Institution: Plymouth Marjon University		
Unit of Assessment: 24		
Title of case study: Enjoyable and Injury-Free Running: Evidence-Based Support for Recreational Endurance Runners		
Period when the underpinning research was undertaken: Nov 2015-Dec 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Professor Gary Shum	Professor of Biomechanics and Rehabilitation	Nov 2015 to present
Dr Alister McCormick	Senior Lecturer	Feb 2016 to present
Period when the claimed impact occurred: November 2015 - present		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact

Research at Plymouth Marjon University (PMU) has underpinned the development of new and innovative methods, in biomechanics and sports psychology, which are evidenced to significantly support novice and recreational runners engaging in endurance events. Based on the findings of the group's research, the following impacts in the areas of **understanding, quality of experience, performance outcomes, health and wellbeing, and professional practice** have been achieved:

1. Improved outcomes for recreational runners, both regionally and nationally, that include: increased understanding of running technique and race preparation; injury risk reduction; improved enjoyment, adherence, perseverance and satisfaction; and attainment of personal goals.
2. Informed and improved practice of run leaders and clinicians.
3. Developed new models for: biomechanical clinical assessment; event psychological interventions and educational workshops for recreational runners/leaders.

2. Underpinning research

Running is a popular sport globally and the most popular in England (Statista, 2020). Running is proven to have significant health and wellbeing benefits but knowing how to run with the correct technique, being prepared, enjoying running, and staying motivated are crucial for continuation (NHS, 2020). To holistically support continued adherence and satisfaction of recreational endurance runners, the underpinning, multidisciplinary research involved collaboration between two teams within the Resilience and Human Performance Group: Biomechanics and Rehabilitation; Sport and Exercise Psychology.

2.1. Improving running gait reduces risk of injury

Despite the benefits, the increasing popularity of distance running (Run Britain, 2015) has been accompanied by an increase in running-related injuries, particularly for novice long-distance runners (NHS, 2018). Lower limb injuries not only place a physical burden on the participant but also a financial burden on both the runner and healthcare service (Runner's World, 2015). Reducing the risk of lower limb injuries can reduce these negative impacts.

Numerous studies have previously highlighted the benefits of running with a midfoot strike pattern wearing minimalist shoes for reducing risk of injury. However, our research was the first to demonstrate that following a running gait retraining programme, a transition from rearfoot to midfoot strike pattern could cause significant increases in knee joint stiffness which are linked with higher incidences of running injuries (R3.1). Our other study was also the first to be conducted in real-world settings with participants running on a natural trail. Our findings demonstrated that running with two contrasting footwear designs, either minimalist or maximalist shoes, would have insignificant effect on impact loading and footstrike patterns in habitual

rearfoot strike trail runners (R3.2). Our findings suggested that a standard gait retraining programme and minimalist footwear advice may not be effective in reducing running injury risks which are often associated with rear foot strike and maximalist shoes. An innovative gait retraining programme using visual biofeedback on instant biomechanics data and gait pattern was therefore designed to address this.

A large-scale randomised, controlled trial (N = 320) with a 12-month follow-up, was the first of its kind internationally to evaluate the effectiveness of the innovative gait retraining programme for injury-free novice long-distance runners with their current footwear (R3.3). Our research evidenced the two-week gait retraining programme was effective in significantly lowering impact loading for the novice runners (R3.3). Findings showed that the running-related musculoskeletal injury incidence was significantly much lower in the gait retraining group when compared to the control group (R3.3). The research demonstrated a 62% lower injury risk in gait-retrained recreational novice runners compared with those without any training during the 12-month follow-up period (R3.3).

2.2. Educational, psychological interventions benefit endurance participants

Three novel studies by McCormick et al. informed the delivery of psychological interventions reported in this case study. Firstly, we used qualitative research to illuminate the psychological demands experienced by a diverse sample of recreational endurance participants of different age, gender, competitive level, distance and experience (R3.4). Preceding research by others was limited to examining demands specific to select participants in specific events. Our findings highlighted that recreational endurance participants (i) can experience stress before events due to the potential for much to go wrong, (ii) can struggle to pace themselves during events, (iii) have to cope with unexpected problems during events, and (iv) struggle with exertion and pain (R3.4).

Secondly, we were the first to evaluate training in a psychological strategy (motivational self-talk) for people completing a real-life endurance event, using a randomised, controlled experiment (R3.5). The interventions were brief, involved education and practical exercises. The findings showed that people found guidance useful (e.g., for persevering and pushing harder, to cope with tough periods of the race) and continued to use it six months later (R3.5).

Thirdly, we identified ways of sharing research findings that will help endurance participants find, use and benefit from them (R3.6). We used a questionnaire that explored how 574 people who participate in events get guidance on the psychological side of their sport, and how they would prefer to receive guidance from experts. Preferred interventions included workshops, sharing expertise through endurance events, and sharing expertise with coaches (R3.6).

Together, these studies help practitioners (including ourselves) to design interventions that are informed by research and intervention users, are relevant to runners and coaches, and are accessible, practical, and beneficial.

3. References to the research

R3.1 Chan ZYS, Zhang JH, Ferber R, Shum G, Cheung RTH. (2020) The effects of midfoot strike gait retraining on impact loading and joint stiffness. *Physical Therapy in Sport,* 42, 139-45. https://doi.org/10.1016/j.ptsp.2020.01.011

R3.2 Mo S, Chan ZYS, Lai KKY, Chan PP, Wei RX, Yung PS, Shum G, Cheung RT. (2020) Effect of minimalist and maximalist shoes on impact loading and footstrike pattern in habitual rearfoot strike trail runners: An in-field study. *European Journal of Sport Science*, 1-32. https://doi.org/10.1080/17461391.2020.1738559

R3.3 Chan ZYS, Zhang JH, Au IPH, An WW, Shum GLK, Ng GYF, Cheung RTH. (2018) Gait Retraining for the Reduction of Injury Occurrence in Novice Distance Runners: 1-Year Follow-up of a Randomized Controlled Trial. *American Journal of Sports Medicine*, 46(2), 388-95. https://doi.org/10.1177%2F0363546517736277

R3.4 McCormick, A., Meijen, C., & Marcora, S. (2018). Psychological demands experienced by recreational endurance athletes. *International Journal of Sport and Exercise Psychology*,*16*(4),415-430. https://www.tandfonline.com/doi/full/10.1080/1612197X.2016.1256341

R3.5 McCormick, A., Meijen, C., & Marcora, S. (2018). Effects of a Motivational Self-Talk Intervention for Endurance Athletes Completing an Ultramarathon. *The Sport Psychologist, 32* (1), 42-50. https://doi.org/10.1123/tsp.2017-0018

R3.6 McCormick, A., Anstiss, P. A., & Lavallee, D. (2020). Endurance athletes' current and preferred ways of getting psychological guidance. *International Journal of Sport and Exercise Psychology*, 18(2), 187-200. https://doi.org/10.1080/1612197X.2018.1486874

Two reviewers, independent of and external to Plymouth Marjon University, have verified that these outputs are of at least 2* quality in terms of originality, significance and rigour.

4. Details of the impact

Our research has had significant impact on: Clinicians' and running group leaders' professional practice on injury prevention and psychological support; Runners' adherence, understanding, quality of experience (e.g., enjoyment, motivation), performance outcomes, and health and wellbeing. Diverse populations of runners (e.g., age, gender, ability level) have benefited, both regionally, nationally and internationally.

4.1. Biomechanical Support

Informed by the research findings impact has been achieved regionally and internationally, specifically:

a) Improved and informed clinical practice and provision for reducing risk of injury for military personnel

Our biomechanics research has informed and improved clinical service at the Ministry of Defence, specifically at HMS Drake, Plymouth. This large rehabilitation department consists of physiotherapists and rehabilitators who support Naval and Marine personnel back to deployment. Shum's findings informed the Ministry of Defence (MOD), in 2017, who considered this vital *"due to the high demand of running during training at the MOD, running related injuries are one of the most common injuries that affect Naval and Marine officers. These injuries are due to the high demand of long distance running which is a key component of military training. Physiotherapists and clinicians have incorporated the research findings in their running gait analysis and improved injury prevention on military of defence personnel. The research findings have improved the understanding on the importance of running gait in injury prevention and thus improved service provision. Professor Shum's research has informed our service in looking into different aspects of gait biomechanics and how to minimise the risks involved in long distance running training. We have advised a number of Naval and Marine officers in modifying their running pattern and footwear in order to minimise the risks involved in long distance running training"* (T5.1).

b) Informed development of motion capture and analysis package

During 2019, the research findings were shared and informed an externally funded International Research and Innovation Staff Exchange (RISE) programme between academia and small and medium-sized enterprises (G5.1). The research findings informed and equipped the health technology enterprise with innovative data analysis and interpretation in running motion analysis, *"Professor Shum's research enabled us to educate our clients on how to make the best use of biomechanics data in real life conditions and life sciences"* (T5.2). The research findings enabled the enterprise to develop their software in data analysis package (T5.2). This enabled them to educate their existing and future clients, from both the private and public sector, on the innovative use of biomechanical data in running gait analysis, gait re-education and thus injury prevention with their existing motion capture and analysis package (T5.2). This has also helped to increase sales growth of this motion capture and analysis package (T5.2).

c) Improved technical understanding of runners and run leaders to reduce injury risk, support adherence and attainment of personal goals

Informed by the research findings, Shum and colleagues designed a Gait Retraining Workshop and Gait Retraining Clinic. The Gait Retraining Workshops were held at the University, between 2017 and 2019 in collaboration with Redrok Event organisers, to prepare runners for the Britain's Ocean City Race Series (2017-2019). To ensure our research findings were accessible to all, the workshops were free to attend. Here the benefits of midfoot strike pattern and softer landing to reduce the risk of injury as well as how this could be achieved were shared with attendees. This enhanced runner's technical knowledge and was evidenced to incite long-term adaption and personal consideration. For example, a 60-year-old, female recreational runner stated "*Shum's research had demonstrated the benefits of concentrating on your foot placement when running to reduce the risk of becoming injured. I hadn't considered this before, but it has become a constant consideration when I am out running now*" (T5.3). This knowledge was valuable to her, informing her rehabilitation and prevented injuries moving forward, "*the workshop had immediate and long-term impacts upon me, vastly improving my technical ability, mental attitude and overall experience of running*" (T5.3).

Based on the underpinning research findings, a running injuries prevention programme at the Sports Injury Clinic was introduced at PMU to offer affordable, evidence-based services to the local community. This was the first such clinical service offered in Plymouth to the local community. Attending runners reflected how this assisted recovery from injury and has reduced the risk of further injury "*The running gait re-education and exercises which they provided me with, improved my recovery from the injury"* (T5.3), *"Applying this advice, I immediately increased my cadence, considered my technique when running and the shin splints almost instantaneously disappeared"* (T5.4). The combination of gait retaining and sharing of the findings was evidenced to support achievement of sustainable independent practice, "*This was so important as the understanding I gained gave me the knowledge and confidence I needed to start improving my own running technique to reduce the number of injuries I was experiencing*" (T5.3) and *"the improvements are becoming second nature to me now, I feel more natural in my running and enjoy this. I have been able to completely adapt my running mechanics because of the advice I have received"* (T5.4). Runners also reported performance improvements *"The advice has made me more efficient in my running."* (T5.4) and *"As a result of changing according to the advice received, my personal best times have improved, for example I am running a half marathon over 12 minutes quicker now. This advice has helped me to particularly improve my performance when running up hill, I am a better hill runner now"* (T5.5). Similar running injuries prevention programmes have been set up with our collaborating research partners in Hong Kong and Sydney, Australia (T5.6).

4.2. Psychological Support

McCormick et al.'s research has underpinned the design of two psychological interventions: 1) mental preparation workshops; 2) 'psyching team' event interventions. These provide recreational runners with effective ways of coping with competitive, organisational, and personal stressors in endurance events. Both interventions supported recreational runners before and during completion of the Britain's Ocean City Half Marathon, 10km and 5km events in 2017-2019 (2020 events were cancelled due to COVID-19). Our underpinning research evidenced that runners required and wanted support from professionals (R3.6). As a result, we designed mental preparation workshops to meet this demand, supporting recreational runners preparing for the Britain's Ocean City events (242 sign-ups between 2017 and 2019). Research evidence relating to effective strategies (e.g., motivational self-talk) was shared via a workshop, which was free to attend at Plymouth Marjon University.

a) Pre-event workshops – Positive impacts on running experience and coaching

Runners reported that using our workshop guidance led to desirable outcomes such as improved performance, finishing an event without stopping, more performance satisfaction, greater enjoyment, and feeling in greater control e.g., "*The Mental Preparation workshop also helped me to gain even more enjoyment from running as I now focus on here and now rather than the goal at the end... I find it less stressful and can get into the 'zone' a lot easier*" (T5.3). The

workshops also impacted the coaching of the leaders of a local running group; a run group leader said, *"I have designed new ways to support my runners as a result of attending the workshop, for example: producing a handout that covers the areas addressed in the workshop"* (T5.7). They (T5.7) highlighted how our workshops provided novel, much-needed support for coaches: *"The topics covered were appropriate to me as a coach as I feel UK Athletics don't support club coaches well enough or provide extra materials for coaches specifically working with endurance runners."*

b) 'Psyching Team' presence – Positive impacts on perseverance, enjoyment, and performance

Our 'Psyching Team' attended the Plymouth 5k and 10k, and Ocean City Half-Marathon from 2017-19, providing vocal encouragement, 'High 5 stations' and motivational signs to encourage a diverse population of runners during the events. As one example highlighted by RedRok Events, runners we supported at the 2019 10k were diverse in gender, age and club affiliation (T5.8). Data collected by the event organisers from the 2019 Ocean City Half-Marathon, showed that 86% of runners (*n*=818) reported the encouragement provided by the 'Psyching Team' helped them to keep running e.g., "*They were so positive and so encouraging; they really helped me to keep going and keep smiling!"* 87% of runners reported that the encouragement helped them to enjoy the event e.g., "*They make the race more special!*"; and *"Always lovely to see a smiling face cheering you on, the high fives and signs offer motive to carry on and a reminder that you're there to have fun on the day. The students are all really friendly and motivating and I feel it's a really fun, unique aspect of the race that makes it a step above other races I've run!"*.

Survey data from the 2019 Plymouth 10k (T5.8) reflected similar results, reporting 91% of runners (*n*=367) found the encouragement provided by the 'Psyching Team' helped them to keep running e.g., "*there were times I was going to start to walk but through their encouragement I kept running*"; and *"They gave motivational support which kept me going to the finish."* 92% reported that the encouragement helped them to enjoy the event e.g., *"Great for the morale of tired runners. Made an enjoyable event even more enjoyable.*" Some runners reported that the motivational boosts led to them achieving desirable performance outcomes, including 'personal best' times e.g., *"They made such a huge difference to my enjoyment of the day and helped me to achieve a finish time I could only dream of before the race."* The event organisers, RedRok, similarly recognised our impact on the quality of experience of the runners: *"As an organisation we have recognised the significance and relevance of Plymouth Marjon's research to us and our customers. Our event survey indicates how the interventions, informed by this research have improved runner's event experiences, assisted them in overcoming challenges, helped them to persevere, to achieve personal goals and continue in the sport of running*" (T5.8).

5. Sources to corroborate the impact

Testimonials:

T5.1 Physiotherapist Testimonial: Ministry of Defence
T5.2 CEO of an International Small and Medium-sized Enterprise.
T5.3 Runner Testimonial: Mental Preparation & Biomechanics Workshops Attendee
T5.4 Client Testimonial: Running Gait Analysis Clinic
T5.5 Client Testimonial: Running Gait Analysis Clinic
T5.6 Research and Clinical Leader Testimonial from external collaborating partner, Australia
T5.7 Runner & Leader Testimonial: Mental Preparation Workshop Attendee
T5.8 RedRok Events Testimonial: Britain Ocean City Race Series

Grants:

G5.1 Research grant awarded to PMU and partnering Small Medium Enterprise as part of the European Commission Marie Skłodowska-Curie Research and Innovation Staff Exchange programme (RISE). Titled: Muscle stress relief - Grant agreement ID: 645648 (2016-2020). £117,519 was awarded to PMU, out of a total grant funding of €1,458,000. https://cordis.europa.eu/project/id/645648