareness and conscious reporting while using the application for obtaining meaningful, accurate and consistent data for dancers, and for companies to support their holistic well-being.

7.4 Materials and methods

Participants

Fourteen professional ballet dancers (female *n*= 8, male *n*=6), over the age of 18-years (*M*=26.0 years, *SD*=2.60) and employed full time in a national ballet company participated in one semi-structured, audio recorded interview, approximately 60 minutes in duration, reflecting on their perceptions and experiences using a wellness application**.**

Procedure

Ethics approval was granted by the relevant University Ethics Committee. An email from the medical team administrator from the ballet company was then distributed inviting ballet dancers to participate in the study which included use of a wellness application and an interview at the end of the data collection period. Interested dancers were informed about the study via a Participant Information Statement (PIS) and consultation with the first author. Prior to the commencement of the study, all dancers were educated about the use of self-report wellness applications and research links between wellness and injury in professional athletes. Dancers were encouraged to enter wellness scores from a holistic perspective, for example when entering their stress score considering both occupational and personal stress collectively, as opposed to separating work stress and personal stress for their rating.

The self-report wellness application had previously been trialled with a small sample of dancers (*n*=5) (Harrison et al. 2021) and was found to be feasible. Subsequently, fourteen professional dancers were recruited to participate in the current study and recorded daily wellness (fatigue, stress, soreness, sleep quality and quantity) and activity (rehearsal or performance) into the wellness application on their electronic device over a four-month period (refer to Harrison et al. 2020a). The four-month period was chosen as it included rehearsal blocks, performance seasons and interstate touring. All participants who were involved in the study entered wellness scores into a wellness application in the morning prior to training, while activity data were entered into the wellness application at the end of the day. Each component took approximately two minutes to complete.

Following the 4-month data entry period, interviews were conducted by the first author with all 14 participants. Interviews were conducted in person, within a two-week window of the data entry period ceasing. The interview data were transcribed verbatim by the first author and analysed via thematic analysis (Braun & Clarke, 2006; 2019). A small subset of participants (*n*= 4) were randomly selected and sent a section of their transcripts to review. This process was adopted to ensure that the interview was transcribed in context, and the participant's experience was recorded as he or she intended it to be portrayed (Mero-Jaffe, 2011). Interviewees validated the transcripts by correcting them if necessary and by clarifying unclear issues (Forbat & Henderson, 2005; Mero-Jaffe , 2011). Only minor word adjustments were made, with feedback from the participants indicating they were satisfied with the content of the interview transcripts. Two reviewers independently coded all transcripts and discussed these codes to reach a consensus. Due to the importance of maintaining confidentiality, the first author chose not to denote participants as 'Dancer A' or 'Dancer B' or use pseudonyms that could have identified participants. Following the analysis of the interview data, dancers were presented with a brief summary of the results of the study via a presentation.

Measures

An interview format was developed by the first author and co-authors, guided by gaps identified in the sport qualitative AMS literature (see Coutts et al. 2007; Gastin, Meyer and Robinson, 2013) and guided by Karreman et al. (2019) interview part 1. The interview allowed the participants to describe, elaborate and reflect on their experiences using the application. The interview schedule consisted of questions relating to the following topics: experiences using the wellness application; self-awareness during data entry; considerations for implementation of the application into the ballet industry; and conscious reporting and reflections of data entry. Specifically, the interview included questions such as: "Can you tell me about your experiences using the wellness application?" "Based on your experience using the wellness application, can you explain the thought processes around daily wellness scoring?" "Can you tell me about your self-awareness of physical and psychological well-being while using the wellness application?"

Analysis of data

The interview material was analysed using thematic analysis, a "…method for identifying, analysing and reporting patterns (themes) within the data" (Braun and Clarke, 2006; 2019). Thematic analysis "…involves searching across a data set in order to find repeated patterns of meaning". In conducting the current qualitative research, the analysis of the data adhered to six phase guideline including familiarisation, generating initial codes, searching for themes, reviewing themes and defining and naming themes (Braun & Clarke, 2006).

7.5 Findings

Thematic analysis of the interview data revealed three overarching main themes: 1) Applicability of a wellness application in the professional ballet industry: experiences entering wellness scores. This theme included two subthemes: further enhancement of physical well-being and self-awareness: encouraging and enabling consideration of wellness states; 2) Dancers conceptualisation of wellness: perceptions and difficulties. This theme included two subthemes: conflicted interpretation of wellness and; identity as a dancer; and 3) Psychological impact of entering wellness scores. This theme included two subthemes: confronting experiences and; avoidance as a coping mechanism.

Applicability of a wellness application in the professional ballet industry: experiences entering wellness scores

All fourteen participants reported that data entry into the wellness application was a quick process and the ease of data entry and brevity was appreciated due to the participants intensive and extensive work demands. Dancers discussed how recording wellness such as stress, fatigue, soreness and sleep quality and quantity enhanced awareness of their thoughts and feelings of their well-being and provided an opportunity for an exploration into their readiness to train and perform. The following sub-themes were identified; 1) further enhancement of physical well-being and; 2) self-awareness: encouraging and enabling consideration of wellness states.

Further enhancement of physical well-being

The first sub-theme to emerge was in relation to dancers exploring their physical awareness of their bodies, pain and injury. Dancers discussed that their profession requires them to be 'in-tune' with their physical health and it is important for their progression as a dancer to be aware of any physical ailments, pain and consequently any impacts on training and performance ability. For example:

> As a dancer, in our profession, we kind of do that anyway (reflect on physical health)…in a week you kind of go I know I'm sore Monday, so on Tuesday I got up and I did an exercise to ease that soreness, so we do reflect and act a lot in that way. Most people are dealing with something most of the time even if it's not too serious, I think we are quite aware.

The application provided an additional opportunity for the dancers to reflect on areas of muscle soreness and impact on participation in training and performance. Dancers reported that entering wellness scores in the morning assisted in reflecting on their previous night's sleep and helped guide their approach to training.

> I think it probably just made me more aware, depending on how I wake up and go through class will determine where I push and not push parts of my body throughout the day, I guess actually logging that made me more aware of all those things. I did use it to modify during the day and class load, doing Giselle (romantic ballet) at night, that was a really heavy foot load, so I found that helpful (the application) then to monitor and modify.

The application components encouraged some dancers to be proactive in the management of their pain, for example 'I made a bit more of a concerted effort to ice and do exercises when I rated this (regions of soreness) on the application, it makes you have to stop and think about what's actually sore and put in place strategies.' Another dancer also explained that the application provided a record of modifications which was used to assess the need for accessing treatment and interventions. For instance:

> I definitely have the mind where if my ankle hurts, I can sort through that, I can do that for a week or 2 but as soon as it gets to the point where I actually admit it out loud and go see the physio, that's when I see it as an issue and the application helped me to track that.

Self-awareness: encouraging and enabling consideration of wellness states

The second sub-theme to emerge was regarding dancer's self-awareness of wellness states beyond the physical well-being spectrum. It was reported that the wellness application encouraged greater consideration of fatigue, stress, sleep quality and quantity and dancers reflected on their experiences entering this data into the application. As an example:

> It's in real-time that you're asked to consider fatigue and stress and that helps you to stay on top of your preparation. That helps. You're playing with fire, I mean at the end of the day in this career, you've got to be on top of it all and careful and try to minimise the risk and this application helps to do that.

Another dancer supported this concept by stating:

> I think when you're in that phase of not sleeping very much and you have sleep deprivation you just kind of soldier on through and it's not until you enter in the data that you become aware of how little sleep you're getting and how fatigued you are. I was actually becoming a bit more aware of how fatigued I was and how little sleep I was getting, and especially how that might affect performance and class. It made me a bit more careful, whereas in the past I might have thought I'm a little bit tired today but that's alright.

For the majority of dancers, using the wellness application provided an opportunity to 'check in,' 'reflect,' and 'make connections between the body and mind.' By way of example:

> I guess making the connection between how you're feeling… normally you just put it in the back of your mind without actually considering how I am feeling and what have I been doing (workwise) over the last 3-4 days. It was good to be able to look back and see that.

The feasibility of the application as a monitoring tool and to enhance self-awareness was discussed by some dancers who stated the application 'helped to keep on track' and provided an opportunity to consider their readiness to train and perform. For instance one dancer noted ‘I enjoyed looking back to see how I was going, I noticed that I could see a drop in how I was feeling and then an injury started to occur, so for me, it was good to track how I was feeling, especially when traveling.’ Another dancer explored their experiences using the application as an opportunity to also become more mindful. For example, ‘it allowed me to become mindful about how I was feeling and that was the best for me to check in and be mindful about how I was holistically feeling.’

Dancer’s conceptualisation of wellness: perceptions and difficulties

Participants discussed their perceptions, experiences and awareness of wellness states whilst using the application. The majority of dancers reported experiencing difficulties in separating their identity as a dancer from themselves holistically (considering the whole person) and discussed the challenges of entering wellness scores from this holistic perspective. The following two sub-themes were identified; 1) conflicted interpretation of wellness and; 2) identity as a dancer.

Conflicted interpretation of wellness

The first sub-theme to emerge was in relation to dancers’ conflicted interpretation of wellness. When considering wellness, dancers discussed mixed interpretations of how to holistically evaluate wellness, both within and outside of their work environment. While dancers discussed that wellness incorporates the body, mind and feelings, they attempted to differentiate these between work and non-work-related experiences. At the commencement of the study, all dancers were educated around the use of the application. Dancers were encouraged to enter wellness scores from a holistic perspective, an approach to health which considers the whole person and how he or she interacts with the environment relating to both occupational and personal wellness as a whole (Association, 2003). Upon reflection, the majority of dancers reported that they were often unable to consider wellness such as stress and fatigue holistically, highlighting the difficulty dancers have with amalgamating professional and personal wellness scores.

> Towards the end of the year, work was fine and I wasn't injured, and I was feeling ok, no physical concerns, but then I had some things happening outside of work that were quite stressful, so I was a bit conflicted as to entering my stress high when it's not work related.

Another dancer supported this concept in the example below:

> I think a lot of the time I am stressed about work, work would be the biggest cause of my stress, so that's easy to identify, like am I stressed about this role or not? But life is fine. But I think, maybe it's just a very 'ballet way,' maybe athletes as well, like it's a very specific thing whether you're stressed about work or life and if it is clumped into the one, I kind of wouldn't be sure whether I should be rating my stress about work, so I usually kind of relate it more to work than life as that was more relevant to me in thinking about my mindset at work.

A consistent message from participants was the difficulty in measuring stress and fatigue. Dancers reported being able to 'more accurately rate muscle soreness severity and enter sleep quantity as these provide clearer structure' and identifiable numerical value to dancers. As an example:

> Obviously, I know how much sleep I got, and I know if something's hurting or it's not, but the fatigue, I think it needs to be quite personal and you need to look back on how you were feeling. I kind of tended to just put a general feeling and then I would remember what that was like and if it was a 7, I might look back and be like oh I feel like that. I think maybe I did it a little too vague, personally.

Identity as a dancer

The second sub-theme to emerge was in relation to dancers' identity impacting perceptions of holistic wellness and the processing of wellness scores. Some of the dancers who explored their experiences entering wellness scores expressed their thoughts and feelings through the 'lens' of their dance identity. These dancers explained the impact of their work identity on their overall identity, discussing that they are 'first and foremost dancers.' Dancers considered the 'dance culture' as a contributor to their all-encompassing identity as a dancer, for instance: 'I think some of the wellness questions were a bit hard, like whether you associate wellness to how your body feels and how you feel about work and ballet because it's such a huge part of our life.' One dancer further discussed identity and the impact this can have on professionals, aligning this concept with professional athletes particularly:

> I think maybe allowing us to be more specific and differentiate (wellness states) might help us… I think for a lot of athletes who have dreamed of being professional their whole life…well a big part of their life is their training, and wellness could be quite hard to differentiate because sometimes that can feel like your athletic identity is your whole life.

Psychological impact of entering wellness scores

In exploring their experiences using the application, dancers reflected on the impact of entering 'sensitive' data. Dancers associated stress and fatigue with sensitivity as it was difficult for them to score these states of wellness and suggested that psychological wellness is harder to acknowledge, talk about and accept. Entering physical data such as regions of soreness and rating the intensity of muscle soreness on a Likert-scale was reported by dancers as 'easier' to assess than scoring wellness states such as stress or fatigue. Dancers acknowledged that they felt there was a better understanding, awareness resources and strategies around their physical health and it was therefore easier for them to enter this data. Considering the psychological impacts of entering wellness scores, dancers reported difficulties in processing their own wellness data consistently, and the impact of consecutive days of poor wellness. The following two sub-themes were identified: 1) confronting experiences and; 2) avoidance as a coping mechanism.

Confronting experiences

The first sub-theme to emerge was in relation to the acknowledgment of poor wellness and the impact on dancers. Majority of dancers explained that when entering wellness scores into the application, 'acknowledging consecutive days of poor wellness was challenging,' 'confronting' and difficult to 'consciously comprehend and acknowledge.' For the majority of professional dancers, pushing through psychological states such as fatigue and stress were 'part of the norm and not something that has much attention.'

> I think using the app kind of constantly brought to my attention how bad I was feeling and how tired I was and how sore I was, I think it got to the point where I was just like I don't want to have to think about that every single day and check in because I know I'm not in the greatest head space emotionally, but I feel like if I had to admit how bad I felt it would make it worse.

In support of the above quote, another dancer reflected on the impact of consistent poor wellness on readiness to perform stating 'I think if I was constantly admitting that (stressed and tired) every single morning, and that was the first thing I thought of in the morning, I don't think I would have made it to my shows because they were such challenging shows.' The concept of acknowledgement of wellness states being confronting was also experienced by another dancer who stated:

> Acknowledging that can be difficult and quite confronting. There is a psychological battle where you have to tell yourself you're not that tired or stressed so that you can continue on. Sometimes you just have to keep going. And then there are times where you can reset and that's when thinking about wellness can help to rebalance.

The application was reportedly a good tool to use to 'check in,' however 'honesty in reporting' at times was reported by the dancers as confronting and challenging, such as:

> In order for me to mentally get through the days I had to almost fake myself into being ok, whereas the app when it alerted me in the morning to enter scores I was having to think about how sore I was and I was like I'm really bloody sore but I don't want to admit that because I will feel more sore than I am.

Another dancer supported this concept stating 'I know that it got to a point where I had consistently put in the same rating and it got to the point where I felt like it was getting too much, like too overwhelming, just seeing the same thing being an issue every day.' Dancers experiences using the application and processing and reviewing their data was at times challenging as illustrated by the below quote:

> Psychologically, I don't know if it would make me feel better, to enter stress and fatigue, it might be one thing to enter it and then not think about it anymore, but if I was entering it in every day, I think it would make me panic, make me stressed about the fact that I am really fatigued and it is really low. Maybe it would stress me out a bit to acknowledge…at times it was a little hard and confronting, I didn't want to acknowledge or indulge in that too much, even though I know it's healthy to acknowledge stress and fatigue, but I think as dancers, we would rather just not acknowledge it. Sometimes it's like I'm feeling really stressed but really, I can't let it affect my day, I kind of have to move on.

Avoidance as a coping mechanism

The second sub-theme to emerge was avoidance as a coping mechanism for dealing with wellness states such as stress, fatigue and sleep. Dancers explored the way they felt when entering wellness scores and reported at times, acknowledging how stressed or fatigued they were was difficult and they would 'push through to survive.' As an example:

> Subconsciously I didn't want to think about it (stress and fatigue) and I didn't want to input it. So, I wonder if without realising I was avoiding, not wanting to see it (wellness scores) because I didn't want it to impact on how I was already feeling about my injury.

Another dancer supported this concept reporting the impact of both short- and long-term coping strategies and survival approaches, particularly 'if I had of continued doing everything and having to admit how bad I felt and how sore and stressed I was I probably wouldn't have gotten on stage, it was survival mode.'

When reflecting on the impact of entering wellness scores and the experiences in completing this daily, dancers reported on their 'mindset' to cope with acknowledging their own wellness scores. For example, 'in terms of wellness, I don't think I was always actually honest. I think it's a coping mechanism, it's mind over matter sometimes.' Another dancer supported the concept of the importance of their 'headspace to cope' with acknowledging and processing their wellness explaining:

> I think sometimes we assume it will pass and we've just got to wait it out and then we don't go and see someone. I would be honest with my scores, but if I wasn't in the right frame of mind, I would leave it and come back to it and do it later.

7.6 Discussion

This study validates the benefits of wellness applications for professional dancers offering valuable insights and depth to the experiences of dancers entering wellness scores, that may assist in further development of wellness monitoring applications for the professional ballet industry. The nature of the environment allowed dancers to provide transparent responses regarding their experiences, as a safe and trusting atmosphere was provided, and this has added further depth to previous qualitative literature around ASRM.

The findings of this study affirm the use of an online self-report wellness application in professional ballet for enhancing self-awareness, specifically psychological well-being which is often 'not at the forefront' of dancers' minds and focused attention. In the current study dancers were more accustomed to reflecting on their physical well-being, however, were not accustomed to scoring psychological constructs such as stress and fatigue. The continued exposure to scoring psychological well-being over time may provide dancers with more confidence in identifying a numerical value that relates to their wellness and assist in identifying individual and group baselines.

It is important to consider the timing of data completion and the frequency of administration (Saw, Main & Gastin, 2015a). Particularly during acute changes in load, it is desirable to capture transient well-being more frequently as relevant changes may be diluted or compromised by recall error if athletes and dancers are asked to reflect on wellness over an extended period of time (Shiffman, 2000). To monitor constructs particularly sensitive to change such as stress and fatigue, wellness could be recorded before activity to determine readiness for training and/or performance and after each activity to determine recovery needs daily and to identify possible fluctuations relative to certain occupational demands. However, this may result in persistent poor compliance due to burden, and responses out of habit rather than reflecting on their true current psychological state (Saw, Main & Gastin, 2015a). Ultimately, a design which is sport/industry specific and presents minimal burden to the athlete, with careful consideration of the frequency of completion to gain quality and meaningful data (Saw, Main & Gastin, 2015a) is recommended for ongoing use of an ASRM.

Difficulty in considering both the impacts of professional and personal factors on wellness scoring in the current study highlighted the strong association to dancer's identity, a concept that has been explored in the dance literature (see Wainright & Turner, 2004). Similarly, it has also been reported that athletes found responding to very broad questions relating to their well-being challenging, differing in their ability to introspect and respond accurately on an ASRM (Saw, Main & Gastin, 2015d; Shrier et al. 2014). In a recent study with vocational dancers, it was identified that when faced with additional challenges, such as major life events or academic workloads and deadlines, dancers' abilities to cope with large training loads were impaired (Blevins et al. 2020). This finding highlights the impact that personal stress might have on recovery–stress balance and suggests that there is benefit in seeking to improve dancers' understanding of the balance between training, performance, recovery and holistic well-being.

Use of a self-report application may encourage dancers to reflect on their preparation for training and performance, and through a sense of accountability, act to improve their psychological self-care and self-management practices. Data obtained via monitoring systems must present perceivable value to the end user in order for them to be willing to sustain use (Saw, Main & Gastin, 2015d). Dancers who were intrinsically motivated and interested in exploring their own data in the current study reported the application provided an opportunity to reflect on their wellness states and 'check-in' with their physical and psychological health. Consistent with previous research exploring monitoring systems in dance (Blevins et al. 2020; Karreman, Keizer-Hulsebosch, & Stubbe, 2019), the current study suggests that introducing monitoring systems within dance training may enable and encourage dancers to understand their individual responses to training, and identify their personal recovery needs from both a physical and psychological perspective. Consistent with Karreman and colleagues (2019) usability of a dance surveillance system were supported, with dancers stating they became more aware of their own physical and psychological health. Dancers in the current study identified that their ability to enter soreness and consider pain and physical ailments was less challenging as they could attribute a numerical value to the soreness experience. Dancers reported a very good awareness of their physical well-being and this may be due to their frequent participation in onsite medical, physiotherapy and physical management treatments, and the openness to report injury in this particular dance company. However, scoring symptoms daily could promote hyper-vigilance, with the potential to impact chronic pain states (Rollman, 2009) and should be further explored by medical teams and companies.

Monitoring applications are used successfully in elite-sport to maintain and enhance recovery and the introduction and continued use of similar practices in dance training and performance environments, might prove beneficial for dancers. In comparison to the relative ease of reporting soreness, the participants experienced confronting feelings with regards to fatigue and stress and reported avoidance as a coping mechanism. Dancers explained difficulties in processing and acknowledging wellness scores and subsequent avoidance as a coping mechanism from 'confronting' experiences of consecutive poor wellness scores. These findings are consistent with Blevins and colleagues (2020) who reported that vocational dancers struggled to identify coping strategies when experiencing stress, and reported negative outcomes related to maladaptive behaviours. Consequently, this aligned with exacerbation of injury, illnesses and prolonged fatigue, indicative of overtraining and burnout (Blevins et al. 2020). The findings in the current study further highlight the avoidant coping strategies adopted by dancers in response to psychological well-being and difficulties some dancers have with acknowledging their own psychological health. Examination of behavioural responses to stress and fatigue, and methods for enhancing awareness and acknowledgement of these states are required in supporting and improving dancer well-being.

These findings have important implications for the targeting of psychological skills taught to dancers by practitioners to cope with wellness fluctuations, to reflect the different experiences and reactions of dancers to a broad array of organisational and personal stressors. Further education for company staff and dancers could focus on acknowledgement and acceptance of poor wellness states, self-care strategies, and greater encouragement and empowerment to seek medical assistance if required. Onsite, and accessible supports in times of high pressure may be valuable for dancers in supporting them to accept and work with fluctuating wellness states, rather than avoid or suppress them. This may assist in enhancing the use of physical and psychological recovery strategies to minimise the risk of fatigue, overtraining and burnout. Companies could implement strategies such as mindfulness training to enhance well-being. Additionally, further examination of relevant coping skills in dance is required to determine whether particular strategies are more effective than others, in combating wellness fluctuations and psychological well-being.

7.7 Practical applications

The current study adds an important contribution to the literature on wellness monitoring. The findings of this study provide support, from a consumer's perspective, for the application of sports-based models of athlete management systems and monitoring applications within a dance-specific context, and highlight the applicability for the dance industry. Wellness applications may provide opportunities for dancers to develop positive adaptive attitudes, behaviours and responses to poorer wellness scores. Data collected through a wellness application may encourage a conversation between dancers and medical staff as an initial step in discussing and providing further supports to dancers.

This study extends theoretical knowledge by introducing factors less common in the ASRM literature around avoidance of compromised well-being as a coping mechanism and psychological impacts of wellness reporting on the individual. The honest and insightful feedback from the dancers in this study highlights the need for further research to evaluate the impact of monitoring on individual dancers and athletes. A greater focus on the dancers' needs and supports when using an application, such as onsite readily available support staff that they can confide in would be beneficial as an early intervention strategy. In addition, the frequency of reporting could be reviewed to alleviate some of the reported stressors and negative experiences of consecutive poor wellness reporting over consecutive days. Daily completion of the same questions has been suggested to be bothersome to athletes (Shrier et al. 2014) and lead to questionnaire fatigue whereby athletes responded in an unvarying or random manner (Halson, 2014; Meeusen et al. 2013).

Dancers discussed entering consecutive days of poor wellness as confronting and consequently avoided acknowledging and seeking support. Acknowledgement of the frequency of wellness reporting and the impacts this has on dancers and athletes should be included in the development of monitoring applications and further focus on supports incorporated for the end user. It is recommended that further research explore and consider the frequency of administration and balance this against the length of the measure, evaluating the impact of daily wellness scoring on psychological well-being and performance before implementing into a company. Furthermore, support systems are required when implementing wellness applications to ensure that dancers have access to supports and referral pathways for professional support as required. Help seeking behaviour requires direction from the individual, but companies could provide a supportive environment for dancers to explore their psychological well-being and dancers could be educated, encouraged and empowered to pursue help seeking behaviour in a supportive, understanding and safe environment.

A number of limitations however do exist that could be addressed by future research. This study was limited by a small sized and homogenous sample, suggesting that the viewpoints disclosed here are not exhaustive and might not be applicable to other contexts. Therefore, additional research is needed to establish support for these findings and extended to other populations and genres of dance. Examination of behavioural responses to heightened stress, fatigue, soreness and poor sleep quality and quantity is required to promote positive coping styles and to identify possible response patterns from enhanced self-awareness to behaviour change. Future research could explore strategies to improve self-awareness of well-being in dance and increase dancer awareness of their holistic well-being beyond their dance identity. It is recommended that at an organisational level, companies and dancers are further educated about the potential implications of poor wellness on holistic well-being and performance and provided with strategies such as mindfulness, psychological skills training and behavioural- stress response techniques.

7.8 Conclusions

Findings from this study could be utilised to tailor a wellness application prior to introduction in a professional ballet company. Wellness monitoring may assist in developing interventions that encourage adaptive behavioural responses to changes in wellness scores for optimal well-being in training and performance. To further enhance awareness of holistic well-being and acceptance of wellness states in ballet, it is recommended strategies such as mindfulness education and techniques, psychological skills training and behavioural-stress response techniques for enhancing recovery be trialled.

Picture 4: The Australian Ballet.

CHAPTER EIGHT:

THE DEVELOPMENT OF A MINDFULNESS INTERVENTION

In order to obtain a comprehensive understanding of the mindfulness process, the doctoral student enrolled in two accredited mindfulness-based courses: Meditation and Mindfulness Teacher Training through the School of Positive Transformation, and the Russ Harris, a six-week online Acceptance-Commitment-Training (ACT) course. The study was registered as a clinical trial through Australian New Zealand Clinical Trials Registry (ANZCTR) (Universal trial number: U1111-1231-8905) and the doctoral student completed modules and an assessment for Praxis Australia (Promoting Ethics and Education in Research).

In the performing arts, reaching peak performance requires mental and physical preparation to ensure that attention and centering of focus are maintained throughout the stage performance (Tremayne & Morgan, 2016). Aspects of mindfulness such as maintaining focus through self-regulated attention and awareness, could be considered an inherent practice of dance, irrespective of the dance genre (Moyle, 2016).

Whilst it appears dancers' training is similar to mindfulness practice in some aspects such as the development of body awareness skills, the focus of that awareness is typically more somatic-based however, and dancers often have to switch amongst time, music, space and the body, compared to being continuously focussed on the body as a central point of awareness (Sze, Gyurak, Yuan, & Levenson, 2010). Dancers sometimes struggle to identify coping techniques (Blevins et al., 2019), adopting avoidant coping strategies in response to challenges in acknowledging their own psychological health and well-being (Harrison et al. 2020). Avoidance motivations appear to influence an individual's ability to regulate their emotions and behaviour during stressful situations, generally leading to the experience of more negative emotions during failure (Lench & Levine, 2008).

The majority RCTs examining mindfulness and acceptance-based effects have used inactive controls, making it difficult to detect unique mindfulness effects (Maccoon et al., 2012). To explore the effects of mindfulness techniques, it has been recommended that research studies employ an active control group that is structurally equivalent to the experiment condition. The control condition should also potentially be therapeutic in relation to athletic goals and performance, include meaningful session activities where the participants are able to discuss particular problems and issues of relevance to sport, be expected to have positive athletic outcomes, and not include mindfulness or any other MAC-specific ingredients (Maccoon et al., 2012; Mohr et al., 2009).

In the current research, it was established that the participants would be randomly allocated to one of two groups, an intervention group, the MAC group who would receive mindfulness plus education material and a control group who would receive the education component only. The doctoral student designed the material for the intervention in consultation with TAB.

The education material was provided to both groups. Session topics were relevant to ballet and performance (Table 10) and chosen to ensure that there was no overlap between the topics relevant for mindfulness training (e.g. concentration, relaxation, self-regulation). The research design and findings from studies 1-3 in this thesis informed the development of research topics and criteria to support dancer's holistic well-being for Study 4. Accordingly, the education material was framed around sleep quality and quantity, fatigue, stress, performance preparation and recovery. The material was researched by the doctoral student and presented to TAB medical practitioner and medical team manager for review and approval to ensure the material was relevant and in accordance with the current evidence-based approaches adopted by the company, in supporting dancer's holistic health and well-being.

The mindfulness material was adopted from the MAC manual (Gardner, 2007) which included audio mindfulness practical exercises. The content was modified slightly to fit into the time available to deliver the material. In some instances, the content was slightly reduced to ensure that the dancers were not being overwhelmed by too much theory without the opportunity to apply the MAC material skills, strategies, and practice in the session. However, the core learnings, skills and strategies from the MAC manual were maintained, and incorporated into the sessions and presented to the dancers.

Participants in the intervention group met once per week, over a six-week period, for 30-minutes, with the doctoral student. The control group met on an alternate day, for 20-minute sessions over six-weeks with the doctoral student. If a participant was unable to attend their allotted group session, the doctoral student met with them individually. Therefore, all participants across both groups completed every session.

Table 10. Description of the topics for the intervention and control group sessions

Session	Control	Intervention
1	Topic: Sleep quality. The focus of this session was on the importance of sleep for athletic recovery. Sleep hygiene guidelines for performers were provided and discussed with the participants.	Topic: Sleep quality + MAC topic: Introduction to mindfulness. Brief Centering Exercise (BCE). Participants were provided with a video defining and explaining mindfulness. Discussion about thoughts and emotions related to the participants recent performances. Mindfulness exercise (mindful breath).
2	Topic: Sleep quantity. The impact of reduced sleep quantity on performance was explored with techniques provided to enhance sleep quantity.	Topic: Sleep quantity + MAC topic: Mindfulness and cognitive defusion BCE. Explanation of the fundamental concepts of mindfulness. Presentation and discussion about thoughts and cognitive defusion. Discussion about the participants' experiences of schemas both within and outside ballet. Mindfulness exercise (Hands as thoughts).
3	Topic: Fatigue. The focus of this session was to provide information about physical and psychological fatigue and explored techniques to manage fatigue.	Topic: Fatigue + MAC topic: Introduction to values and values-driven behaviours BCE. Discussion about the participants' reflections of the last session. Presentation of the relation between goals, values and behaviours. Values worksheet identifying work and non-work-related values. Choice point worksheet completion and discussion. Discussion about the differences between emotion-driven choices and values-driven choices. Mindfulness exercise (mindful breath).
4	Topic: Stress. Considering different origins of stressors and their associated cognitive processes.	Topic: Stress + MAC Topic: Introduction to the concept of acceptance: BCE. Discussion about the participants' reflections of the last session.

	Discussion of current coping mechanisms utilised by participants.	Presentation of the acceptance concept. Discussion about the differences between acceptance and avoidance. Participants were encouraged to describe situations where they had experienced avoidance. Mindfulness exercise (Dropping an anchor).
5	Topic: Performance preparation. The focus of this session was to explore preparation techniques leading into performance considering physical and psychological preparation.	Topic: Performance preparation + MAC topic: Enhancing commitment BCE. Discussion about the participants' reflections of the last session. Presentation of the concepts of accepting emotions and working wit them not against them. Exploration of self-compassion and the links with values, committed action and acceptance. Mindfulness exercise (mindful breath).
6	Topic: Recovery. Participants were reminded of recovery techniques and the benefits for physical and psychological well-being.	Topic: Recovery + MAC topic: Combining mindfulness, acceptance and commitment in practice. BCE. Discussion about the participants' reflections of the last session. Discussion about the possibility to integrate mindfulness into the dancer's class, rehearsal and performance demands, preparation and recovery. Mindfulness exercise (mindful breat full body scan, awareness of self).

CHAPTER NINE:

EXPLORING MINDFULNESS PRACTICE FOR PROFESSIONAL BALLET DANCERS: A PILOT STUDY (STUDY 4)

9.1 Preamble

The previous chapter provided valuable insight into the challenges dancers experience in relation to the acknowledgement of their holistic well-being, specifically fatigue and stress. Dancers reported that they found fluctuations in wellness confronting and often adopted avoidance coping styles. To further enhance awareness of holistic well-being and acceptance of wellness states in ballet, a mindfulness intervention was explored. Although no statistically significant differences between pre- and post- intervention for both mindfulness and control groups were found, trends were observed that warrant further exploration. Dancers were interviewed in addition to completing questionnaires, to gain further insight into their experiences of the mindfulness and education sessions, to help guide future designs for the potential embodiment of mindfulness practice into ballet and dance companies.

9.2 Abstract

Background. Mindfulness and acceptance-based approaches have been trialled in professional sport. The present pilot study was a randomised controlled trial with professional ballet dancers investigating the effectiveness of the Mindfulness-Acceptance-Commitment (MAC) approach, developed for athletes, compared to education for dancers. Methods. Participants included 16 professional ballet dancers (2 men and 14 women) who were randomly assigned into either the MAC or education group for six weekly sessions. Participants were assessed pre-and post-intervention using the Mindfulness Inventory for Sport (Jha, Krompinger, & Baime) and the Acceptance Action Questionnaire (AAQ-II).

Within 2 weeks of the final mindfulness session, all participants completed a semi-structured interview. Results. No statistically significant differences were found when comparing the questionnaire responses between pre- and post- intervention, nor between the MAC group and the control group at post intervention for all subscales. Although dancers reported in the interviews that the sessions were valuable, they advised their ability to dedicate time to mindfulness ongoing would be challenging.

Conclusions. To demonstrate statistical significance for mindfulness interventions, longer session durations, extended intervention periods and increased frequency of sessions are recommended. For consistent and ongoing mindfulness practice, future designs should seek to embed mindfulness practice into dancer and company schedules.

9.3 Introduction

To enhance physiological and psychological performance readiness and recovery, psychological skills training (PST) techniques have been previously adopted in dance (see Klockare, Gustafsson & Nordin-Bates, 2011) and sport (see Birrer & Morgan, 2010), including goal setting, mental rehearsal, arousal control, self-talk and precompetitive routines (Hasker, 2010). To potentially influence physiological and psychological states on a continuum of athletic functioning, mindfulness approaches have gained traction (Bernier, Thienot, Codron & Fournier, 2009; Brown & Ryan, 2003; Gardner, 2007; Gardner & Moore, 2004, 2017; Hasker, 2010; Ivarsson, Johnson, Andersen, Fallby and Altemyr, 2015; Moyle, 2016; Zhang, Si, Chung & Gucciardi, 2016). The primary focus of mindfulness-based and acceptance-based intervention models is to stimulate a modified relationship with internal states (such as cognitions, emotions and physiological events) in contrast to most forms of psychological skills training (PST) interventions that directly aim to change dysfunctional thoughts and emotions (Pineau, Glass, Kaufman & Bernal, 2014).

Studies evaluating the efficacy of mindfulness and acceptance-based therapies have reported symptom improvements in conditions such as anxiety and depression (Forman, Herbert, Moitra, Yeomans & Geller, 2007; Grossman, Niemann, Schmidt & Walach, 2004; Riemann, Hertenstein & Schramm, 2016) and effectiveness in symptom reduction and improved emotional functioning for chronic pain (Baer, 2003; Grossman et al. 2004). In sport specifically, mindfulness-based and acceptance-based protocols have demonstrated reductions in psychological symptoms, emotional distress and improved sport performance (Gross et al. 2018; Josefsson et al. 2019), decreased rumination and increased self-regulation leading to better coping capacity (Josefsson et al. 2019), reduced experiences of burnout (Frode, Phillip and Frank, 2015) and decreased injury risk (Ivarsson et al. 2015; Zadeh, Ajilchi, Salman and Kisely, 2019).

For the purpose of enhancing performance and psychological well-being in athletes, a theoretical and empirically supported acceptance-based behavioural intervention was developed: Mindfulness-Acceptance-Commitment (MAC). Mindfulness-Acceptance-Commitment (MAC) is the most prevalent acceptance-based approach adopted in sport (Bernier et al. 2009; Gardner, 2007; Gardner & Moore, 2004, 2012, 2017). When displaying a high level of mindfulness, athletes are theorised to be able to redirect their focus of attention toward thoughts and behaviours that benefit performance by acknowledging and accepting the presence of external stimuli, bodily sensations, emotional reactions, and cognitions, without overreacting to them (Gardner, 2007; Gardner & Moore, 2004).

A better understanding of mindfulness-acceptance approaches in sport and dance is required to further confirm the applicability and effectiveness (Bernier et al. 2009). In dance, a 9-week mindfulness-meditation acceptance-based program was delivered to all students undertaking full-time University dance training (N = 106), with an aim to assist students in the further development of performance psychology skills (Moyle, 2016). An upward trend in levels of mindfulness awareness was identified however, the results were not significant. Qualitative feedback indicated that participation in the mindfulness program and the development of the associated mental skills had resulted in positive performance and personal outcomes (Moyle, 2016). Moyle (2016) contended that further mindfulness and dance research is required to identify benefits for both performance enhancement and general health and well-being for dancers, and to assist in expanding the literature in performance settings. This research has been presented at a conference and published as a book chapter (see Moyle, 2016), yet no results have been published as a peer reviewed paper. To the researcher's knowledge, literature examining the effectiveness of a mindfulness intervention in dance and professional ballet has not been published and warrants exploration.

Dancers are taught to cultivate increased awareness of proprioceptive sensations from muscles, balance and posture to guide and coordinate complex movements (Aalten, 2004), however it appears that awareness, acknowledgement and acceptance of psychological health and holistic well-being is less familiar to dancers (Harrison et al. 2020). To further enhance awareness of holistic well-being and acceptance of wellness states, it was recommended that strategies such as mindfulness be trialled in professional ballet (Harrison et al. 2020). Therefore, the current study sought to explore the effects of a mindfulness intervention via a randomised controlled trial (RCT) with a MAC group and a control group (who were provided with meaningful education sessions). The central purpose of this study was to examine whether the MAC program (Gardner, 2007) could meet the needs of professional ballet dancers and provide the ballet company with an intervention program to enhance awareness of psychological health and compare the MAC program to their current approach of providing education sessions to dancers.

9.4 Methods

Participants

Sixteen professional ballet dancers (2 men and 14 women), employed at a national ballet company, volunteered for the study. Participants were between 19 to 35 years old (*M* = 25 years, *SD* = 4.88), and their number of years of experience as a professional ballet dancer ranged from 1 to 16 years (*M* = 6.87, *SD* = 4.75 years). Ranks in the company included Principal Artist (1), Senior Artist (1), Soloist (4), Coryphee (3) and Corps De Ballet (7). Participants were excluded from the study if they had participated in a mindfulness program in the last 12 months.

Procedure

Ethics approval was granted by the University Human Ethics Committee (ID number HEC19093) and the project registered via the Australian and New Zealand Clinical Trials Registry (Universal trial number: U1111-1231-8905).

Participants provided written consent and were randomly allocated via block randomisation to one of two groups: 1) Intervention: MAC (*n*=8) or 2) wait-list education control group (*n*=8). The education material was developed in consultation with a ballet company medical practitioner and provided to both groups. Session topics were relevant to ballet and performance (See Table 10), and chosen to ensure that there was no overlap between the topics relevant for mindfulness training (e.g. concentration, relaxation, self-regulation). The mindfulness material was adopted from the MAC manual (Gardner & Moore, 2007) including audio mindfulness practical exercises.

All sessions were directed by an accredited instructor in acceptance-commitment therapy who had experience delivering mindfulness education to dancers and injured workers (including both physical and psychological injuries). Participants in the intervention group met once per week, for 30-minutes, with the instructor, for 6 weeks. The control group met on an alternate day, for 20-minute sessions over 6 weeks (see Appendix). If a participant was unable to attend their allotted group session, the instructor met with them individually. Therefore, all participants across both groups completed every session.

Baseline data were collected after randomisation. To obtain intervention data, participants completed the Mindfulness Inventory for Sport (MIS) (Thienot et al. 2014) and the Acceptance Action Questionnaire (AAQ-II) (Bond et al. 2011) at weeks 1 and 6 of the intervention.

Within 2 weeks of the final MAC session, all participants (*n*=16) completed a semi-structured interview that included questions about their experiences of the sessions, recommendations for further development and how they felt the program contributed to their professional and personal lives. Interview data were transcribed by the primary researcher and analysed using thematic analysis. After the interviews were completed, the MAC sessions were offered to the 8 waitlisted participants.

Measures

The Mindfulness Inventory for Sport **(MIS)**

The MIS is a 15-item questionnaire which assesses dimensions of awareness, re-focusing and nonjudgement. Each item is measured on a 6-point Likert scale where *1*= not at all *3*= sometimes and *6*= very much. The MIS comprises three subscales: (i) awareness (items 1-5); ii) non-judgemental thought (items 6-10, reverse scored); and iii) re-focusing (items 11-15). The awareness subscale assesses an athletes' ability to be cognisant of their thoughts, emotions and physiological responses. The non-judgment subscale assesses the attitude adopted toward the scenario. The refocusing subscale assesses an individual's ability to quickly regulate attention toward goal-related cues.

The MIS demonstrates acceptable reliability ($\omega \geq 0.7$), strong test-retest reliability ($.43 \leq r \leq .61$) (Noetel, Ciarrochi, Sahdra & Lonsdale, 2019) and acceptable internal consistency for each of the subscales awareness: α .77, non-judgmental: α .78, refocusing: α .77 (Thienot et al. 2014).

It has been recommended that sport research measure dispositional mindfulness using an instrument developed specifically for athletes (Josefsson et al. 2019; Thienot et al. 2014; Zhang, Chung & Si, 2017). To the researcher's knowledge this is the first study to use this scale in dance and professional ballet.

***The Acceptance Action Questionnaire* (AAQ-II)**

The AAQ-II is a 10-item measure that assesses an individual's psychological flexibility, which is the act of being intentionally receptive and open to experiences, and to engage in behaviours consistent with valued life directions (Bond et al., 2011). Each item is rated on a Likert scale ranging from 1 (never true) to 7 (always true). All 10 items are summed to form a global index score. The AAQ-II is frequently used in both clinical psychology (see Meyer, Morissette, Kimbrel, Kruse & Gulliver, 2013) and mindfulness- and acceptance-based research (see Gross et al. 2018). Reliability of the AAQ-II is high; .84, and adequate 3- and 12-month test–retest reliability of .81 and .79, respectively (Bond et al., 2011). The AAQ-II also demonstrates adequate internal consistency levels (Cronbach's alphas) generally ranging from 0.80 to 0.90 (Brown & Ryan, 2003). The AAQ-II, is the most commonly used measure of psychological inflexibility (Hayes, Levin, Plumb-Vilardaga, Villatte & Pistorello, 2013).

Statistical analysis

Data were entered into statistical software SPSS v25 (IBM) on a Windows 10 platform. Questionnaire items were summed to obtain scale scores for awareness, non-judgement, re-focusing, and acceptance and action.

Prior to analyses, data were screened for outliers via Box Plots using a criterion of +/- 2.5 Standard Deviations from the mean, and no outliers were identified. Data was checked for assumptions of normality using Shapiro-Wilk test, all tests were $p > .05$.

For each variable, a single-factor between subjects' analysis of covariance (ANCOVA) was used to analyse the intervention effect by comparing the post-intervention scores between the intervention and control groups, controlling for pre-intervention score at baseline. The magnitude of group differences was interpreted using partial η^2 and 95% confidence intervals (Ivarsson et al. 2015; Zhang, Hedo, Rivera et al. 2019). This approach is consistent with athlete mindfulness research with similar sample sizes (Aherne, Moran & Lonsdale 2011; Hasker, 2010). The magnitude of the effect size was interpreted using Cohen (1988) where a small partial η^2 was interpreted as 0.01, medium 0.06 and large 0.14.

To check whether our non-significant results were due to a lack of statistical power, we conducted post hoc power analyses with power (1 - β) set at 0.80 (80%) and α = 05, two-tailed (Borm, Fransen & Lemmes, 2007).

The interview material was analysed using thematic analysis, a method for identifying, analysing and reporting patterns (themes) within the data (Braun and Clarke, 2006). Thematic analysis involves searching across a data set in order to find repeated patterns of meaning. In conducting the current qualitative research, the analysis of the data adhered to a six-phase guideline including familiarisation, generating initial codes, searching for themes, reviewing themes and defining and naming themes (Braun and Clarke, 2006).

9.5 Results

Quantitative data

Descriptive statistics, means and standard deviations are included in Table 1.

Non-judgement

A significant relationship was found between the pre-and post-intervention scores, $F(1, 13) = 16.61$, $p < .001$, $\eta^2 = .56$, 95% CI [.13, .74] for non-judgement in the MAC group. After controlling for pre-intervention score, a non-significant difference was found at post-test between groups, $F(1, 13) = 3.35$, $p = .09$, $\eta^2 = .21$, 95% CI [.00, .50].

Group sample sizes of n= 8 and n= 8 achieved 26% power with post intervention difference detected as 3.0. Adjusting for the pre intervention score using an ANCOVA test, a pre and post score correlation of 0.69 was found with a significance level (alpha) of 0.05.

Re-focusing

A significant relationship was found between the pre-and post-intervention scores, $F(1, 13) = 9.58$, $p = .009$, $\eta^2 = .42$, 95% CI [.04, .66] for re-focusing in the MAC group, however a non-significant difference was found at post-test between groups, $F(1, 13) = .12$, p = .75, $\eta^2 = .009$, 95% CI intervention [.00, .25].

Group sample sizes of n= 8 and n= 8 achieved 11% power with post intervention difference detected as 1.1. Adjusting for the pre intervention score using an ANCOVA test, a pre and post score correlation of 0.66 was found with a significance level (alpha) of 0.05.

Awareness

A non-significant relationship was found between the pre-and post-intervention scores for awareness, $F(1, 13) = 0.04$, $p = .84$, η^2= .003, 95% CI [.00, .10]. No difference was found at post-test between groups, F (1, 13) = 1.16, $p = .30$, η^2= .08, 95% CI [.00, .38].

Group sample sizes of n= 8 and n= 8 achieved 21% power with post intervention difference detected as 1.5. Adjusting for the pre intervention score using an ANCOVA test, a pre and post score correlation of -0.088 was found with a significance level (alpha) of 0.05.

Acceptance and Action Questionnaire (AAQ-II)

A significant relationship was found between the pre-and post-intervention scores, $F(1, 13) = 15.67$, $p = .002$, $\eta^2 = .55$, 95% CI [.12, .73], however a non-significant difference was found at post-test between groups, $F(1, 13) = .34$, $p = .57$, $\eta^2= .03$, 95% CI intervention [.00, .29] (Table 1). An upward trend in levels of acceptance and action was identified in the MAC group between pre- and post- intervention however, the results were not significant.

Group sample sizes of n= 8 and n= 8 achieved 6% power with post intervention difference detected as 1.0. Adjusting for the pre intervention score using an ANCOVA test, a pre and post score correlation of 0.732 was found with a significance level (alpha) of 0.05.

Figure 11. Mean (standard deviation) Mindfulness Inventory for Sport and Acceptance Action Questionnaire Sub-scale Scores for Intervention and Control Groups.

	MIS: Awareness		MIS: Non-judgement (reverse scored)		MIS: Re-focusing		AAQ-II: Acceptance and action	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Intervention Group (n = 8)	24.13 (2.17)	26.00 (1.69)	16.50 (5.40)	20.63 (5.37)	19.25 (2.43)	22.00 (3.96)	43.88 (7.75)	46.75 (9.62)
Control Group (n=8)	26.00 (1.60)	24.50 (3.30)	17.88 (7.49)	17.63 (7.13)	19.50 (4.31)	20.88 (4.39)	45.00 (9.02)	45.75 (9.39)

Qualitative data

Interviews with all 16 participants revealed the following themes: 1. Education: a good place to begin; 2. Mindfulness: experiences, perceptions and benefits; and 3. Implementing the MAC program: in class and beyond.

1. Education: a good place to begin:

The majority of dancers suggested that the education was "not really anything new, but good to go over" and that the environment enabled them to talk about key points and reflect amongst their peers. PowerPoint information slides were reported to be beneficial for dancers who struggled to retain information without a visual representation of the information. Some dancers reflected that the information and slides reinforced topics discussed by the company medical team.

2. Mindfulness: experiences, perceptions and benefits:

All dancers who participated in the mindfulness sessions reported that their experience was "beneficial," "insightful, " "valuable" and enabled them to feel "calm and refreshed before class." Dancers appreciated the dedicated time to the practise of mindfulness stating that, "it didn't really feel like an effort, it was a really helpful session to go to." The sessions assisted dancers to "name" certain concepts such as "noticing self" that encouraged greater self-awareness and connection with self.

After each session, dancers reflected on their experiences and how they were then able to translate these experiences into practice throughout class and their working day. "I focused on little mindful things, like in the studio being able to have different ways to calm myself and different ways to find focus and feel grounded was good." The mindfulness sessions enhanced dancers' awareness of mental health. For example; "I've always figured mental health is important, along with physical health and I think those sessions and listening to how work effects other people as well was good, and to notice mental health is important."

The inclusion of practical components and short audio meditations were reported to be "enlightening" and "interesting" to dancers as this enabled them to get a "feel for mindfulness" without feeling overwhelmed. The sessions encouraged dancers to engage with their surroundings, to be more aware, and acknowledge thoughts and feelings, and dancers discussed that this practice "takes you out of auto-pilot, so it's been good to try and break that and become more self-aware."

Additionally, dancers suggested that ongoing, regular sessions, especially when working interstate could be "really beneficial." It has been identified that dancers have extensive daily, weekly and monthly work demands and it was reported that if mindfulness sessions were scheduled regularly it would help to remind dancers to focus on their mental health. "In the future, to entwine the sessions into the company would be beneficial to then also be tailored to what is coming up, for example performances, auditions, travel periods." Although dancers reported the sessions were valuable, they advised their ability to dedicate time to mindfulness ongoing would be challenging.

2.1 Peer interactions: MAC program encouraging conversations and support

When reflecting on the composition of the sessions, dancers reported that the group environment felt "safe, reassuring and kind," with dancers stating "it was nice to hear you are on the same track as everyone else, to hear they are going through similar things was good." It was reported that the group sessions encouraged and enabled conversations around work, the environment and pressures and helped to normalise the experiences discussed. Dancers also considered the potential benefits of individual sessions for more tailored strategies and discussions, such as "being able to hear other people's opinions was great, but it would also be great to have one-on-one with you and I did (as this dancer had missed a group session), which was really great because the focus was on each other and there was a lot to gain from having that attention.” Another dancer suggested that individual sessions could be offered to enhance personal development and growth holistically. Although the group sessions encouraged collaborative discussion, the sessions also encouraged dancers to reflect on their personal experiences.

3. Implementing the MAC program: in class and beyond:

Dancers discussed being more aware of and paying more attention to their senses such as sights and sounds and listening to mindfulness apps between sessions. Breathing techniques, observing self, unhooking techniques, reflecting on values and focusing on the present moment were elements that resonated with dancers. “I used self-kindness like we were talking about. I loved the “hands as thoughts” strategy, even yesterday in class I noticed that if you allow yourself to open up, you can really see things that are around you and in front of you.”

Dancers further discussed how they implemented mindfulness strategies and tuned into their senses, noticing the sound of the music and tuning into all of the instruments when standing side stage. “Sometimes the atmosphere is really nerve wrecking because you see lights and see people. So, I really liked the strategies provided for side stage and taking it all in, this really clicked for me.” When reflecting on the performance itself, one dancer discussed how the sessions and the strategies helped to enhance their focus and their experiences during a performance. For example:

> *Focusing through mindfulness I have noticed that I am more focussed throughout my performance, I think that is because I have been able to lower my nerves and not be anticipating in my mind, just being present and focus on the moment and what I have to do there and then.*

Another dancer reflected on their experiences implementing mindfulness post performance:

> *In more stressful situations, after a show, I meditated for 5 minutes and it really grounded me because I was getting really worked up. I was quite anxious afterwards, but the mindfulness sessions really reminded me to feel the floor and breathe. I think any workplace should have this, especially in performance where there is adrenaline and heightened states. Every night we go from the high and then try to switch off and lie down and sleep can be hard.*

Dancers also reflected on the use of mindfulness outside of performance settings and the impact regular practice may have on their holistic well-being. One dancer stated that she had previously considered trialling mindfulness when she felt stressed. However, following the sessions she reflected on the importance of practising mindfulness in different psychological states to further enhance the skills and utilisation. For example: "since being educated and trying mindfulness strategies when I am calm, I have noticed when I feel really stressed that I can manage these emotions better because of the preparation and prior practice." Another dancer supported this notion of ongoing practice of mindfulness indicating that being mindful is more achievable when you're "not completely highly strung." "The more you use it and practice it, the more it becomes natural and then a tool to use when you become heightened and stressed."

Two dancers were not as confident they would utilise mindfulness techniques as they have engaged with sport psychologists who have assisted with previous issues and concerns. For example, "I think the material is good, I don't know how applicable it would be for me to use. I think for me, I have seen the sports psych several times and that's been much more beneficial because I have much more specific things that I want to address and talk about." Another dancer also reflected on the generic nature of the sessions stating that: "I think it was kind of more like a blanket, maybe a bit too general. I thought the resources were good, so from a practical point of view it was good. I think more specific strategies for each individual would be more productive for dancers' specific needs."

9.6 Discussion

The six-week MAC program implemented with professional ballet dancers extends research into the potential effectiveness of mindfulness practice in dance. To our knowledge, this is the first published pilot RCT examining MAC's effectiveness when compared to an active control in professional ballet. The majority of RCTs examining mindfulness and acceptance-based effects have used inactive controls, making it difficult to detect unique mindfulness effects from the effect of attention (Maccoon et al. 2012). To accurately explore the effects of mindfulness techniques, it has been recommended that research studies employ an active control group with meaningful components, to enable and encourage participants to discuss particular problems and issues of relevance (see Baskin, Tierney, Minami and Wampold, 2003; Maccoon et al. 2012; Mohr et al. 2009). As such, an active control, receiving meaningful material relevant to professional ballet was implemented into the present study in order to control for the effect of attention as both the MAC and control groups received comparable amounts of time with the same instructor.

This study was exploratory in nature and conducted as a pilot study. Dancers discussed overall positive experiences of the mindfulness sessions and applied concepts to their professional and personal lives. Findings from the present study suggest that dancers in the MAC group may have begun to adopt a non-judgmental attitude towards their cognitions and emotions and may have begun to refocus and regulate their attention to their professional and personal lives, tasks and experiences. Changes in the acceptance and action scores in the MAC participants suggest a possible increase in experiential acceptance of cognitions, emotions and sensations post-MAC intervention, although no statistically significant findings were identified. The sample size was too small to expose if a significant effect between pre and post scores was achieved. An increased sample size may help to detect if there is a difference in awareness, non-judgment, refocusing and acceptance and action scores with mindfulness intervention in dance.

Changes in the AAQ-II suggest an increase in experiential acceptance of cognitions, emotions and physical sensations, however in the current study whilst trends were observed, these were not statistically significant. Increases in psychological flexibility were found in a case study of an adolescent springboard diver who completed a nine session MAC program (Schwanhausser, 2009) and were also recorded in the MAC group of collegiate basketball players (*n*=11) who completed seven MAC sessions (Gross et al. 2018). Gross and colleagues (2018) found changes in the AAQ-II between post-intervention and one-month follow up suggesting that changes in psychological flexibility may not be captured in the initial post-intervention questionnaires. A one-month post-intervention questionnaire was not administered in the current study due to dancer's extensive work commitments, however, this could be incorporated into further research to examine both initial and longer-term intervention impacts of mindfulness practice.

The MAC group showed a slight, albeit nonsignificant, improvement in mindfulness ratings, compared to an active control group, similar to findings in previous studies (i.e., Goodman, Kashdan, Mallard, and Schumann, 2014; Hasker 2010). However, the results in the current study are not entirely comparable to earlier studies, as Goodman and colleagues (2014) did not use an active control group and tested MAC in combination with Hatha yoga, and other MAC studies (Goodman et al. 2014; Hasker 2010) did not use mindfulness questionnaires specifically designed for athletes.

Separating mindfulness questionnaires into components may have theoretical and practical benefits for future research (Noetel et al. 2019). For example, if refocusing is the best predictor of performance and refocusing is amenable to change, then interventions may be more effective if they target refocusing, rather than awareness or non-judgement (Noetel et al. 2019). In ballet, there is a standard of perfection in dancer's skills and technique, and perfectionism may be considered contextually relevant to the study of mindfulness-performance relationships (Van Dyke, 2019). The current study elected to utilise the MIS as it was suggested that the refocusing subscale may identify perfectionism concerns (Thienot et al. 2014). Considering potential contrasts between elements of perfectionism (e.g., self-critical evaluations) and elements of mindfulness (e.g., acceptance and self-compassion), further research integrating the two constructs may assist in understanding how mindfulness, judgement and perfectionism can interact within dancer's experiences. Incorporating an exploration of perfectionism with mindfulness was beyond the scope of the current study however this could be explored in a follow-up longitudinal study utilising the same mindfulness outcome measure for comparison.

Research in dance and mindfulness has tended to explore dance as a means of meditational therapy, as opposed to mindfulness as a mechanism for performance enhancement (Evans, 2019). Exploring a mindfulness intervention in a dance setting, Moyle (2014) also failed to identify statistically significant findings in a nine-week mindfulness program, however reported an upward trend in levels of mindfulness awareness in dance students. Mindfulness has been explored with dancers in thesis dissertations recently (for example Blevins, 2019; Evans, 2019) however no peer reviewed published literature investigating a mindfulness intervention in dance is available. Further exploration of the effects of mindfulness practice for professional and personal wellbeing is therefore required to provide a greater depth of understanding of mindfulness practice for dancer's preparation, performance and recovery and to expand on the current study's preliminary findings.

The implementation of mindfulness practice ongoing may be challenging for dancers and companies. In the current study, the MAC program was reduced slightly from 7 sessions to six to align with the dancer's availability, and each session ran for 30 minutes instead of the proposed 45- 60 minutes duration. Dancers were still provided with all aspects of the MAC program, however as the intended dose of MAC was reduced slightly participants consequently may not have been able to reflect on the concepts discussed with as much depth and consideration. Nevertheless, research has yet to clearly identify the most effective doses of mindfulness practice to achieve optimal results (Gross et al. 2018). It has been suggested that intervention periods of mindfulness practice longer than 4 weeks have a larger impact on an athlete's personal development, with intervention periods ranging between 5 (Khoury et al. 2013) and 8 weeks (Gardner and Moore, 2004). Similarly, the Australian Football League (AFL) have reported one of the biggest challenges in engaging players in mindfulness and well-being interventions is time (Mitchell and Hassed, 2006). The AFL Players' Association have subsequently sought to creatively weave mindfulness, as part of a broader well-being strategy, into player support through highlighting and working with influential players and coach ambassadors who are willing to talk about their mindfulness practice and subsequent impact on their life and sporting performance, and dance could follow a similar trajectory. Dancers in the current study provided valuable insight and considerations for future mindfulness programs. Recommendations such as dedicated time to practice, flexibility in the delivery of the techniques and individualised content has provided key insights for the development of further mindfulness research studies in dance and sport, and for ongoing utilisation and adaptation by companies and sporting organisations. Ultimately, mindfulness practice has been found to be effective when participants persist and engage in the intervention (Zhang et al. 2016) and prolonged exposure and longitudinal examination of mindfulness outcomes is warranted.

The current study has provided valuable insight regarding mindfulness in professional ballet; however, the findings should be considered within the context of several limitations. First, the small underpowered sample size and restricted number of sessions limits the interpretation of the effectiveness of the mindfulness intervention compared to education alone. Second, the mindfulness data were self-reported, thus susceptible to individual interpretation. Third, Zhang and colleagues (2017) reported that direct-worded items instead if reverse-worded acceptance items used in questionnaires may be more appropriate for athletes. The MIS and AAQ-II used in the current study both included reverse-scored items that may have been misinterpreted and may have contaminated scores rather than preventing response bias (see Sonderen, Sanderman and Coyne, 2013). Fourth, in the current study, no performance data or observations from medical or artistic staff were recorded to identify possible performance enhancement through mindfulness practice. It is recommended that performance measures (such as dancer self-reflection and artistic and medical staff observations) and outcomes (such as perceived and observed performance quality) be incorporated into future mindfulness research to explore MAC's effectiveness in improving performance in professional ballet. Additionally, future research exploring longitudinal outcomes following mindfulness and acceptance-based training could include the exploration of injury incidence, stress, fatigue and sleep quality recordings and dancer's awareness, acknowledgement and acceptance of psychological health for enhanced holistic wellbeing.

9.7 Conclusions

The findings of this pilot study via RCT showed some signs of positive shifts, however, did not reach significance possibly due to the underpowered sample size, limiting the interpretation of the findings. It is recommended that a larger, fully powered RCT to determine the impact of mindfulness on professional ballet dancers be investigated. The qualitative data suggest the pilot of implementing a MAC intervention with dancers, with dancers reporting value in mindfulness training and practice. However, due to their extensive work demands and schedules their ability to dedicate time to ongoing mindfulness would be challenging. Future intervention designs should address this barrier and diarise mindfulness into the dancer's schedule to encourage opportunities to check in with self, reflect and potentially enhance awareness of psychological and holistic wellbeing. The effectiveness of tailored mindfulness sessions in addition to providing group mindfulness practice should also be explored.

Picture 5: The Australian Ballet.

CHAPTER TEN:

GENERAL DISCUSSION AND CONCLUSIONS

This chapter considers how the research produced in this thesis have contributed to the literature pertaining to wellness among professional ballet dancers. The overall aim of this thesis was to explore the use and feasibility of a wellness App designed to monitor wellness, activity and participation status in professional ballet and to pilot an intervention designed to explore the effectiveness of mindfulness practice with professional dancers at TAB. Four studies were conducted to achieve this aim.

Study 1: A pilot study: Monitoring wellness in Professional Ballet Dancers.

Study 2: Self-reported wellness in training and performance: a comparison of professional ballet dancers and professional athletes.

Study 3: An exploration of the perceptions and experiences of professional ballet dancers using a wellness application.

Study 4: Exploring mindfulness practice for professional ballet dancers: a pilot study.

The overall aim of this thesis was to explore the use and feasibility of a wellness App designed to monitor wellness, activity and participation status in professional ballet and explore an intervention designed to enhance awareness of well-being in professional dancers at TAB. The findings from this thesis provide insight into wellness fluctuations in performance compared to training periods and highlight opportunities for further development of wellness Apps and mindfulness interventions in professional ballet.

This chapter is comprised of four sections: i) summary of research findings, ii) limitations of this research, iii) implications and directions for future research and iv) conclusions.

10.1 Summary of research findings

10.1.1 Use and feasibility of a wellness App in professional ballet

Preliminary self-report data from a dance-specific wellness App was collected in Study 1 (pilot), supporting the use and feasibility of the monitoring technology with a professional ballet population. In the pilot study, five dancers trialled the App for one-month and reported that recording and reviewing their own wellness data on a regular schedule was valuable because wellness and mental health is “not at the forefront of their minds.” Access to the App via smart phones facilitated the data entry process for wellness, activity, and participation information to be recorded in real time for immediate personal reflection. Dancers summarised their experience using the App as positive, beneficial, and practical for use in professional ballet. Supporting the continued development and exploration of monitoring systems in dance, Karreman and colleagues (2019) similarly found that dancers indicated a willingness to continue using a dance-health surveillance system (PAHM), appraising the PAHM as user-friendly and an easy way to answer a questionnaire related to their health. Dancers stated that they became more aware of their own physical and psychological health and were open to continued use of the system to improve their general health and prevent overuse injuries (Karreman et al., 2019).

Including the end user (dancers) in the development process of wellness Apps may assist with App specificity, buy-in for ongoing use, and for user perspectives and recommendations to guide further development. A lack of end-user input in the construction of an App can lead to suspicion, with detrimental effects on the longevity, validity, and reliability of the App (Luxton, McCann, Bush, Mishkind, & Reger, 2011). Traditionally, the development of healthcare Apps had been practitioner led (Luxton et al., 2011) however there has been a trend in recent times to engage service users’ perspectives in the development of Apps in areas such as headaches (Huguet et al., 2014), schizophrenia

(Ben-Zeev et al., 2013) and chronic pain sufferers (Slater, Campbell, Stinson, Burley, & Briggs, 2017). End-users can provide valuable insights into App development, using their own experiences to assist practitioners in defining how Apps should continue to evolve for sustained implementation and use (Goodwin, Cummins, Behan, & O'Brien, 2016). Incorporating qualitative methodology with consumers to explore how an App or program develops and unfolds initially, and what variables might influence implementation outcomes from an end-user's perspective, has gained increasing momentum as an important component of the framework for assessing programs and Apps in their early phases (Shapiro et al., 2015). Commencing with a trial period where the possibility exists to modify or adapt the process has been suggested as beneficial for initial and ongoing use of an App (Beckmann & Kellmann, 2004).

In accordance with these important development and implementation concepts, dancers in Studies 1-3 completed a one-week familiarisation period where they practiced using the App prior to the commencement official data collection, and the doctoral student met with dancers after the first week of data entry to clarify and address any concerns. This process was aimed at encouraging the dancers to feel more confident using the App and provided an opportunity to adjust and modify the App prior to data collection periods, if/as required. Technological issues were addressed by completing the familiarisation period and engaging with the dancers in the trial. Additionally, the design of Study 1 (pilot) also incorporated a focus group component to provide an opportunity for dancers to discuss their experiences and to provide suggestions and areas of improvement for further development of the App. This strength of engaging with the end-user (of the monitoring tool) is consistent with the work of Saw and colleagues (2015, 2017) in sport, who highlighted that engaging athletes in the development of ASRM may lead to better quality data entered by athletes, and ongoing commitment to use ASRM as key implementation strategies for App sustainability (Saw et al., 2015; Saw, Main, Robertson, & Gastin, 2017).

Feedback regarding the usability of the App was collected in real-time in Study 1 and was instrumental in guiding changes to the App to potentially enhance engagement, compliance, and ongoing use for subsequent studies and for ongoing App implementation processes at TAB. From the focus group interviews, a visual calendar in the App to trace data entries and address the potential for missed or duplicated data being entered was incorporated, and contact details for the medical GP and Employee Assistance Program (EAP) were included. These small advancements were adopted for Studies 2-3 and this demonstrates the benefits of seeking end-user perspectives for enhancing App functionality and use in the preliminary stages of App development and implementation. It is suggested that these advances assisted dancers to identify if they had completed the questionnaire requirements to address possible issues with engagement, compliance and missing data. It is unknown however whether dancers increased utilisation of EAP due to the contact details being included in the App as EAPs are a confidential service.

Application of the wellness App was explored further in Study 2 (comparison to athletes) and Study 3 (qualitative exploration of the use of the App). In Study 2 and Study 3, 14 dancers entered wellness and activity data into the App over 4-months to record changes over time in wellness parameters. To add to the quantitative data obtained via the App, professional dancers were interviewed to assemble personalised (i.e., qualitative) feedback following App utilisation (Study 3). To ensure transparency of data, dancers were assured that their responses were private, confidential, and de-identified. The results revealed that dancers reported that they were more accustomed to reflecting on topics related to their physical well-being (e.g., muscle soreness) than indicators of mental well-being. When considering wellness and psychological well-being factors of their occupation and personal lives, dancers reported that they were not accustomed to ratings-based self-report measures, and that they lacked confidence when they rated (i.e., assigning a numerical value) specified wellness parameters. It appears that further exposure to wellness recording is warranted to address this gap in rating confidence between physical and psychological health.

These findings highlight opportunities for medical staff, artistic staff and companies to further promote the importance of holistic well-being and psychological health in dance through continued use of wellness likert scales, to improve familiarity and competency in rating wellness and further promote psychological health. In addition to the continued use of wellness Apps and monitoring tools, companies could incorporate psychological well-being seminars with content that educates dancers about the potential impacts of fluctuations and changes in wellness and the subsequent risks to performance quality and injury. An informed understanding of the potential risks to performance and injury may assist with dancer's compliance to continue using an App to enter wellness data consistently as an early intervention, alert system. This proposal aligns with Brener and co-authors (2003) recommendations for the rationale and potential benefits of self-report data entry to be effectively promoted to incentivise participants to respond accurately. The ongoing practice of rating wellness via an App and the integration of education strategies with evidence-based rationale for monitoring wellness, may also address dancer's apprehensions to using the App. By providing education and increased exposure to wellness recording, dancers may be able to more confidently rate wellness numerically and subsequently gain further value using the App for their preparation and recovery from performance.

Overall, a willingness to continue using the App was reported by the majority of dancers interviewed in Study 1 and Study 3. The focus group (Study 1) and semi-structured interviews (Study 3) provided further evidence to support continued use of a wellness App in dance, highlighting benefits, limitations, and recommendations for further development of monitoring tools in dance companies. The App encouraged some dancers to be proactive in the management of their pain, encouraged greater consideration of fatigue, stress, sleep quality and quantity, and provided an opportunity for ballet dancers to consider their readiness to train and perform. Therefore, it appears that a dance-specific wellness App is useful and feasible and further implementation of the App companywide, may provide further guidance for the development, implementation, and sustainability of wellness Apps in professional ballet. Furthermore, with sustained use, greater identification of wellness fluctuations and trends could be identified. The identification of such trends could help guide early intervention and preventative strategies and support services for dancers both individually and as a group to enhance holistic well-being and minimise injury risk.

10.1.2 OSTRC: areas of soreness, illness, and participation

In addition to recording wellness in the App, dancers in Study 1 (pilot) were required to complete the OSTRC questionnaire (Clarsen et al., 2013) to capture self-reports of the severity of a physical complaint and the impact that complaint had on their participation, training volume, and performance. Previous studies have administered the OSTRC questionnaire weekly, fortnightly, and monthly to review symptom progression (Clarsen et al., 2014; Schwellnus et al., 2016) however in Study 1 dancers were instructed to complete the OSTRC questionnaire daily. The rationale for daily completion in the current doctoral research was to identify how symptoms may fluctuate from day to day, with daily OSTRC questionnaire reporting anticipated to provide a greater understanding of the progression and development of overuse injuries, potentially enhancing the sensitivity of the measure to recognise early overuse concerns in ballet.

Overuse injuries in ballet and dance have been consistently reported in the dance literature (Allen et al., 2012; Boeding et al., 2019; Gamboa et al., 2008; Sobrino et al., 2015). It was identified in Study 1 that foot pain was the most frequently reported area of soreness for dancers. This is consistent with research in ballet where the foot, ankle and lower limb were more frequently reported as sore and/or injured (Allen et al., 2012;

Gamboa et al., 2008; Prisk et al., 2008). The number of days lost from work due to injury can range from seven days to 28 days among professional dancers (Bronner et al., 2003; Byhring & Bø, 2002; Nilsson et al., 2001), with 90% of time loss due to foot and ankle injuries (Byhring & Bø, 2002). Ballet technique is intricate and dancers complete challenging sequences with high demands on their lower limbs, ankles and feet. Therefore, the use of the OSTRC questionnaire to capture early signs of overuse injury in professional ballet appears valuable to dancers to manage symptoms, seek treatment and potentially modify participation to avert exacerbating pain and soreness and the consequences of time loss injury if left unaddressed and untreated.

The five dancers in Study 1 were unable to participate due to a physical complaint on two occasions over a one-month period and recorded seven illness events that impacted participation and performance. Dancers in Study 1 did not report that they were unable to participate in full due to illness. These findings are consistent with Jeffries and colleagues (2020) who also reported that dancers missed few performances, despite injury and illness and continued training without modifications even when affected by injury and illness. Collectively, these results suggest that dancers persist with training and performance despite illness, and further exploration of the consequences of pushing through illness symptoms on health and well-being and potential subsequent injury occurrence warrant further exploration in dance. The type of illness, symptoms and diagnosis were not recorded in the App. Therefore, for future App development, it is recommended that a further prompt in the App be included to record symptomology, specific impact on training and performance and diagnosis (if a diagnosis by a medical professional has been provided) to review symptom progression across days and to review the seriousness of the illness and the impact on dancer activities.

In Study 2 (athlete comparison) a modified version of the OSTRC was incorporated to capture participation frequency categorised as full, rest, modified and unable to participate. The ballet dancers completed the same OSTRC questionnaire components as the athlete comparison group for consistency. Dancers recorded they were unable to participate due to illness on six days over the four-months and athletes were unable to participate due to illness on two days in the four months. Again, the App did not provide an entry field for dancers or athletes to explain their symptoms or record the specific diagnosis of their illness. The OSTRC questionnaire format (Clarsen et al., 2014) does not allow for such data to be recorded, thus it is recommended that the option to record symptoms and diagnosis be incorporated into App development, to profile and monitor trends over time and gain further insight into the presenting symptoms, their progression or recovery and impact on the dancer. Further, it has been recommended that further research explore the potential causes of illness onset, such as TL management, travel and lifestyle factors, as persistent illness symptoms can have a negative effect on health and performance (Jeffries et al., 2020).

Monitoring illness via a wellness App may be useful to identify risks to well-being and subsequently guide early symptom management strategies (Jeffries et al., 2020; Svendsen, Gleeson, Haugen, & Tønnessen, 2015; van Wilgen et al., 2010; Watson et al., 2017). For example, increases in training volume have been associated with an increased risk of illness in elite swimmers (Hellard, Avalos, Guimaraes, Toussaint, & Pyne, 2015) and elite junior tennis players (Novas, Rowbottom, & Jenkins, 2003). High chronic TL was found to be predictive of illness in youth soccer players, with illness risk increased by 50% as a result of weekly higher chronic TLs and increased by 54% in response to monthly higher TLs (Watson et al., 2017). Watson and colleagues (2017) proposed that the use of daily ratings of TL, wellness and illness may allow for the identification of increased risk of injury both individually and collectively in athletes. Tracking of daily impacts and influences on an athlete's holistic well-being can help to avoid consecutive days of heightened load and impaired wellness for example, which have been found to increase injury risk (Watson et al., 2017). The majority of prior research has evaluated wellness collected or aggregated on a weekly or monthly basis (Drew & Finch, 2016), however information provided by athletes on a daily basis may be useful to identify risk timelier to more efficiently guide intervention to improve athlete health. Watson and colleagues (2017) recommendations for tracking of daily impacts therefore guided the design of the current doctoral research whereby wellness, activity and participation data were entered into the App daily.

Incorporation of the OSTRC questionnaire in dance has been supported for continued use in monitoring systems with professional ballet dancers (Karreman et al., 2019) and pre-professional and professional contemporary dancers (Kenny et al., 2018) and contemporary dance students (van Winden et al., 2019). It has previously been reported by dancers using the OSTRC questionnaire that data relating to missed classes as a consequence of health issues, was important for them to reflect on for performance preparation (Karreman et al., 2019). The OSTRC questionnaire may alert dancers and medical staff to opportunities to adjust individual training and workloads by exploring the severity and participation impact recordings via the OSTRC questionnaire (Karreman et al., 2019).The preliminary findings of Study 1 and Study 2 of this doctoral research support self-monitoring methods in professional ballet and suggest ongoing use to record health problems including overuse injuries and illness through the OSTRC questionnaire. The OSTRC questionnaire may assist in the identification of the development of health problems and their associated burden for dancers, in order to detect health concerns at an early stage and provide holistic support to dancers to enhance their performance capacity (Jeffries et al., 2020; Karreman et al., 2019). Only one mental health issue could be reported into the OSTRC mental health questionnaire in van Winden and colleagues (2019) research with contemporary dance students, consequently the results could depict an underrepresentation of the mental health issues experienced. In the current research, dancers were also required to record a physical health concern they perceived as most severely impacting their participation and similarly, an underrepresentation of issues experienced may have resulted.

Findings from Study 1 support previous research that suggested that the OSTRC questionnaire could be revised to be more dance-specific, and carefully tailored to differentiate between class, rehearsal and performance to gain further insight into the work demands and subsequent injury and illness fluctuations (Karreman et al., 2019). By doing so, this may help to identify overuse injuries earlier and assist in the identification of adjustment of training and workload needs for individual dancers. Illness episodes may arise as a consequence to occupational demands and present as variations in wellness such as increased stress or fatigue (Jeffries et al., 2020; Karreman et al., 2019). Therefore, it is suggested that multidimensional impacts of well-being such as wellness, activity and illness symptoms should be explored further in dance and sport injury surveillance to assist with management, treatment, and rest strategies.

10.1.3 Wellness and work-related activity

In dance, injury incidence and work-related activity findings differ, with some researchers finding that injuries occur more frequently during performance seasons relative to when dancers are engaged in additional work-related activity (Garrick & Requa, 1993; Liederbach & Gleim, 1992; Liederbach et al., 2008; Liederbach & Richardson, 2007). Conversely, others contend that there is a greater risk of injury and higher injury incidence when new work is being learned, with repetitive rehearsal to consolidate the choreography (Bronner et al., 2003; Evans et al., 1996; Scialom et al., 2006). Manifestations of training distress may emerge if an appropriate balance between training and recovery does not exist, increasing injury risk (Grove et al., 2013). The use of a dance -specific wellness App, as piloted in Study 1 was therefore adopted for Study 2 in a comparison to professional athletes, to identify if meaningful fluctuations in wellness, relative to work-related activity were apparent, to potentially guide targeted interventions to improve overall well-being and therefore possibly reduce injury risk.

As shown in Study 2, in the context of elite sport, dancer's average wellness scores (stress, fatigue, sleep quality and quantity) were comparable to athletes, although dancers reported lower wellness averages, with poorer sleep quantity and higher stress levels compared to athletes. Not surprisingly, ballet dancers and athletes reported feeling more stressed and fatigued during performance compared to training, and these findings align with previous dance research (Chavarria-Soto & Salazar-Rojas, 2011; Liederbach et al., 2013; Noh et al., 2005). During performance periods artists tend to be highly critical of themselves and can experience persistent anxiety about their performance and the feedback from choreographers and audience observers (Chavarria-Soto & Salazar-Rojas, 2011). Small changes in concentration associated with mood, anxiety and sleep problems have been shown to account for associations between dance injuries and psychological distress (Adam et al., 2004). The preliminary findings from Study 2 suggest that stress and fatigue appear to be impacted in dancers during performance periods. These findings have important implications to further develop support structures for dancers during performance periods specifically, and for the development of stress and fatigue management strategies during these work demands where dancers wellness appears to be at risk of decline and consequently may increase the risk of injury.

Clearly defining the constructs being investigated and articulating this to the dancers/ athletes is also recommended to ensure that the wellness scores reflect wellness status accurately. For example, the term fatigue could be interpreted as physical and/or cognitive fatigue and could as be related to exhaustion as a consequence of poor sleep quality and quantity. The dancers and athletes were asked to record fatigue from a holistic perspective, encompassing all fatigue elements into one rating. Similarly, dancers and athletes were asked to record stress holistically, considering both personal stress and occupational stress. Stress can present as psychological symptoms and as physical symptoms in the body (such as muscle tension). Separating these constructs may assist athletes and dancers to better identify a numerical value that represents their fatigue and stress status to guide specific interventions and supports. The various components of stress and fatigue might require different management, support and intervention strategies, and therefore further specificity might assist medical teams in developing specific treatment goals.

Data obtained from athletes on measures of wellness in the days leading up to and proceeding matches/ performance have revealed how professional athletes think and feel toward the preparation and recovery stages of competition (Buchheit et al., 2013; Gallo et al., 2017). For example, Gallo and colleagues (2017) found that perceptions of wellness in AFL players returned to a positive state three days post-match (performance). However, the wellness items (sleep quality, stress, fatigue, mood, and muscle soreness) were combined to form an overall average wellness score, and therefore the identification of specific wellness variable fluctuations post-match were not identified, reducing the sensitivity of the wellness measure (Saw et al., 2015c). When wellness variables are monitored and analysed independently, specific trends may be identified. For example, in a case study of an AFL player, Gastin and colleagues (2013) identified in the weeks leading up to hamstring and groin injuries, the player's subjective fatigue and muscle soreness ratings appeared elevated and stress experiences encountered. These findings have important implications for future researchers and dance companies in their review of wellness data. Individual dancer monitoring may highlight concerns for potential injury risk that could be identified through the monitoring App and actioned by medical team members timely, as opposed to collating group wellness averages. Considering individual data in addition to tracking group averages may be more advantageous to the dancer and company to mitigate injury risk.

In sports with frequent competition schedules, fatigue scores have been found to return to baseline up to five days post-competition (McLellan, Lovell, & Gass, 2010), and can result in accumulative fatigue over time if not addressed and managed effectively (Chiu & Barnes, 2003). In Study 2, whilst it was identified that performance for both athletes and dancers resulted in heightened stress and fatigue, the days pre- and post-performance were not analysed to identify possible wellness fluctuations leading into and stabilising trends following performance/ competition. This was due to varying performance schedules across the different ranks of the dancers, where the days pre-and post-performance were not always consistent. For example, in a performance period some dancers performed over consecutive days, whereas others had a break between days. This could have been overcome if the dancer's wellness fluctuations were analysed individually. However, this was not considered ethical in Study 2, where all data were reported as group averages due to confidentiality requirements. Therefore, considering the group wellness averages pre- and post-performance periods was not achievable for this research, unless separated by ranks and reported as individual data, which was beyond the scope of this preliminary exploration of wellness in ballet.

In professional ballet, performances rarely occur in isolation. Dancers at TAB perform over consecutive days and weeks and frequently perform twice per day. An accumulation of fatigue may occur when the potential to recover between training and competition demands is not adequate, consequently compromising performance quality and resulting in an increased risk of injury and illness (Cunniffe et al., 2010; Meeusen et al., 2013a). The exploration of dancer's wellness during high-performance periods, and their wellness scores post-each performance and post-performance periods may therefore assist to guide early intervention strategies during these peak demands. Further, research investigating both group and individual wellness patterns and fluctuations following each performance and post-consecutive performance periods could provide valuable insight for training and performance scheduling and well-being considerations. Due to the repeated and consecutive exposure to performance demands, it may take dancers longer to return to a “more positive” wellness average, however there is currently no research to support this hypothesis.

The findings from Study 2 provide preliminary insight into the changes in wellness status for stress and fatigue, specifically during performance. Intervention by medical staff in response to alerts through the App to poor wellness may positively impact the time it takes for wellness scores to return to their baseline reference point, and subsequently decrease injury risk. Further exploration of the impacts of poor wellness on performance quality, injury risk and recovery are required, and should incorporate an analysis of the trends leading into, during and following performance to optimise preparation and recovery support initiatives.

10.1.4 Acknowledgment of holistic well-being

The stress-injury model (Andersen & Williams, 1988; Williams & Andersen, 1998) proposes an interplay between psychosocial factors such as personality, history of stressors and coping strategies/ resources and injury. When athlete’s ability to cope with stressful situations and daily events is compromised due to a lack of coping skills, resources and social support, their vulnerability to injury may be heightened (Andersen & Williams, 1988; Dawson, 2000; Downs, 2013; Wiese-Bjornstal, 2010). For example, athletes are two to five times more likely to sustain an injury when experiencing high life stress compared to athletes with low life stress (Maddison & Prapavessis, 2005). Responses to a stressful situation if extreme, may predispose dancers to be at risk of injury due to the attentional and physiological changes that accompany negative cognitive appraisals according to the stress-injury model (Andersen & Williams, 1988). Although exploring relationships between injury and well-being was beyond the scope of the current research, exploration of the stress-injury relationship in ballet warrants ongoing consideration and analysis to continue to identify and respond early and proactively to potential injury risks.

Consistent with previous research exploring monitoring systems in dance (Blevins et al. 2020; Karreman, Keizer-Hulsebosch, and Stubbe, 2019), Study 3 findings suggest that introducing monitoring systems within dance training may enable and encourage dancers to understand their individual responses to training and identify their personal recovery needs from both a physical and psychological perspective. Dancers reported a very good awareness of their physical well-being and this may be due to their frequent participation in onsite medical, physiotherapy and physical management treatments, and the openness to report injury in this particular dance company.

When considering wellness, dancers in Study 3 discussed mixed interpretations of how to holistically evaluate wellness and attempted to differentiate these between work and non-work-related experiences. Dancers were encouraged by the doctorate student to consider their holistic well-being and think about both personal and occupational factors. For example, when entering a stress score, in an induction meeting with the doctorate student dancers were advised to consider stress beyond just their occupational demands, to consider daily life stress and hassles in their appraisal of their wellness linking with the stress-injury model framework. Although education was provided to dancers in relation to holistic wellness and the use of the App to potentially identify and alert fluctuations in well-being for injury risk, dancers reported that at times this was difficult for them to score holistically. Dancers reported that amalgamating wellness and numerically conceptualising this was challenging and something they were not accustomed to. Similarly, it has also been reported that athletes found responding to very broad questions relating to their well-being challenging, differing in their ability to introspect and respond accurately on an

ASRM (Saw, Main and Gastin, 2015d; Shrier et al. 2014). To address some of the challenges and apprehensions to entering wellness data as identified in Study 3, further education focusing on holistic well-being and the links between personal stressors, injury risk and performance output is required, and should be considered in future studies in both the preparation phases of App implementation and ongoing support to dancers.

In a recent study of dancers who had completed at least one year of vocational dancing and worked as a professional dancer, it was found that dancers abilities to cope with concurrent large training loads were impaired when they were confronted with major life events, academic stressors and deadlines (Blevins et al., 2019). Dancers struggled to identify coping techniques and adopted avoidant coping strategies when challenged to acknowledge their own psychological health and well-being. Avoidance motivations appear to influence an individual's ability to regulate their emotions and behaviour during stressful situations, generally leading to the experience of more negative emotions during failure (Lench & Levine, 2008). These findings are consistent with the responses provided by dancers in Study 3, where avoidance as a coping mechanism to the acknowledgment of psychological well-being was also a prevalent theme. Dancers explained difficulties in processing and acknowledging wellness scores and subsequent use of avoidance as a coping mechanism from 'confronting' experiences of consecutive poor wellness scores. If dancers avoid 'honest' reporting of particular dimensions of their wellness however because it is confronting for them to do so, the App will not be able to effectively alert dancers themselves and medical staff to potential injury risks.

These findings have important implications for the development of supports for dancers when entering data into wellness Apps. The frequency of wellness reporting and the impacts this has on dancers and athletes should be considered in the development of monitoring Apps. It is suggested that companies provide a supportive environment for dancers to explore their psychological well-being and dancers could be educated, encouraged, and empowered to pursue help seeking behaviour in a supportive, understanding, and safe environment. Mental health attitudes, opinions and perceptions are often impacted by people close to athletes, such as their teammates, family members, athletic trainers, coaches, practitioners and the administrative environment around the athlete, and each parties' health-oriented opinions and actions can impact how an athlete will respond to challenges and whether they engage in positive help-seeking behaviour (Moreland, Coxe, & Yang, 2018). Athletes are more likely to utilise mental health services, monitoring Apps and engage in help-seeking behaviours if a supportive, encouraging and facilitating environment is provided (Moreland et al., 2018). It is therefore important to consider the dance companies organisational structure and the attitudes, opinions, and behaviors of those close to the dancer as these factors will impact whether an athlete chooses to utilise services. These concepts should be considered when implementing monitoring tools and supports with dancers to ensure that a facilitating environment is provided to encourage dancers to seek help as required for the enhancement of their health and well-being.

Furthermore, the incorporation of a mental health literacy program and mental health first aid training for all company staff and dancers could aid in the advocation of mental health services and enhanced awareness and understanding of presentations, symptoms, and how to support people with diminished mental health presentations. Upskilling through professional development training opportunities, seminars and podcasts focusing on how to approach dancers who may be experiencing mental health challenges would also be recommended to move towards a culture where help seeking behaviour and conversations around seeking help for mental health is normalised, supportive and collaborative.

10.1.5 Mindfulness

To address some of the identified themes in Study 3 such as confronting experiences entering wellness and avoidance of acknowledging wellness and psychological well-being, a mindfulness RCT was developed to explore the pracicality of mindfulness with professional ballet dancers. The RCT (Study 4) comprised an experimental group which received mindfulness and education material (MAC) and a control group which received dance specific education. Sixteen professional ballet dancers were randomly assigned into either the MAC or education group for six weekly sessions and were assessed pre-and post-intervention using the Mindfulness Inventory for Sport (MIS) and the Acceptance Action Questionnaire (AAQ-II). Within 2-weeks of the final mindfulness session, all participants completed a semi-structured interview. Findings from Study 4 suggested that dancers in the MAC group may have begun to adopt a non-judgmental attitude towards their cognitions and emotions and may have begun to refocus and regulate their attention to their professional and personal lives, tasks, and experiences. These findings suggest that incorporating elements of mindfulness training and practice prior to using the wellness App may be opportunistic, to help address the concerns dancers raised about the confronting experiences of the App when reporting poor wellness. Enhancing dancer's awareness and acceptance of their thoughts and feelings via mindfulness prior to App implementation may therefore assist dancers to record consecutive days of poor wellness into the App as opposed to engaging avoidance coping mechanisms as they reported they often did in study 3.

In considering the model of stress and athletic injury (Andersen & Williams, 1988), further investigation of a mindfulness-based program that focuses on attentional disruption/distractibility may help determine if targeting attentional processes is associated with lower injury risk. For example, following mindfulness intervention it has been found that athletes appraised fewer situations as stressful (Weinstein et al., 2009) and increased their abilities to focus on task-relevant stimuli (Jha et al., 2007). It is anticipated that mindfulness practice may therefore aid to reduce injury risk through changes in cognitive appraisals, stress reactions and improved attentional processes, contributing further depth of insight into the relationships between core variables of the model of stress and athletic injury (Williams & Andersen, 1998) for injury prevention, early intervention and management strategies. In Study 4, dancers discussed how they implemented mindfulness strategies and tuned into their senses, noticing the sound of the music and tuning into all of the instruments when standing side stage. They reported that the sessions and strategies helped to enhance their focus and experiences whilst performing. Injury incidence was not recorded during the RCT to identify possible reductions to occurrence and potential links to the mindfulness practice, as this was beyond the scope of the pilot study. In future research designs, exploration of injury incidence should be considered to further explore the core components of the stress and injury model in identifying possible injury prevention associations to mindfulness (Andersen & Williams, 1988).

Athletic research has indicated that mindfulness is beneficial for performance enhancement and well-being in athletes (Bernier et al., 2009; Gardner & Moore, 2012; Jouper & Gustafsson, 2013; Moore, 2009; Walker, 2013). A RCT of high performing athletes from NCAA Division I (*n*=118), demonstrated a highly significant reduction in experiential avoidance and significantly greater clinically relevant increases in coach ratings of performance in MAC participants (defined as at least 20% improvement) than participants receiving traditional PST procedures (Gardner, 2007). Study 4 incorporated self-report questionnaires and an interview with each of the participants, however, the study did not include observational ratings/ feedback/ assessment from artistic or medical staff. Furthermore, the neurobiological effects of mindfulness-based practices on stress reactivity are not well understood (Pascoe, Thompson, & Ski, 2017), therefore it is suggested that future research incorporate physiological measures of stress such as cortisol levels and autonomic measures such as resting heart rate and blood pressure in response to mindfulness practice. Incorporating objective measures that assess the physiological outcomes and markers of stress, can provide vital information about physiological compositions associated with debilitating illnesses such as anxiety and depression, to subsequently provide strong objective data to any changes that may arise with mindfulness practice as an intervention, to protect against mood disorders by regulating stress reactivity and inflammation (Pascoe et al., 2017).

A consideration of the number of mindfulness sessions and the duration of these sessions should be incorporated into intervention design to ensure that the material is effectively delivered, without burdening the dancers or athletes for continued commitment and participation. Dose-response interactions are one of the most challenging measures in meditation based research (Rusch et al., 2019). It is challenging to assess how mindful, versus mind wandering, a person is during meditation practice (Davidson & Kaszniak, 2015). Kauffman and colleagues (2011) examined intervention persistence and proposed that intervention periods of mindfulness practice longer than 4-weeks have a greater impact on an athlete's subjective development compared with short-term methodologies (Kaufman, Glass, & Arnkoff, 2009). Intervention periods examining the effects of mindfulness tend to range between five (Khoury et al., 2013) and eight weeks (Gardner & Moore, 2017), suggesting that a five week program might be sufficient to influence and explore subsequent mindfulness effects (Rusch et al., 2019). The majority of MAC RTCs appear to provide an average of seven sessions of mindfulness, as per the MAC manual (Gardner & Moore, 2004). As depicted in Table 3 (summary of athlete MAC intervention research), key athlete MAC intervention sessions ranged from 6-8 sessions, and durations ranged from 30 minutes to 90 minutes. In the current doctoral research, six sessions were delivered of approximately 30 minutes in duration. The doctoral student was cautious to include the material as per the MAC guidelines within the shorter time allowance and also careful not overwhelm the dancers by cramming too much content into each session. It is recommended that future research also align with participant availability for buy in and engagement, however, it is also important to maintain commitment to the content for effective delivery and for consistency in mindfulness practice delivery and intervention. Additionally, as highlighted in Table 3, consistency of quantitative scales and measures adopted in mindfulness research is lacking. Depending on the research objectives, researchers have adopted various measures to assess mindfulness and changes in responses between pre- and post-intervention reducing the generalisability of research findings consequently. It has been recommended therefore that to improve the quality of mindfulness research, clear and comprehensive theories and consistent measures should be adopted (Farias & Wikholm, 2016).

The use of mindfulness techniques in dance has rarely been published. The findings by Moyle (2016) are consistent with Study 4, whereby statistical significance was not reached in a nine-week mindfulness program however, a potential upward trend in awareness post-intervention was identified. Consistent with the qualitative feedback from Moyle's (2016) findings, dancers in Study 4 indicated overall that participation in the mindfulness program and the development of the associated mental skills had resulted in positive perceptions of the MAC program. Dancers reported via qualitative discussion that they valued the sessions and recommended the incorporation of both group and individual sessions to provide specific and targeted mindfulness training in addition to generic practice and strategies. The qualitative component provided further insight into the potential benefits of mindfulness practice in professional ballet, highlighting key considerations for further researchers and mindfulness intervention developments in ballet and the performing arts industry.

10.2 Limitations

Limitations for each study have been highlighted in the discussion of each paper (Chapters 5-7, 9) and in 10.1 of the discussion sections of this doctoral research. Subsequently, further limitations of the studies are discussed in the preceding section.

10.2.1 Participant sample size

At the time of data collection, there were 74 full-time professional dancers employed nationally at TAB, therefore the overall available population sample was small. Data collection for this thesis occurred during peak training and performance demands for dancers who were involved in long hours of training and vigorous performances. Although a small number of dancers volunteered to participate in the studies, collectively one-quarter of the available population was involved in the research: Study 1 *n*=5 (4% of dancers at TAB), Studies 2 and 3 *n*=14 (10% of dancers at TAB) and Study 4 *n*=16 (12% of dancers at TAB). Participation was also reliant on dancers' daily commitment to wellness reporting over the four-month period for Study 2 and Study 3, and six-weeks in the mindfulness study (Study 4). Participation in sessions outside of the required work commitments was an additional challenge of the research. Therefore, the four studies necessitated a sample of convenience, limiting sample size and statistical power.

In Study 4, the relationship between pre- and post- mindfulness constructs failed to reach statistical significance on a number of analyses, a finding that could be predominantly attributed to the small sample size. It was established via power analysis that the sample size was too small to expose if a small effect was achieved. Drawing a large sample from a relatively small population of ballet dancers (74 dancers in the whole company) was challenging, and future research would need to consider multi-centre recruitment. Despite the small sample, a diverse representation of dancers across the four studies participated in the research for example in Study 4 participant ranks included: Principal Artist (1), Senior Artist (1), Soloist (4), Coryphee (3) and Corps De Ballet (7). A further limitation of the research was with respect to the gender. Due to the limited number of males who took part in the research wellness variables could not be compared across genders. At the time of data collection there were *n*=34 male dancers and *n*=40 female dancers in the company. As traditional dance research has focussed predominately on female dancers, due to the higher participation rate in ballet, encouraging and empowering more male dancers to participate in ballet dance research is warranted. Incorporating gender as a variable in study designs and analyses may enable a more succinct analysis of the data that may highlight gender specific trends for the development of gender specific interventions and specific support programs.

As a result of limited sample sizes across the four studies, evaluating the relationship between injury, participation status (full, modified, unable, rest) and wellness fluctuations was not possible. Despite the small number of participants recruited for the research, potential evidence regarding the feasibility and efficacy of a wellness App through a pilot study, athlete comparison and qualitative exploration was provided. These findings provide a baseline for further research investigating ballet-specific wellness App development, implementation, and utilisation.

10.2.2 Athlete comparison

In Study 2, the doctoral student sought to explore dancer wellness profiles with professional athletes. The professional athletes were age-and sex- matched to dancers, however it is acknowledged that elements of their professional skills, work demands, training and competition structure differ to dancers. Activity data were collected for both groups; performance (on stage for dancers and tournaments for athletes) and training. Training intensity in terms of sRPE was not captured or compared between the two groups in the review of wellness profiles during each activity. It is also important to note that dancers at TAB had not previously engaged in wellness recording nor had they been exposed to wellness monitoring throughout their pre-professional and professional careers. The professional athletes in Study 2 however had been exposed to wellness monitoring prior to this research. The professional athletes were therefore more accustomed to wellness reporting and this may have impacted the average wellness scores reported by professional athletes, and their subsequent higher average quality of wellness when compared to dancers. The interpretation of athlete average wellness and comparability to the ballet dancers may be limited by self-report bias and questionnaire fatigue (Taylor, 2012). It is unclear whether such elements contributed to the data obtained in Study 2, and future research should continue to explore conscious and subconscious reporting (e.g., faking good) and questionnaire fatigue as potential interacting components for wellness monitoring. Study 3 provided insight into reporting bias and avoidance as a potential coping mechanism to identified decreases in wellness for dancers, and this may have also impacted the average wellness scores obtained.

Wellness was recorded in the morning before activity for both groups, however a daily structured reporting schedule across a whole day (e.g., after each activity) could provide further data that shows patterns of fluctuations that occur during days of multiple training components and demands. Dancers and athletes may feel refreshed in the morning however by midday or the evening wellness states may have reduced or heightened and may impact injury risk. Consideration of wellness at different time points throughout the day, activity durations and intensities were however not included in the current study but are recommended for future research. Nonetheless, the overall purpose of Study 2 was to explore wellness profiles within the context of elite in-season regimes and investigate the relationships between wellness and work-related activities (training and performance) in professional ballet dancers and professional athletes.

The wellness App template was designed from the sporting AMS model, with data entry conducted in the morning, consistent with other AMS and self-report wellness monitoring guidelines. In the dance population, further wellness variables could have been explored through the wellness App to provide further specificity, however for the purpose of this research and the comparison, some of the opportunities to explore wellness were limited consequently.

In Study 1, a focus group exploring the wellness App feasibility identified recommendations for further improvement and development to enhance dancer's preparation for performance and training (refer also to Chapter 5: section 5.8 Additional content: expansion of the focus group responses):

- Dancers identified that their perceptions of wellness varied throughout the day, however they only reported wellness in this research in the morning before the commencement of activity. Recording wellness data at multiple time points and following various work-related activities may provide further insights into the trends and fluctuations in wellness daily to identify reduced wellness and possible injury risk. "Even if there were a few questions on there like how you felt at the beginning of the day compared to the end of the day," for preparation and recovery monitoring.
- Another suggestion was in relation to the possibility of entering medication data. Dancers reported that if they were taking anti-inflammatories or pain relief this may impact swelling and muscle soreness recording and severity of pain ratings.
- Dancers reflected on their workloads and differing schedules and queried the impact load may have on their wellness scores. For example, one dancer suggested an option to select medium, heavy or light after each activity entered may be a good way to track load in terms of physical demands on the body and mind.

- The degree of difficulty for rehearsal performances to identify physical and psychological fatigue may assist dancers with preparation and recovery.

The above insights provide a guide for further wellness App development in ballet and dance companies however as mentioned were beyond the scope of this research to coordinate and implement.

10.2.3 Exclusive use of self-report measures

The monitoring of wellness scores was based on the dancer's self-report ratings. The data collected throughout the current research were self-report only and not supported with data from objective devices. For example, sleep-wake patterns, sleep efficacy and sleep duration have been previously recorded using an actimetry sensor in ballet (Fietze et al., 2009) and saliva, from which the stress markers cortisol (sCort) and alpha-amylase (sAA) were determined, collected prior to and after competition in addition to the completion of self-report measures with elite athletes (Mehrsafar et al., 2019). Therefore, the recording of data is based on individual interpretation only.

Confidentiality was a key priority for the company and participants in the current research. Therefore, only group averages were reported, with no individual data tracked or analysed. Analysing individual's wellness scores and changes over time may provide clarification into each dancer's well-being needs for specialised intervention and support. Monitoring individual wellness and subsequent injury and illness consequences from fluctuations may help to provide greater information to dancers and medical staff in supporting each dancer through their professional careers. Even so, the four studies provide a basis for further research to expand and explore in greater depth potential relationships for proactive management strategies and supports for enhancing the holistic well-being of individual professional dancers and athletes.

10.3 Implications and directions for future research

This section outlines key implications and recommendations elicited from the findings of the present research. These recommendations are considered in relation to i) dancers and ii) dance companies/organisations. This is then followed by a final section highlighting future research directions. The collaborative findings of the research studies in this thesis provide a clearer path for the ballet industry to develop wellness interventions and programs that promote and support dancer well-being. Implications and directions for future research have been explored in each of the research papers presented (see chapters 5-7, and 9) and in the earlier sections of the discussion.

One of the main strengths of this thesis was the high response rate and the frequency of administration of the questionnaires. It was unique that wellness, activity and participation status data were collected on a daily basis with a high response rate over a period of months. The commitment of the dancers to participate in the wellness App research over 4-months and a 6-week mindfulness intervention was a testament to the time taken by the doctoral student to develop rapport with the company dancers in attending orientation days and by frequently occupying the dancers communal break areas. The principal researcher continued to develop rapport and trust with the dancers following recruitment, with ongoing communication throughout the data collection period via in person check ins and email correspondence. Furthermore, the principal researcher spent time developing rapport with the medical team throughout the development and implementation phases of the research and subsequently earned their trust and support throughout the research studies. Collaborative development of the research aims with TAB was also a key aspect to enhance the quality of the research, commitment by TAB to support the research studies and to ensure the aims were also specific to the company's research desires and needs.

10.3.1 Implications for dancers

The findings generated from this research support the use of a wellness App in professional ballet. The wellness App was found to be useful, quick to complete, enhanced awareness of wellness and psychological health and provided an opportunity for dancers to reflect on their preparation and recovery wellness states. Results indicate that dancers are physically in tune with their bodies and at TAB dancers have access to a multi-disciplinary team of medical professionals who guide and support the dancers through pain management and injuries. A culture of fear, avoidance, and stigma regarding injuries has been deeply ingrained within the dance industry (Jacobs et al., 2017), however, it appears that TAB has addressed some of these barriers in seeking treatment for physical pain, soreness, and injury via the onsite support of the multi-disciplinary team and confidence building initiatives to seek medical assistance.

Whilst the dancers have access to psychologists via EAP and a sport psychologist available at different times throughout the week, it was apparent that for many of the dancers who participated in this research, acknowledging wellness and holistic well-being was "not at the forefront of their minds." These findings support the challenges dancers may have utilising a wellness App if implemented companywide and this is an important consideration for further development of the App, in order to guide implementation processes. For the App to be effective in capturing fluctuations and changes in wellness, it is important that dancers are confident in accurately rating their wellness so that any deviations can be addressed and managed. The interviews in Study 3 provided the opportunity to explore multiple perspectives around the use of the App and the experiences entering wellness data, which illuminated avoidance coping styles. Dancers reported avoidance coping styles with poor wellness states, and consequently sometimes altered their wellness rating, as it was identified that consecutive poor wellness was confronting for the participants. Consistent with recommendations by Hopper and colleagues (2020) for effective implementation of dancer monitoring initiatives, the current doctoral research also advocates that open communication, feedback and transparency be incorporated into the implementation design and for dancer engagement in the development process to ensue, to enhance the perceived value of the monitoring process for dancers for ongoing and sustained use.

Mindfulness has been found to significantly reduce experiential avoidance (which is the effort to avoid the experience of uncomfortable internal states) in athletes (Gardner, 2007). The incorporation of mindfulness practice in Study 4 was reported by dancers to be helpful in enhancing their awareness of psychological well-being. For professional ballet dancers, the ongoing exposure to wellness reporting via the App, company support and advocation of mental health and mindfulness practice to enhance awareness of holistic well-being are options that could be considered.

Ideally, the App could be incorporated into the whole company to assist dancers monitor their own preparation and recovery, and to track their daily wellness scores for proactive and early intervention strategies. Both individual and group wellness profiles should be explored by medical teams to develop specialised support structures and interventions. Study 2 provided preliminary data regarding wellness profiles in professional ballet, however the analysis of individual dancer’s wellness changes is recommended to address deviations that may pose a risk to injury for that dancer in a timely manner. By closely monitoring each dancer’s wellness via alerts to consecutive days of poorer wellness and fluctuations, a more specialised plan may be devised. Specialised care plans to support and assist dancers through challenging times, could incorporate the possibility of adjusting training schedules, referral to specialists and ongoing coordinated care. For example, if a dancer reports consecutive days of high stress, the dancer and the medical team would be alerted through the App and this process would facilitate communication between the dancer and medical team to develop a proactive management strategy. If it is identified that a dancer is experiencing heightened cognitive fatigue their support pathway and proactive interventions may differ to another dancer who is reporting heighted physical fatigue related to exhaustion for example. Therefore, interventions may be different between each dancer and tailoring the responses will be important for the dancer's progress, recovery and return to their baseline wellness average.

In considering data collectively, this approach also has potential benefits for the development of company interventions to identify trends and concerns across multiple dancer ranks and work demands. It is recommended that a single point of contact through the medical team is set up initially to review and respond to alerts to changes in wellness averages so that dancers may be able to develop rapport, trust, and have confidence that the staff member is using their wellness data by means of assisting the dancers to improve their holistic well-being as opposed to potentially being apprehensive and concerned about how their data may be used and who within the company may have access to it. The medical staff member is alerted immediately if poorer wellness is recorded for timely and efficient intervention.

10.3.2 Implications for dance companies

There are several potential consequences of ineffective implementation of ASRM. Information that is not truly reflective of the training response and wellness status of a dancer, may result in misguided management strategies (Saw et al., 2015b). Subsequently, dance companies may not be able to comprehend the potential return benefits of a wellness App if an inaccurate quality of data undermines the applicability and sustainability of the approach (Halson, 2014a). Furthermore, in dance companies where financial resources may be scarce and access to appropriate physical and psychological supports limited, it is imperative that implementation of interventions such as wellness Apps and mindfulness practice are employed to optimal effect, for sustainability of the intervention to support well-being and performance goals (Saw et al., 2015b).

Further research is warranted to understand if and how wellness monitoring may be effectively incorporated into dance companies over a long-term period. This is based on varied occupational demands such as training, rehearsal and performance and travel impacts on holistic well-being, performance output and recovery. Once a wellness monitoring App has been developed in consultation with the end-user(s) (for example dancers), medical and artistic staff, it is recommended that prior to App use, clear instruction and directions are provided to demonstrate to a dancer how to use the App and the importance of recording accurate information. It is further suggested that training sessions, co-presented with a senior member of the dance company for added credibility should focus on the importance of early intervention and proactive injury prevention approaches in sport and in ballet.

For smaller companies, different genres of dance and other professionals within the performing arts industry, an initial approach to monitoring wellness may be around the use of an online survey platform such as Survey Monkey or the Alchemer Survey platform. This approach is cost effective and easy to develop as an initial approach to collecting wellness data. From these surveys companies and performing arts institutions may be able to explore changes and fluctuations in survey responses and this might guide which wellness items are selected in the progression towards the use of an App, with a paid subscription, should funding permit this investment. Furthermore, a paper form questionnaire could be provided to dancers in a handbook to complete daily over a period of time and submitted for analysis of trends, should cost be a limiting factor to utilising an online platform. Wellness and mental health awareness brochures could be developed with worksheets and templates for dancers and performing artists to access online, posted in for example AusDance and Australian Society of Performing Arts Healthcare newsletters and dance and performing arts social media (Facebook, Twitter, Instagram) platforms. Surveys and templates could also be made available to all dancers, professional, pre-professional and freelance dancers through a central organisation, such as AusDance.

Dancers at TAB appear to have a very good relationship with the medical staff, however sharing this information may have influenced the dancer’s wellness scores and reporting accuracy if they were apprehensive to have the medical staff member alerted. TAB identified that the key to enhancing dancer’s trust and rapport was by having a consistent point of contact, Sue Mayes (Principal Physiotherapist and Medical Team Manager) who has been employed at the company full-time since 1997. Throughout her employment at the company she has spent many years gaining dancer’s trust with the support from Artistic Directors and ballet staff to encourage, support and empower dancers to report early minor complaints so that minor modifications to workloads can be negotiated and coordinated so that dancers don’t miss opportunities. For other dance companies, it is recommended that they focus on developing trust and rapport with their dancers via effective and collaborative communication. TAB published an Injury Risk Management Program (updated 2020) (TAB, 2007), advocating a multidisciplinary approach to managing a dancer’s injury involves consultation amongst team members with the aim of complete recovery and an understanding of measures to prevent recurrence. An example of the multidisciplinary approach in the case of an injured dancer is outlined below. This approach may assist other companies in the management and support of their dancers as an early intervention and supportive approach:

1. An accurate injury diagnosis is achieved through Medical &/or Physiotherapy consultation and appropriate investigations if required.
2. Short and long-term goals are set with consultation between the Dancer, Artistic Director, Artistic Health Team and Ballet Staff.

3. Management of the injury is achieved with appropriate Physiotherapy and Myotherapy treatment. Management may also involve modified workload or cessation of training or performance.

4. The Rehabilitation Physiotherapist and Strength and Conditioning Coach work together in consultation with the dancer, to devise a ballet-specific exercise program.

5. The Ballet Rehabilitation Facilitator works with the dancer in the studio in preparation for a return to class, rehearsal and performances.

6. A dancer would consult with the Welfare and Development Co-ordinator to explore career and personal development opportunities and resources and referrals to support wellbeing.

7. The Psychologist may work with the dancer to deal with any issues relate to mental health or performance that could facilitate returning to work and provide education about self-management techniques.

8. The dancer would have access to the advice and support of company Doctors throughout the process.

9. The Artistic Health Team communicate with the Artistic Director and Ballet Staff to ensure dancers' workloads are appropriate to promote injury resolution.

(TAB, 2007).

By closely monitoring each dancer's wellness via alerts a more specialised plan may be devised. Specialised care plans to support and assist dancers through challenging times, could incorporate the possibility of adjusting training schedules, referral to specialists and ongoing coordinated care, which may build trust in the dancers when recording wellness scores. Further, dancers should be provided with instructions on how to enter their wellness data and provided with strategies for identifying, acknowledging, and processing fluctuating and poorer wellness. Dancers in Study 3 acknowledged that poorer wellness was "confronting" and it was reported that at times dancers adopted avoidance coping strategies which included ignoring and adjusting their wellness scores. Hence, it would be beneficial to educate dancers about avoidant coping styles, and the associated negative consequences when this behaviour is displayed, and how it impacts an individuals health, well-being and injury risk. Furthermore, input from experienced, respected role model dancers in a company to champion the interventions being developed and implemented, could enhance commitment and interest by other dancers in the company.

Sport injury prevention measures and strategies have been found to be more effective when athletes are provided with an explanation of research findings and real-life applications and case-studies (Finch & Donaldson, 2010). Psychosocial education of athletes, coaches, and conditioning staff regarding an intervention's efficacy and worthiness has been found to increase uptake (Hrysomallis, 2007), subsequently improving compliance and multidisciplinary conformability to the measure being advocated (Timpka, Risto, & Björmsjö, 2008). Therefore, incorporating on-going awareness through monthly education modules, links to psychological growth and performance podcast materials and quarterly guest speakers may further encourage dancers to consider the impacts of their holistic well-being on their performance output. With continued promotion, exposure and discussions around holistic well-being, dancers may become more active in the process of acknowledging, recording, contextualising and acting on wellness data.

Descoteaux (2018) recommended that education about anatomy, injury prevention, and nutrition for example be implemented alongside clinical practice or in workshops to continue to support and enhance health and well-being for dancers. Accordingly, dancers at TAB are provided with evidence-based material relating to performance, recovery, pain and injury during induction sessions at the start of each year. The persistent exposure and promotion of mental health throughout the company could however be incorporated in training, rehearsal, performance and travel periods. For example, companies could promote mindfulness Apps, podcasts, and e-books to dancers to listen to whilst they are completing their strength and conditioning exercises or on their commute to training. These resources could be promoted through company online portals, posters and emails to attract attention and enhance awareness of wellness and psychological health, and in turn these methodologies could demonstrate to dancers the company's commitment to the holistic well-being of their performers.

Although the App successfully alerted the medical team manager and dancers when data entry (Study 1 and 2) was not entered, future study designs could support initiatives such as confidential one-on-one meetings with dancers to 'check in' on their psychological well-being. If companies are considering monitoring wellness data as an early intervention and preventative strategy, it is vital that the dancers feel confident and comfortable to record their data. The efficacy of an ASRM is dependent on all parties being actively engaged in the process consistently, therefore ongoing support strategies to ensure shared understanding of the role and practices of ASRM use amongst dancers and support staff is recommended in the ongoing development and implementation of wellness Apps in the performing arts industry. It is important that the follow up period to an alert of poor wellness occurs timely, within 24 hours, to support the dancer to access resources, treatment and/or to commence a conversation. The App therefore serves as a proactive measure to initiate the development of an intervention strategy efficiently, which is of benefit to both the dancer and the company in mitigating potential injury risk and also further demonstrating commitment to dancer's health and well-being.

It is also suggested that companies continue to promote, educate, and encourage dancers to focus on their mental health and well-being for optimal training and performance output and quality. This may be achieved via the implementation of wellness Apps and mindfulness interventions with younger, aspiring dancers. In pre-professional schools such as the Australian Ballet School and Victorian College of the Arts, the ongoing incorporation of these tools may assist in addressing and changing components of the ballet culture, enhancing awareness of holistic well-being, and encouraging dancers to self-reflect on their mental health and adopt positive behavioural responses. Younger dancers are evolving in an era of expansive technological advancement and their attitudes towards using a wellness App may be more open-minded and part of the 'norm' in their pre-professional journey and preparation into their potential professional career. Wellness Apps and mindfulness interventions could therefore be highly beneficial in supporting the development of future professional ballet dancers.

10.3.3 Directions for future research

A number of recommendations for future research have been highlighted within the manuscripts comprising Chapters 5-7,9 and discussed throughout the previous sections in the thesis (Chapter 10). A summary of the key directions for future research are provided below.

Explore behavioural responses to changes in wellness

Wellness Apps may identify patterns and fluctuations in wellness relative to work-related activity and demands, however further depth of data collection is suggested. It is recommended that wellness Apps be adopted for a longer duration with a greater sample size to provide more meaningful data on wellness, injury incidence and the impact on training and performance. Examination of behavioural responses to heightened stress, fatigue, soreness and poor sleep quality and quantity is required. It appears that dancers adopt avoidance coping mechanisms in response to declines in their wellness and psychological health. Exploration of dancer's coping skills, subsequent adaptive and maladaptive behaviour to declines in wellness and their willingness to seek support could be explored via further qualitative analysis and inductive content analysis to categorise the coping strategies to inform and guide interventions to address negative coping styles.

Explore recovery opportunities

It was identified that dancers stress experiences are heightened during performance periods. To investigate stress and recovery from performance periods, the Recovery-Stress Questionnaire (RESTQ-Sport) could be administered. RESTQ-Sport was designed to assess the multi-dimensional nature of stress and recovery in athletes and to enable coaches and athletes to select specific intervention strategies that might assist them avoid unplanned overtraining. For example, the RESTQ-Sport has been used to identify acute changes in athlete's stress–recovery status in the weeks leading into major championships (Kellmann et al., 2001; King et al., 2010) and during periods of intensified training (Coutts & Reaburn, 2008; Coutts et al., 2007). Each of these previous studies demonstrated that the RESTQ-Sport was able to effectively detect changes in stress and recovery in athletes in both short and longer periods (~6 months) (Filaire et al., 2001). Therefore, the incorporation of the REST-Q in subsequent dance research exploring stress, recovery and performance could be adopted. The RESTQ-Sport comprises numerous items however (long version comprises 76 items, 52 items in the short version and 36 items in the modified version) (Kellmann, 2010b) and potential questionnaire fatigue should be considered if seeking to administer such questionnaires weekly or fortnightly for a period of time. While an advantage of all questionnaires is that they are non-invasive, most established tools are often considered too lengthy to foster compliance from athletes, are non-specific, and are impractical for daily use, particularly in team sport athletes (Twist & Eston, 2005). Subsequently, customised, shortened questionnaires into athlete monitoring practices has gained momentum (Buchheit et al., 2013; Coutts & Reaburn, 2008; Gastin et al., 2013). Short wellness scales that have <1 minute completion time may be easier to implement

(Shearer et al., 2015), such as the approach adopted in Study 1 and Study 2. However, the differences in the levels of evidence for validation between psychometric tools and short, modified wellness questionnaires are important factors when considering their use in an applied setting (Shearer et al., 2015). Entering data daily in response to the same questions may be monotonous and lead to questionnaire fatigue, hence it is important that the frequency of administration balance the length of the measure (Halson, 2014a; Meeusen et al., 2013b). Consequently, further research is warranted to examine the use of shortened perceptual wellness scales in ballet and in sport. However, this line of investigation should focus on construct validity to ensure the questionnaire measures the intended domains and constructs in a rigorous, scientific manner.

Incorporate sRPE into wellness App designs

Injury can have significant physical and psychological consequences on dancers and their careers (Jeffri & Throsby, 2006; Roncaglia, 2006; Thomas & Tarr, 2009). It is recommended that future research consider the inclusion of recording training duration and intensity via sRPE to assist with load management, dancer preparation for performance and recovery strategies. Although injury incidence was beyond the scope of the studies in this doctoral research, it is recommended that injury incidence be monitored in conjunction with wellness, work-related activity and sRPE to identify possible relationships for early intervention strategies. Exploring varying wellness throughout and across workdays, and before and after certain work-activity may also provide valuable insight into a dancer’s ability to cope with the demands of training and performance. Measuring sRPE may provide coaching staff, medical staff, and individual dancers with valuable data regarding exertion and output that may help guide training and recovery strategies and interventions.

Further investigate the impacts of touring and travel

Many professional dance companies travel extensively throughout the year, and the impacts of seasonal work periods (e.g., rehearsal, international touring, national touring, performing) over the course of a year on a dancers' musculoskeletal well-being and psychological well-being is limited (Bronner & Wood, 2017). Further exploration is recommended to examine health and well-being across differing work-demands; for example, comparing touring and non-touring wellness scores and injury incidence. When touring, if dancers experience heightened stress and fatigue, and reduced sleep due to changes in their environment, specific interventions and additional supports could be implemented. Further support services and resources during extended work periods should be investigated to improve training and performance quality and recovery, for enhanced physical and psychological fitness (Fietze et al., 2009). The effects of touring could be explored via the wellness App and quantitative analysis to identify trends in wellness and injury incidence and opportunities to further support and prepare dancers for performance during these periods. A lack of external social support providers and reduced access to health professionals when travelling are anticipated, and these factors could guide well-being initiatives and preventative strategies during travelling periods to enhance holistic well-being in professional ballet.

Embed mindfulness practice into company resources and schedules

Further mindfulness and dance research is recommended to identify benefits for both performance enhancement and general health and well-being for dancers, and to assist in expanding the literature in performance settings. The incorporation of individual mindfulness sessions may also aid in identifying potential benefit of mindfulness. Specific concepts could be explored with individual dancers depending on their presentation and goals for the mindfulness sessions. In these sessions, the mindfulness material, resources and practices could be measured via questionnaires pre- mindfulness exposure and at various timepoints throughout the working relationship to identify possible changes in mindful attention, awareness, refocusing, judgement and performance quality.

The pilot MAC RCT provided a foundation for which further research can be developed in relation to holistic well-being, awareness, performance quality and ultimately to reduce injury. It is suggested that future research could explore strategies to improve self-awareness of well-being in dance and increase dancer awareness of their holistic well-being beyond their dance identity. It is recommended that at an organisational level, companies and dancers are further educated through workshops, seminars, guest speakers and podcasts about the potential implications of poor wellness on holistic well-being and performance and provided with strategies such as mindfulness, psychological skills training and behavioural- stress response techniques. It is further recommended that the skill of mindfulness practice be embedded into the dancer/ athlete schedule to promote psychological and holistic techniques for preparation and recovery. Additionally, sports organisations should also support the development of mindfulness sessions for specialised mindfulness strategies at the group and individual level and support services targeted to those dancers who require a more personalised approach.

10.4 Conclusion

This doctoral research sought to investigate wellness profiles in professional ballet, via the use of a wellness App and explored the effectiveness of a mindfulness intervention for enhancing awareness of holistic well-being in a professional ballet company. Subjective ratings of wellness (e.g., fatigue, muscle soreness, stress, sleep) appear sensitive to changes in work-demands and provide a useful tool to monitor adaptive responses to training and performance in professional ballet dancers.

Study 1, a pilot study, highlighted the feasibility of a ballet-specific wellness App with professional ballet dancers. The App captured self-reported wellness, participation in work-related activities, and injury status data and provided alerts to missing data entry points and poor wellness and injury reporting. These features facilitate a timely and proactive intervention for holistic well-being.

Study 2 investigated wellness, activity (e.g., training and performance) and participation status between professional ballet dancers and professional athletes. Similar wellness profiles relative to work-related activity of performance and training in professional dancers and athletes were found, with stress and fatigue higher in both groups during performance.

Study 3 reported the perceptions and experiences of professional ballet dancers utilising a wellness App. Ballet dancers at TAB appeared to have comprehensive awareness of pain and injury, and subsequent help-seeking behaviours through their advanced medical team. Nevertheless, results indicated that their awareness and acceptance of mental health, holistic well-being and wellness requires further intervention and support services.

Study 4 explored the pracitcality of a mindfulness intervention via a RCT with a MAC group and a control group.

Overall, results from this doctoral research recommend that dancers are provided with education, support structures and strategies for coping with fluctuating wellness. Although further exploration of mindfulness in dance is required, the current research identified that such interventions could be incorporated into company schedules to encourage the practice of mindfulness to enhance awareness and holistic health. Companies should continue to promote, educate, and encourage dancers to concentrate on their mental health and well-being for optimal training and performance output and quality. To achieve this, it is recommended that wellness Apps and mindfulness interventions also be integrated into the formal training with pre-professional aspiring dancers within dance companies. The ongoing incorporation of these tools may assist in addressing and changing components of the ballet culture, enhancing awareness of holistic well-being, and encouraging dancers to self-reflect on their mental health and adopt positive behavioural responses.

In an era of expansive technological advancement and the evolution of attitudes towards wellness Apps, the new “norm” associated with holistic well-being should form part of the pre-professional journey. Wellness Apps and mindfulness interventions will therefore be highly beneficial in supporting the development of current and future professional ballet dancers.

CHAPTER ELEVEN:

APPENDICES

12.1	**Appendix A**	**Ethics**
12.2	**Appendix B**	**Participant Information Statements (PIS)**
12.3	**Appendix C**	**Consent forms**
12.4	**Appendix D**	**Flyer seeking participants for pilot-study**
12.5	**Appendix E**	**Questionnaires**
12.6	**Appendix F**	**Interview schedules**
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12.8	**Appendix H**	**Permission to use article**

12.1 Appendix A: Ethics

12.1.1 Ethics approval Studies 1-3

The following project has been assessed as complying with the National Statement on Ethical Conduct in Human Research. I am pleased to advise that your project has been granted ethics approval and you may commence the study.

Application ID: S17-224
Application Status/Committee: Science, Health & Engineering College Human Ethics Sub-Committee

Project Title: INVESTIGATING THE RELATIONSHIP BETWEEN WELLNESS, WORK-RELATED ACTIVITIES AND INJURY IN PROFESSIONAL BALLET DANCERS.

Chief Investigator: Mandy Ruddock-Hudson

Other Investigators: Carly Harrison, Paul O'Halloran, Scott Ruddock, Ms Susan Mayes, Jillianne Cook

Date of Approval: 22/01/2018
Date of Ethics Approval Expiry: 30/11/2019

If you have any further questions, please contact the Human Research Ethics team through the following email address: humanethics@latrobe.edu.au
Warm regards,

Human Research Ethics Team
Ethics, Integrity & Biosafety, Research Office

Research Office
To Mandy Ruddock-Hudson

From SHE College Subcommittee

HEC Number S17-224

Project title Investigating the relationship between wellness, work-related activities and injury in professional ballet dancers.

Subject Modification request received from Carly Harrison dated 23.05.2018 re:
(1) Addition of focus groups
(2) Addition of semi-structured interviews

Date 27 May 2018

The SHE College Subcommittee approved the modification to this project submitted above. If this project is a multicentre project you must forward a copy of this letter to all Investigators at other sites for their records.

Please note that all requirements and conditions of the original ethical approval for this project still apply.
Should you require any further information, please contact the Human Research Ethics Team on:
T: +61 3 9479 1443| E: humanethics@latrobe.edu.au.

La Trobe University wishes you every continued success in your research.
Warm regards,

Agnes Hazi
Deputy Chair, SHE College Subcommittee

12.1.2 Ethics approval Study 4

The following project has been assessed as complying with the National Statement on Ethical Conduct in Human Research. **I am pleased to advise that your project has been granted ethics approval and you may commence the study.**

Application ID: HEC19093
Application Status/Committee: University Human Ethics Committee

Project Title: Mindfulness Acceptance Commitment (MAC) for Performance Enhancement: A randomised controlled trial for Professional Ballet Dancers

Chief Investigator: Mandy Ruddock-Hudson

Other Investigators: Scott Ruddock, Carly Harrison, Paul O'Halloran, Ms Susan Mayes

Date of Approval: 29/04/2019
Date of Ethics Approval Expiry: 29/04/2024

Should you require any further information, please contact the Human Research Ethics Team on:
T: +61 3 9479 1443| E: humanethics@latrobe.edu.au.

Warm regards,

Human Research Ethics Team
Ethics, Integrity & Biosafety, Research Office

12.2 Appendix B: Participant Information Statement

12.2.1 PIS Studies 1-3

Investigating the relationship between wellness, work-related activities and injury in professional ballet dancers.

La Trobe University in partnership with The Australian Ballet are evaluating the efficacy of an Athlete Management System (AMS) for professional dancers. This research will investigate the relationship of wellness with work-related activities and injury in active individuals (dancers and athletes). This project is a PhD research project conducted by Carly Harrison who is responsible for overseeing and conducting the study under supervision (names listed on page 3).

Aim:

The objective of this research is to explore weekly wellness profiles of professional dancers. The aim is to evaluate the association between self-reported wellness scores entered into an Athlete Management System with work related activity and injury in professional ballet compared to professional sport.

Who are we recruiting?

Professional dancers employed full time at The Australian Ballet over the age of 18 years will be recruited. Professional athletes over the age of 18 who currently enter wellness scores into an Athlete Management System (AMS) have consented to the release of their data for comparison for this research.

What is involved?

There are four tasks participants will be asked to complete:

1. We are inviting you to complete a short survey which contains demographic questions (age, sex, injury history and experience). The survey takes approximately 5 minutes to complete. All data provided will remain confidential and will be coded by the researcher.
2. You will be invited to attend an information session, approximately 15-20 minutes in duration. You will be provided with a handbook to assist with recording data into the Athlete Management System.

3. An account with a username and password will be set up. The athlete management application to record daily wellness, work-related activity and injury will be downloaded onto your smart phone, i-pad or other electronic device.

- You will record wellness (muscle soreness, fatigue, sleep quality and quantity, stress and overall wellness) in the morning every day before approximately 10.30am.
- You will record work-related activity (such as class, coaching class, rehearsal, strength and conditioning and whether you performed) and injury status (by answering a set of questions between 1 and 4 questions about your training/injury status and selecting the areas of the body from an image that are most limiting performance, if applicable) into the application daily at approximately 4.30pm.
- It is anticipated that this will take approximately 2-5 minutes in total to complete per day.

4. Interview:

- Being interviewed on one occasion at the end of data recording via the Athlete Management System, in person, on the telephone or via Skype at a location of your choice.
- The time of the interview as well as the location of the interview will be at a time convenient to the participant.
- The interview questions will seek your opinion on the applicability of The Athlete Management System for The Australian Ballet. It is anticipated that the interview will take approximately 60 minutes.
- The interview will be conducted by the Principal Investigator who is a PhD student at La Trobe University and will be audio recorded.

The data collection period for this research is 4 months, plus a 1-month familiarisation period. Five months in total.

- Project 1: (Study 1)
  To identify patterns and fluctuations in self-reported wellness, work activity and injury in professional ballet dancers, entered into an Athlete Management System.
- Project 2: (Study 2)
  To evaluate the association between self-reported wellness scores entered into an Athlete

Management System with work related activity and injury in professional ballet compared to professional sport.

Where will my data be stored and used?

Wellness, injury and activity data will be stored within the Athlete Management System (AMS) as per standard practices. The Athlete Management System has been funded by The Australian Ballet. At the end of the ten-month data collection period, data from the AMS will be exported to a spreadsheet and coded.

The spreadsheet will be coded and <u>will not include names of participants</u>. The researcher will not be able to identify any participants from the coded data. Weekly group average wellness scores will be reviewed to identify any fluctuations and patterns of change in wellness for both the athlete group and the ballet group. A comparison of the two groups (ballet and athletes) will occur to identify if ballet dancers have wellness comparable to athletes, according to work related activity and injury.

<u>Group averages</u> will be utilised in completing a final report for La Trobe University and The Australian Ballet, and in the presentation at conferences and publication in academic journals. **No individual data will be reported**. Researchers are bound to research policies and procedures and any allegations of breach or research misconduct, will be dealt with according to the La Trobe University Research Misconduct Procedures.

What will happen to my data?

The data that we collect will be stored electronically on a secure hard drive, and will only be shared between those investigators (names listed on page 3) who are directly involved with the research. As per La Trobe University guidelines, the data will be destroyed five years after the completion of the research. All hard copy documents will be stored in La Trobe University's Research Repository and all electronic files will be stored on a privately-owned laptop, owned by the Principal Researcher, which is password protected. Your data <u>will not</u> be made available to other researchers in the future for possible use in another project. You may request a summary of the collective group results at the conclusion of the study. Personal data will be provided to you if requested.

What are the potential benefits of the project?

Through undertaking this research, the findings are expected to contribute to a greater understanding of the patterns and fluctuations in wellness relative to athletic work-related activity. Recording wellness may assist in the development of early intervention strategies and programs to support athletes and dancers, which may positively influence both team and individual performance.

Adverse effects and withdrawal:

There are no disadvantages, penalties or adverse consequences for not participating in the research. There are no known risks associated with this research project and you are not expected to be subject to any harm or discomfort by participating. If you feel distressed or uncomfortable and wish to talk to someone, you can call Lifeline Australia on 13 11 14. One of the researchers is also a registered Psychologist and can refer you to services as needed.

You have the right to withdraw from active participation. Withdrawal of data can occur up to one month following data collection. You may withdraw by calling or emailing the Principal Researcher Carly Harrison (contact details included below) and completing the withdrawal form provided.

Further information:

Any questions regarding this project may be directed to the Principal Researcher, Carly Harrison listed below. **If you would like to participate in this research, please:**

- Complete and return the attached consent form and survey via email to: c.harrison@latrobe.edu.au or submit in person at the education session.

If you do not want to participate in this research, there is no further action required.

Thank-you for taking the time to read this information statement.

Carly Harrison
Principal Researcher, School of Psychology and Public Health
T: 0401 614 638
E: c.harrison@latrobe.edu.au

If you have any complaints or concerns about your participation in the study that the researcher has not been able to answer to your satisfaction, you may contact the Senior Human Ethics Officer, Ethics and Integrity, Research Office, La Trobe University, Victoria, 3086 (P: 03 9479 1443, E: humanethics@latrobe.edu.au) Please quote the application reference number (S17-224).

LA TROBE UNIVERSITY

12.2.2 PIS Study 4

<table>
<tr><td colspan="3">The research is being carried out in partial fulfilment of PhD under the supervision of
Mandy Ruddock-Hudson, Paul O’Halloran, Scott Ruddock, Susan Mayes and Jill Cook.
The following researcher will be conducting the study:</td></tr>
<tr><td>Role</td><td>Name</td><td>Organisation</td></tr>
<tr><td>Student Researcher</td><td>Carly Harrison</td><td>La Trobe University</td></tr>
<tr><td>Research funder</td><td colspan="2">This research is supported by in-kind support by La Trobe University and The Australian Ballet.</td></tr>
</table>

1. **What is the study about?**

   You are invited to participate in a well-being and performance enhancement program for professional dancers. Dancers with be provided with education relating to well-being, performance and recovery. We hope to explore weekly wellness profiles of professional dancers whilst they are participating in education training relating to performance enhancement. We aim to have at least twenty dancers participate in this study.

2. **Do I have to participate?**

   Being part of this study is voluntary. If you want to be part of the study we ask that you read the information below carefully and ask us any questions.

   If you decide you do not want to participate, this won’t affect the treatment you are currently receiving, or your relationship with La Trobe University or any other listed organisation. You can read the information below and decide at the end if you want to participate.

3. **Who is being asked to participate?**

   You have been asked to participate because:

   - You are a professional dancer employed full time at The Australian Ballet over the age of 18 years.

4. **What will I be asked to do?**

The study requires your attendance to a 30-40 minute education session once a week, for 6 weeks.

1. We are inviting you to complete a short survey which contains demographic questions (age, sex, injury history and experience). The survey takes approximately 5 minutes to complete. All data provided will remain confidential and will be coded by the researcher.

- We are inviting you to complete a set of questionnaires relating to well-being, recovery and performance. It is anticipated that the questionnaires will take approximately 15-20 minutes to complete. All data provided will remain confidential and will be coded by the researcher.
- We require you to attend 6-weekly education sessions. These sessions will be no longer than 30-40 minutes in duration. The education sessions will be presented by the Principal Investigator.

Interview:

- Being interviewed on one occasion at week 7- 8 of the study (the final week).
- The time of the interview as well as the location of the interview will be at a time convenient to the participants.
- The interview questions will seek your opinion on the applicability of education sessions for performance enhancement. It is anticipated that the interview will take a maximum 15-30 minutes.
- The interview will be conducted by the Principal Investigator who is a PhD student at La Trobe University and will be audio recorded.

Study procedure

	Assessment/task	**Study commencement**	**Week 6**	**Week 7- 8**
Procedures	**Information session**	**x**		
	Demographic information	**x**		
	Informed consent	**x**		
	Questionnaires	**x**	**x**	
	Brief interview			**x**

5. **What are the benefits?**

Through undertaking this research, the findings are expected to contribute to a greater understanding of the patterns and fluctuations in wellness for professional dancers. A well-being and performance enhancement program may further assist in the development of early intervention strategies and programs to support athletes and dancers, which may positively influence both team and individual performance.

6. **What are the risks?**

We do not foresee any risks associated with this study.

If you experience something that you aren't sure about, please contact us immediately so we can discuss the best way to manage your concerns.

Organisation	**Position**	**Telephone**	**Email**
La Trobe University	Deputy Director of Sport Exercise and Rehabilitation Registered Psychologist	9479 5607	p.ohalloran@latrobe.edu.au

If you feel distressed or uncomfortable and wish to talk to someone, you can call Lifeline Australia on 13 11 14.

7. **What will happen to information about me?**

- We will **collect** information about you in ways that <u>will not</u> reveal who you are.
- We will **store** information about you in ways that <u>will not</u> reveal who you are.
- We will **publish** information about you in ways that <u>will not</u> be identified in any type of publication from this study.
- We will **keep** your information for 5 years after the project is completed. After this time, we will destroy all of your data.

The storage, transfer and destruction of your data will be undertaken in accordance with the Research Data Management Policy https://policies.latrobe.edu.au/document/view.php?id=106/.

The personal information you provide will be handled in accordance with applicable privacy laws, any health information collected will be handled in accordance with the Health Records Act 2001 (Vic). Subject to any exceptions in relevant laws, you have the right to access and correct your personal information by contacting the research team.

8. **Will I hear about the results of the study?**

You may request a summary of the collective group results at the conclusion of the study. Personal data will be provided to you if requested.

9. **What if I change my mind?**

At any time you can choose to no longer be part of the study. You can let us know by:

1. Completing the 'Withdrawal of Consent Form' (provided at the end of this document);
2. Calling us; or
3. Emailing us

Your decision to withdraw at any point will **not** affect your relationship with La Trobe University or any other organisation listed.

10. **What happens when the study ends?**

When the study ends you will be debriefed. Group data will be provided to you once analysed and any further questions can be directed to the research team.

11. **Who can I contact for questions or want more information?**

If you would like to speak to us, please use the contact details below:

Organisation	Position	Contact	Email
La Trobe University	Student Researcher	Carly Harrison	c.harrison@latrobe.edu.au

Organisation	Position	Contact	Email
La Trobe University	Principal Researcher	Mandy Ruddock-Hudson	m.ruddock@latrobe.edu.au

Organisation	Position	Contact	Email
La Trobe University	Investigator	Paul O'Halloran	p.ohalloran@latrobe.edu.au

Organisation	Position	Contact	Email
The Australian ballet	Medical Team Manager, Principal Physiotherapist	Susan Mayes	SueM@australianballet.com.au

Organisation	Position	Contact	Email
La Trobe University	Investigator	Jill Cook	j.cook@latrobe.edu.au

Organisation	Position	Contact	Email
La Trobe University	Investigator	Scott Ruddock	s.ruddock@latrobe.edu.au

12. What if I have a complaint?

If you have a complaint about any part of this study, please contact:

Ethics Reference Number	Position	Telephone	Email
HEC19093	Senior Research Ethics Officer	+61 3 9479 1443	humanethics@latrobe.edu.au

12.3 Appendix C: Consent form

12.3.1 Consent form Studies 1-3

Title of the project: Investigating the relationship between wellness, work-related activities and injury in professional ballet dancers.

I ....… have been invited to participate in the above study, which is being conducted under the direction of Carly Harrison. I understand that while the study will be under her supervision, other relevant and appropriate persons may assist or act on her behalf. My consent is based on the understanding that the study involves the procedures as explained in this document.

- I have read the 'Participant Information Statement and Consent Form' and understand the general purposes, methods and requirements of the study.
- All of my questions have been answered to my satisfaction.
- I understand that the project may not be of direct benefit to me.
- I have the right to withdraw from active participation in this project at anytime and, further, to demand that data arising from my participation is not used in the research project provided that this right is exercised within four weeks of the completion of my participation in the project.
- I consent to the publishing of results from this study provided my identity is not revealed.
- I hereby voluntarily consent and offer to take part in this study.

I (*the participant*) have read (or, where appropriate, have had read to me) and understood the information above, and any questions I have asked have been answered to my satisfaction. I agree to participate in the project, realising that I may withdraw at any time. I agree that research data provided by me or with my permission during the project may be presented at conferences and published in journals on the condition that neither my name nor any other identifying information is used.

Name of Participant (block letters):

Signature:

Name of Principal Researcher (block letters): CARLY HARRISON

Signature:

12.3.2 Consent form Study 4

I (the participant) have read (or, where appropriate, have had read to me) and understood the participant information statement, and any questions have been answered to my satisfaction. I agree to participate in the study, I know I can withdraw at any time. I agree information provided by me or with my permission during the project may be included in a thesis, presentation and published in journals on the condition that I cannot be identified.

I would like my information collected for this research study to be:

☐ Only used for this specific study.

☐ I agree to have my interview audio and/or video recorded

☐ I would like to receive a copy of the results via email. I have provided my details below and ask that they only be used for this purpose and not stored with my information or for future contact.

Name	**Email (optional)**

Participant Signature

☐ I have received a signed copy of the Participant Information Statement and Consent Form to keep

Participant's printed name	
Participant's signature	
Date	

Declaration by Researcher

☐ I have given a verbal explanation of the study, what it involves, and the risks and I believe the participant has understood;

☐ I am a person qualified to explain the study, the risks and answer questions

Researcher's printed name	
Researcher's signature	
Date	

* All parties must sign and date their own signature

12.4 Appendix D: Flyer seeking participants for pilot-study (study 1)

Wellness Study

We value your input

Professional ballet and professional sport.

<u>Participation in this study will involve:</u>

- Completion of a brief demographics questionnaire;
- Daily recording of wellness, work-related activity and injury through an application on a smart phone/ipad for the duration of 2018.
- <u>This will take approximately 2-4 minutes to complete each day.</u>
- Brief interview, approximately 15-20 minutes at the end of 2018.
- Wellness measures include: fatigue, sleep quality and quantity, muscle soreness, stress and overall wellness.

- ➢ Changes in wellness scores have been found to predict injury in sports.
- ➢ The relationship in ballet is unknown.
- ➢ Findings could lead to interventions to raise awareness around holistic wellness in ballet.

Contact our investigators for further information:

Carly Harrison: T: 0401 614 638: E: c.harrison@latrobe.edu.au

Dr Sue Mayes: E: SueM@australianballet.com.au

Prof Jill Cook: E: j.cook@latrobe.edu.au

Dr Paul O'Halloran: E: p.o'halloran@latrobe.edu.au

12.5 Appendix E: Questionnaires

12.5.1 Demographics questionnaire (utilised in all 4 studies)

Sex:

- ☐ Male
- ☐ Female

Age:

Injury History:

Have you had an injury over the last 12 months that resulted in time off from dance?

- ☐ Yes
- ☐ No

If yes, what was the injury(s): (injury type and location)

How long were you unable to engage in rehearsals/performances for?

Experience:

Number of Years' experience dancing professionally:

Number of years dancing at The Australian Ballet:

Rank in the company:

- ☐ Principal artist
- ☐ Senior artist
- ☐ Soloist
- ☐ Coryphee
- ☐ Corps de ballet

12.5.2 Pre- and post- intervention questionnaire (study 4)

The statements below describe a number of things that athletes may experience just before or during their sport performance. Please place a number between 1 and 6 in the empty column below that best indicates how much each statement is generally reflective of your recent experience. There are no right or wrong answers.

1 = not at all 3 = sometimes 6 = very much

1. I am aware of the thoughts that are passing through my mind.	
2. I am able to notice the intensity of nervousness in my body.	
3. I am able to notice the sensations of excitement in my body.	
4. I am able to notice the location of physical discomfort when I experience it.	
5. I pay attention to the type of emotions I am feeling.	
6. When I become aware that I am thinking about a past performance, I criticise myself for not being focused on my current performance.	
7. When I become aware that I am angry at myself for making a mistake, I criticise myself for having this reaction.	
8. When I become aware that I am not focussing on my own performance, I blame myself for being distracted.	
9. When I become aware that I am thinking of the final result, I blame myself for not being focused on relevant cues for my performance.	
10. When I become aware that I am really upset because I am losing, I criticise myself for reacting this way.	
11. When I become aware that some of my muscles are sore, I quickly refocus on what I have to do.	
12. When I become aware that I am thinking about how tired I am, I quickly bring my attention back to what I should focus on.	
13. When I become aware that I am really excited because I am winning, I stay focused on what I have to do.	
14. When I become aware that I am tense, I am able to quickly bring my attention back to what I should focus on.	
15. When I become aware that I am not focussing on my own performance, I am able to quickly refocus my attention on things that help me to perform well.	

Below you will find a list of statements. Please place a number between 1 and 7 in the empty column below that best indicates how much each statement is generally reflective of your recent experience. There are no right or wrong answers.

1 = never true 4 = sometimes 7 = always true

1. It's OK if I remember something unpleasant.	
2. My painful experiences and memories make it difficult for me to live a life that I would value.	
3. I'm afraid of my feelings.	
4. I worry about not being able to control my worries and feelings.	
5. My painful memories prevent me from having a fulfilling life.	
6. I am in control of my life.	
7. Emotions cause problems in my life.	
8. It seems like most people are handling their lives better than I am.	
9. Worries get in the way of my success.	
10. My thoughts and feelings do not get in the way of how I want to live my life.	

12.6 Appendix F: Interview schedule

12.6.1 Studies 1 and 3

Due to the semi-structured, explorative nature of this component of the study, precise questions will not be formulated.

The interview will cover areas related to the following:

- Dancer's experiences using the application
- Dancer satisfaction
- Adherence issues
- Applicability of the Athlete Management System for The Australian Ballet
- Reviewing data – looking at the history function
- Setting reminders – functioned used? Effectiveness?
- Self-awareness:
    - Wellness
    - Injury status
    - Muscles soreness
- Areas for improvement

12.6.2 Interview schedule Study 4

The interview will cover areas related to the following:

- Dancer's experiences/ thoughts throughout – education and mindfulness
- As an introductory to mindfulness how did you find the sessions
  - Content
  - Audio clips
  - Handouts
  - discussions
- Dancer satisfaction
- Experience of mindfulness techniques such as breathing
- Self-awareness:
  - Wellness
  - Muscles soreness
  - Class/ performance/ rehearsal
- Recommendations for future education and interventions in the ballet population
- Would you recommend other dancers to do this?
- Do you think you will continue using some of the techniques?

12.7 Appendix G: Wellness App handbook

Athlete Management System (AMS)

The Australian Ballet Induction Handbook

The Australian Ballet

LA TROBE UNIVERSITY

Prepared by
Carly Harrison

Why an Athlete Management System has been constructed?

- Changes in wellness scores have been found to predict injury in sport.
- The relationship in ballet is unknown.
- Findings could lead to interventions to raise awareness around holistic wellness in ballet.

User benefits

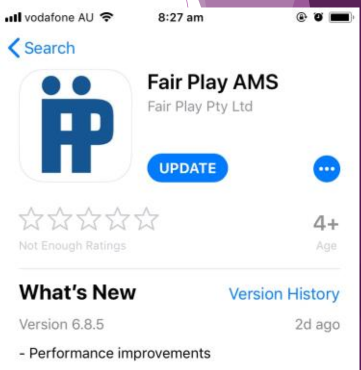
- <u>Approximately 2 minutes to complete!!</u>
  Maximum 5 minutes in total per day to record wellness, work-related activity and injury data;
- Encouraging and allowing dancers to become more active and educated in their athletic preparation and;
- Supporting dancer well-being as a means of maximising training response and performance.
- *"An AMS lets you reflect on yourself at that moment. You actually have to think about what you're doing, and all your plans, and how you're actually treating your body." Professional Athlete (Saw, 2015).*

Data entry

- Wellness and activity are to be recorded **everyday**.
- Wellness and activity can be recorded directly into the AMS via smart-phone, ipad or laptop/computer.
- You may enter your wellness and activity in private or once on-site at the company before and after classes commence.
- Reminders will be sent to you if you do not record your wellness and activity for 2 consecutive days.
- Automatic alerts will be sent to Principal Researcher (Carly Harrison) and Sue Mayes when low wellness ratings and high muscle soreness/ injury ratings are recorded. If this occurs for 3 consecutive days, a member of the Medical Team, either Sue Mayes or Sophie Emery will contact you.

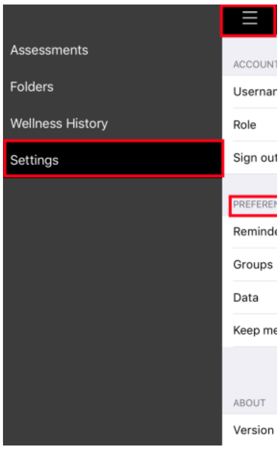
Getting started

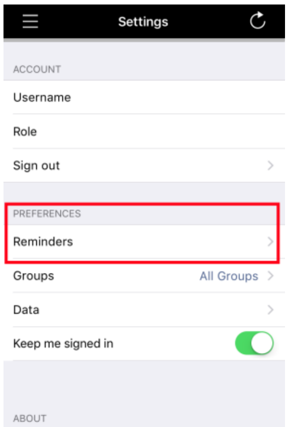
- Go to the app store on your phone and type 'FairPlay' AMS
- Once downloaded onto your phone enter the following:
  - Username: your Australian Ballet email address
  - Password: Ballet.2018



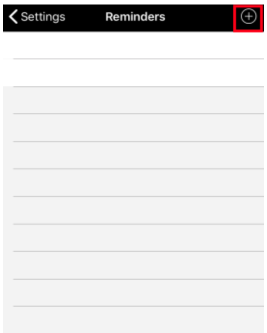
Setting reminders

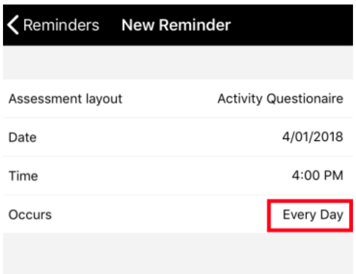
- Click on the 3 lines icon top left hand corner and select ‘**Settings.**’
- Under the ‘**Preferences**’ heading click on ‘**Reminders.**’





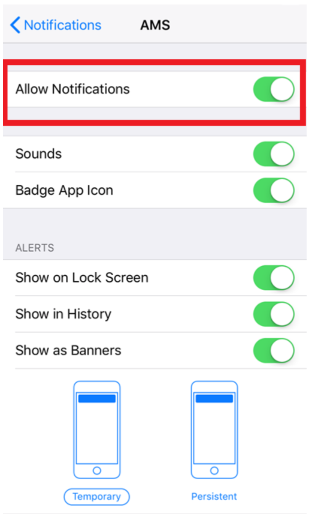
- Press the plus sign in the top right hand corner to add a reminder.
- **Complete this for <u>both</u> the Activity Questionnaire (afternoon time) AND the Wellness Questionnaire (morning time).**
- Select ‘**Save.**’





- In your <u>phone/i-pad settings</u>:

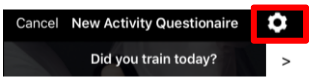
  Under ‘**notifications**’ ensure you have ‘**allow notifications**’ switched on in your notification settings.

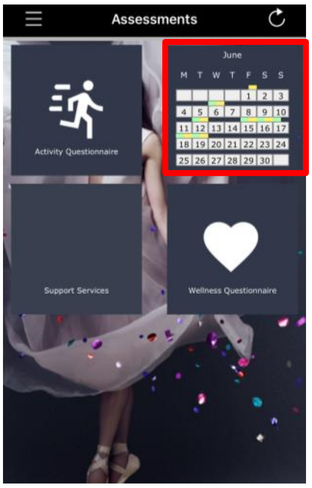


Wellness Questionnaire

It is important that you reflect on your wellness from a <u>holistic perspective</u>

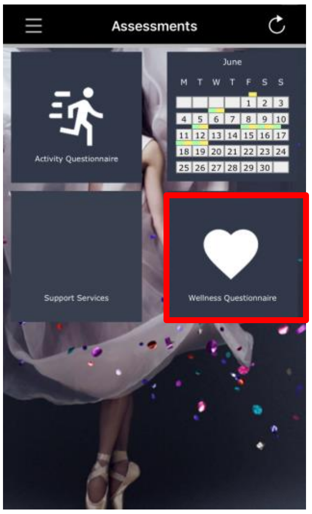
- The calendar image indicates when wellness and activity questionnaires have been completed.
- A green mark above the date indicates the wellness questionnaire has been completed.
- A yellow mark above the date indicates the activity questionnaire has been completed.
- To enter data for a previous day, select the settings icon at the start of each of the questionnaires and change the date.





- **Wellness Questionnaire:**

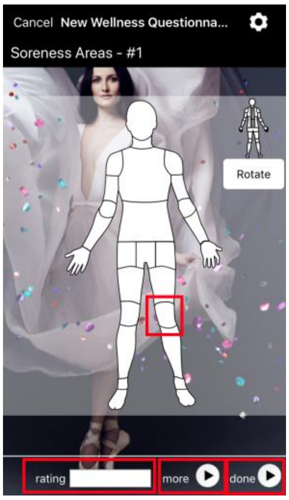
  To be completed <u>**every morning**</u> at approximately the same time each day prior to 10.30am class.

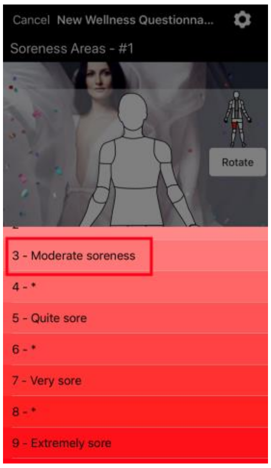


Muscle Soreness

FRONT VIEW:

- Select an area of soreness on the body.
- Enter a rating out of 10 from the drop down list of options.
- To enter additional areas of muscle soreness for the front of the body press **'more.'**

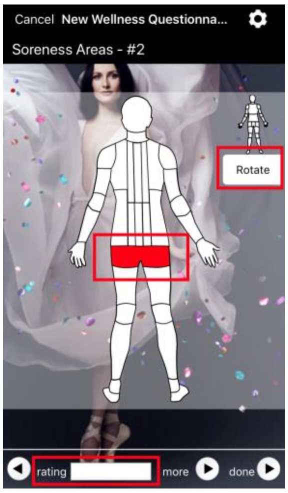




Muscle Soreness

BACK VIEW:

- Click '**rotate**' to see the back of the body.
- To enter additional areas of soreness on the back view of the body press rotate each time.
- NOTE:
  This is different to the injury region in the Activity Questionnaire.
- Click '**done**' when completed.

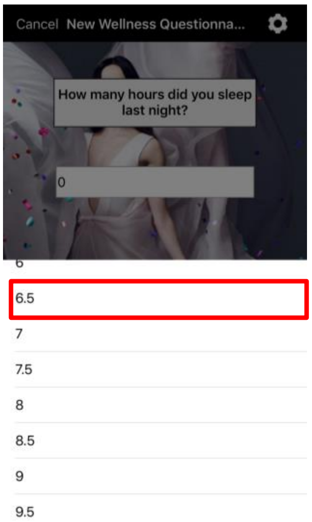


Fatigue

- Select the option that best reflects your current fatigue level.

Sleep quantity

- Select the approximate number of hours you slept last night from the drop down list.



Sleep quality

- Select the option that best reflects your sleep quality last night.

Stress

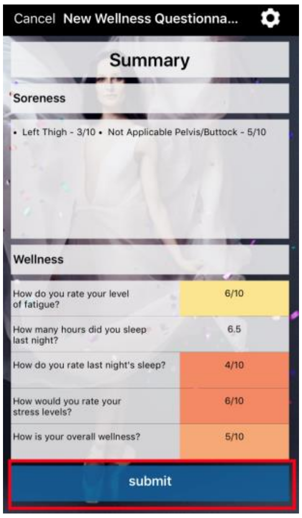
- Select the option that best reflects your current stress levels.

Overall wellness

- Select the option that best reflects your current overall wellness.

Summary

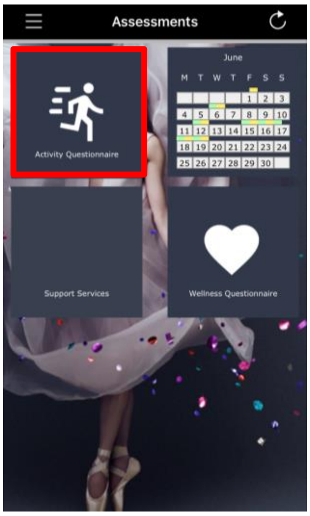
- Review your ratings.
- To change a rating on the summary page, click on the wellness option to alter.
- Click '**submit.**'



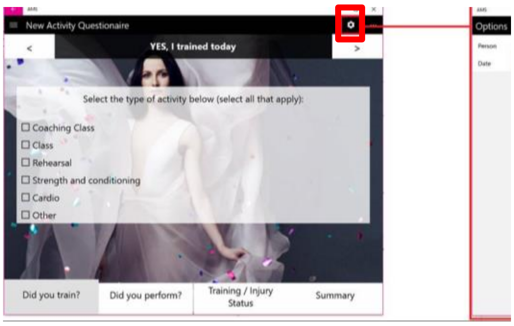
Activity Questionnaire

- **Activity Questionnaire:**

  To be completed **everyday** at the **end** of your last work-related activity (including rest days and weekends).



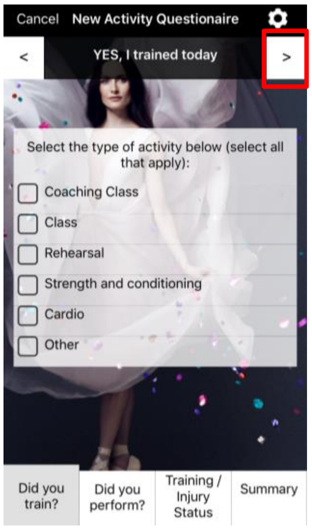
- If you need to enter activity data and it is **past midnight:**
- Choose the 'Settings' icon top right hand corner on the first page of the activity questionnaire to change the date you are entering data for.



Did you train today?

YES:

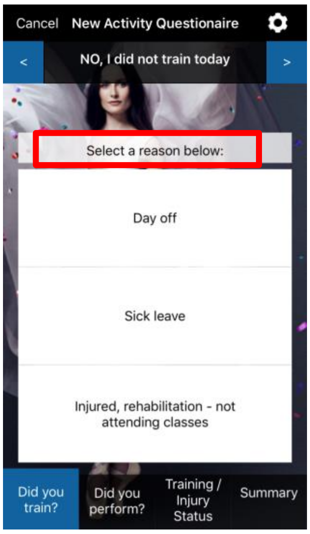
- Select the activities from the list provided.
- You can choose more than one activity.
- You can enter text after pressing other to include additional activities.
- Press > top right hand corner to go to the next screen.



Did you train today?

NO:

- Select the reason from the list provided in the next screen.



Did you perform today?

YES:

- Select whether you were on tour (interstate) or not.
- Select whether it was a double show day.

NO:

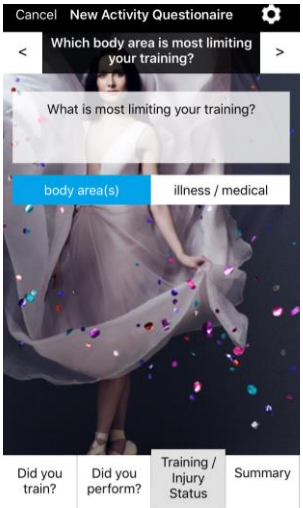
- No further action.

Training / Injury Status

- Select an option that best reflects your training status **today**.
- If you select 'full participation without injury/illness' this section will be completed.
- If you select any of the other 3 options you will be required to enter further details from the subsequent options provided.

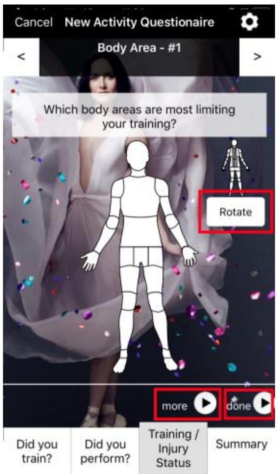
Training / Injury Status

- What is **most limiting** training?
- Select either:
  - body area(s)
  - illness/ medical



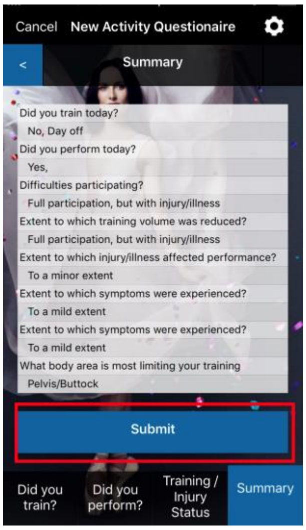
Body area:

- Click on the body area(s) most limiting performance.
- Press '**rotate**' for the back view of the body then click a body area.
- You can select multiple body areas by clicking **'more >'**
- Click '**done**' once this section is complete.



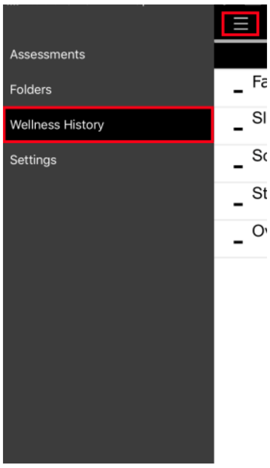
Summary

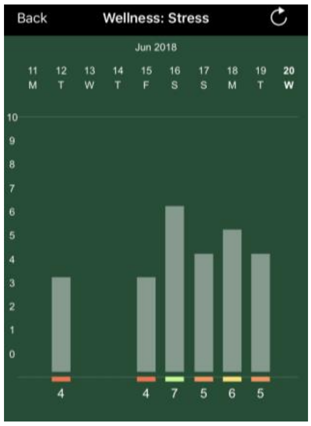
- Review your ratings.
- To change any details on the summary page, click on the option you would like to change to alter it.
- Click '**submit.**'



Wellness History

- You can review your weekly wellness history by clicking on the 3 lines icon top left corner and selecting ‘**Wellness History**.’
- Click on a wellness measure e.g. stress to view the last 10 days.





12.8 Appendix H: Permission to use article

12.8.1 Wellness monitoring for professional ballet dancers: a pilot study (study 1)

Date: 24th October 2020

RE: Harrison Ruddock O'Halloran Mayes Cook Ruddock-Hudson: Wellness Monitoring for Professional Ballet Dancers: A Pilot Study

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Wellness Monitoring for Professional Ballet Dancers

A Pilot Study

Carly Harrison, MHSc, Scott Ruddock, PhD, Paul O'Halloran, PhD, Susan Mayes, PhD, Jill Cook, PhD, and Mandy Ruddock-Hudson, MHSc, PhD

Proofs to: c.harrison@latrobe.edu.au

Abstract

Self-report wellness measures are used extensively in elite sport as valid indicators of the adaptive responses to training and performance of an athlete. Wellness parameters such as quality and quantity of sleep, muscle soreness, fatigue, and stress are monitored in professional sport via Athlete Management Systems (AMS) and self-report monitoring applications (App). However, the use of a monitoring App specifically for professional classical ballet dancers has not been tested. This study piloted a self-report App to measure wellness constructs in a professional ballet company. Three male and two female dancers volunteered to take part in the mixed-method study, entering daily wellness data, frequency of work-related activities, and injury status into an App on their smart phones. Via a focus group interview session, perceptions of wellness and experiences using the App were found to be favorable, with dancers reporting that the App enhanced awareness of their well-being. To further develop monitoring tools in professional ballet companies, it is recommended that the App be made specific to the wellness needs of dancers.

Training imposes stress on athletes, often shifting their physical and psychological well-being along a continuum that progresses from acute fatigue to overreaching, and ultimately overtraining syndrome.[1] Such disturbances may also be reflected in an increased risk of injury.[2-4] In dance-specific research, positive correlations have been reported between stress, maladaptive coping behaviors, and injury.[5-8] At any given point in time, strain on the body from the physical stress of training may combine with other psychosocial stressors to exert a negative influence on physical state, mental state, and as a consequence, ability to perform.[9] Exhaustion is the central symptom related to stress and associated with intense training and competitive demands.[10,11] Many dancers have perceived fatigue and overwork to be a major contributing factor to their injuries.[12] Once fatigued, the ability to perform movements requiring complex skill is compromised. This can lead to poor technique, faulty alignment, inefficient biomechanics, and resultant stress placed on the muscles and joints that can only be tolerated to a limited extent before injury occurs.[13]

An Athlete Self-Report Measure (ASRM) that records daily wellness can provide valuable insight into the adaptive responses of athletes when training and competing.[14] The use of self-report measures in wellness research is widespread, with 84% of surveyed high-performance sports in Australia and New Zealand incorporating a wellness self-report measure as part of their monitoring strategy.[15,16] Athlete monitoring has been found to increase the sense of accountability and subsequently improve self-management behaviors in athletes, such as taking the initiative to seek information and assistance from staff, forming better habits, and being "less likely to sit on pain and injury."[1] Furthermore, the act of completing a self-report data form has been suggested to increase athletes self-awareness and ownership of their training, which may, in turn, lead to better training and performance-related behaviors.[1,17,18]

Athlete monitoring Apps have been implemented in many professional sports[14,15,19,20] and have provided coaches and medical staff with data that may assist with prescribing and adjusting training load, thus optimizing adaptation and performance while reducing the risk of overtrain-

Carly Harrison, MHSc, Scott Ruddock, PhD, Paul O'Halloran, PhD, and Mandy Ruddock-Hudson, MHSc, PhD, School of Psychology and Public Health, College of Science, Health and Engineering, La Trobe University, Victoria, Australia. Susan Mayes, PhD, The Australian Ballet, Southbank, Victoria, Australia. Jill Cook, PhD, School of Allied Health, College of Science, Health and Engineering, La Trobe University, Victoria, Australia.

Correspondence: Carly Harrison, MHSc, School of Psychology and Public Health, College of Science, Health and Engineering, La Trobe University, 3086 Victoria, Australia; c.harrison@latrobe.edu.au.

https://doi.org/10.12678/1089-313X.mm.dd.yyyy

12.8.2 Self-reported wellness in training and performance:

a comparison of professional ballet dancers and professional athletes (study 2)

Date: Oct 22, 2020

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Article

Self-Reported Wellness in Training and Performance

A Comparison of Professional Ballet Dancers and Professional Athletes

Carly Harrison, MHSc,[1] Scott Ruddock, PhD,[1] Susan Mayes, PhD,[2] Jill Cook, PhD,[3] Paul O'Halloran, PhD,[1] Katia Ferrar, PhD,[2,3] and Mandy Ruddock-Hudson, PhD[1]

OBJECTIVE: In high-performance sport, the use of self-report measures is expanding. The exploration of wellness states in response to training and performance requires further investigation for professional ballet dancers and athletes. This study therefore aimed to: compare wellness scores between professional ballet dancers and athletes in training and performance; report frequency of self-reported modified participation during training and performance; and report frequency of self-reported inability to participate due to pain and illness in dancers and athletes. **METHODS:** Fourteen professional ballet dancers (mean 26 yrs, SD 2.6) and 14 sex- and age-matched professional athletes (mean 27.7 yrs, SD 2.9) recorded daily wellness (fatigue, stress, sleep quality and quantity), participation (full, rest, modified, or unable to participate) and activity (performance, training) into a wellness application on their smart phone over a 4-month period. Mixed factorial ANOVAs were conducted to assess the interaction between group (ballet dancers and athletes) and activity (performance and training) on the dependent variables (stress, fatigue, sleep quality, and sleep quantity). **RESULTS:** Stress and fatigue levels were higher for both dancers and athletes during performance compared to training periods. Dancers recorded lower sleep quantity than athletes, with no difference in sleep quality. Modified participation appears more common in dancers compared to athletes. Dancers and athletes were rarely unable to train or perform/compete over the 4 months. **CONCLUSION:** Self-reported wellness scores appear sensitive to activity type and can provide valuable information to guide intervention and recovery strategies. Further research on the impact of poor wellness on performance, illness, and injury in professional ballet is warranted. *Med Probl Perform Art* 2020;35(4):196–201.

C. Harrison is a PhD candidate at the School of Psychology and Public Health, College of Science, Health and Engineering, La Trobe University. From the [1]School of Psychology and Public Health, College of Science, Health and Engineering, La Trobe University; [2]The Australian Ballet, Southbank; and [3]La Trobe Sport and Exercise Medicine Research Centre, School of Allied Health, College of Science, Health and Engineering, La Trobe University, Victoria, Australia.

Presented in summary at the Australian Society for Performing Arts Healthcare conference (ASPAH), Melbourne 2019, and Sports Medicine Australia (SMA) Conference, Twin Waters, Qld, 2019.

The authors declare no funding or conflicts of interest related to this study.

Address for correspondence: Carly Harrison, School of Psychology and Public Health, College of Science, Health and Engineering, La Trobe University, 3086 VIC, Australia. Tel +61 (0) 3 9479 3526. C.Harrison@latrobe.edu.au.

https://doi.org/10.21091/mppa.2020.4028

IN DANCERS, physical and mental health problems can lead to discomfort, require treatment, inhibit artistic development due to absence from dance activities (i.e. classes, rehearsals and performances) and can be career-threatening.[1–3] The physical stress of training combined with other psychosocial stressors can add strain on the body and as a consequence impact the readiness to perform.[4] An association between maladaptive coping and high levels of stress among professional dancers[5] and a relationship between coping styles and injury frequency has been reported.[6] Elite performers must be able to cope with and recover from stressors to maintain and improve performance.[7] When athletes do not receive adequate time to recover between training and competition, fatigue can accumulate which can compromise performance and increase the risk of injury or illness.[8–11] Similarly, an imbalance between training-specific stressors, psychosocial stressors and recovery activities can negatively affect physical and mental states and readiness to perform in dance.[4]

Poor sleep quantity and quality can considerably impact health and wellbeing.[12] Several studies indicate that elite athletes and dancers sleep less and have poorer sleep quality than members of the general population.[13–15] This is important given that sleep is suggested to be the best recovery strategy available.[9,16] As with other markers of wellness, the quantity and quality of sleep reported in dance and its impact on training and performance requires further exploration.

Poor athlete wellbeing can increase the risk of injury and impact performance,[17–19] and monitoring athlete wellbeing is[17] common practice in high-performance

CHAPTER TWELVE:

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