STAND UP PADDLE BOARDING: AN ANALYSIS OF A NEW SPORT AND RECREATIONAL ACTIVITY.

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Faculty of Health Science and Medicine
Abstract

Stand up paddle boarding (SUP) has been described as the fastest growing sport in the world. In theory SUP possesses many facets of an ideal rehabilitative exercise. These include being performed in standing, utilising multiple muscles for stability and propulsion and performed in both dynamic and unstable environments. Advocates have reported SUPs benefits to fitness, core strength and balance, yet a review of the literature, at the time this thesis was written, found only two papers on its reported benefits. Both of these papers were found to be of poor methodological quality leaving a void in scientific research published on the sport or on SUP’s proposed benefits (Chapter 2). Consequently there is little validated information in the research literature regarding training and competition preparation and the acute and chronic effects of SUPs participation.

Due to the aforementioned lack of information, Chapter 3 aimed to explore the sport of SUP. An initial performance analysis was undertaken on an elite SUP competitive race to determine and identify key elements and attributes important to SUP. Paper 1 highlighted the importance of physiological parameters which included both aerobic and anaerobic fitness. Participants were shown to spend a majority of a race both within 80-100% of their age predicted maximal heart rate and also requiring themselves to match the speed of waves to maximise propulsion. Additionally, the importance of musculoskeletal parameters including muscular strength and endurance were highlighted by the necessity to be paddling for in excess of an hour. A high level of balance control was also found to be important due to the dynamic environment in which it is performed. Race performance analysis found only a moderate correlation (r=0.38) between distance covered and position over the line. This finding suggests that both technical and tactical factors also influence race results along with extrinsic and intrinsic variables such as swell (direction and height), water currents, wind, race line chosen by the competitor, power output of each stroke and length of stroke.

Chapter 4 explores the methodological design required to assess SUP. Paper 2 directly compares the maximal aerobic power of elite SUP athletes in tightly controlled conditions of a laboratory to field based measures. The results of this study found that laboratory based measures demonstrated a high correlation (r=0.907) to field based measures. Despite minimal research existing on the sport of SUP, comparisons were made to other similar water based sports that included canoeing, kayaking, surfing and dragon boat racing. Elite SUP athletes were found to
possess aerobic power similar to elite athletes from these listed sports of which were upper limb dominant water based sports. A pilot (Pilot Study 1) then assessed the activity of relevant muscles while stand up paddle boarding. The results of this pilot found a number of methodological challenges which included signal drop out, water protection of EMG, difficulty in establishing a true MVC and also inconsistent results due to variations in paddling technique. Alternative methods of quantifying muscle activity were then explored resulting in the utilisation of isometric endurance testing for the research to follow. Finally, ways of inferring dynamic balance ability in sport was explored for use in SUP to complete the methodological design/exploration.

Chapter 5 profiled individuals across a range of paddling SUP abilities. Paper 3 directly compared three groups which included elite SUP, recreational SUP and sedentary individuals. The results published in this publication found a significantly greater aerobic and anaerobic fitness in elite SUP when compared to both recreational SUP and sedentary controls. Trunk muscle endurance was found to be significantly higher in the elite group when compared to the recreational and control groups. Further, static and dynamic balance displayed significantly greater balance ability in the elite group when compared to both the recreational and sedentary control groups. The results of this study provided normative values for elite SUP and also showed that the sport of SUP is associated with high levels of aerobic and anaerobic fitness, trunk muscle endurance and increased levels of balance.

Chapter 6 evaluates the acute and chronic effects of SUP and presents the final paper of this thesis (Paper 4). This consisted of an intervention study in which a group of untrained individuals (n=18) were recruited for a six week training programme utilising stand up paddle boarding as the training tool. Compliance to the training was found to be high with 90.27% attendance by participants during the research. At the end of this study significant improvements in fitness, strength and self-rated quality of life were reported. Long-term follow up after a year further demonstrated improvements in these aforementioned areas and maintenance of the initial gains of the SUP training activity.

In conclusion, the results from this research provide evidence for the anecdotal claims of the benefits for participation in this new aquatic activity of SUP. Stand up paddle boarding is associated with high levels of aerobic and anaerobic fitness, core muscle strength and balance. It is an enjoyable, alternative means of training with a multitude of health and fitness benefits. This
thesis has uncovered novel data in regards to the performance aspects essential for success in SUP from a competitive aspect and also provides evidence for the positive health and fitness benefits associated with its participation.
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It is with great appreciation that I acknowledge my two supervisors for their support and guidance through the development of this thesis. To my primary supervisor, Professor Wayne Hing who was supportive of my continuation through to post graduate studies and whose experience and knowledge is truly humbling. Your ability to constantly challenge and motivate at the same time is second to none and my academic experience is richer for your participation.

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Keywords
SUP, Stand Up Paddle Boarding, Stand Up Paddle Surfing, Paddle Boarding, Profiling, Intervention.

Australian and New Zealand Standard Research Classifications (ANZSRC)
110317 - Physiotherapy.

Author’s Confirmatory Statements
The opinions expressed in this study are those of the author and do not necessarily reflect those of Bond University.
The National Statement of Ethical Conduct in Human Research (developed jointly by the National Health and Medical Research Council, Australian Research Council and the Australian Vice Chancellors Committee, March 2007) has been strictly adhered to during the conduct of this research.
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List of Abbreviations

AIHW – Australian Institute of Health and Welfare
ANOVA – Analysis of Variance
AP – Anterior to Posterior
AuSUP – Australian SUP
BF – Biceps Femoris
BMI – Body Mass Index
BOSU – Both Sides Up
COP – Centre of Pressure
EMG – Electromyography
EC – Eyes Closed
EO – Eyes Open
Eo – External Oblique
ES – Erector Spinae
Gmax – Gluteus Maximus
Gmed – Gluteus Medius
ISA – International Surfing Association
JMSUP – Jamie Mitchell Stand Up Paddle Company
LDL – Low Density Lipoprotein
HDL – High Density Lipoprotein
HR – Heart Rate
HRmax – Max Heart Rate
MF - Multifidus
ML – Medial to Lateral
MVC – Maximal Voluntary Contraction
PL – Peroneal Longus
RA – Rectus Abdominus
sEMG – Surface Electromyography
SENIAM - Surface ElectroMyoGraphy for the Non-Invasive Assessment of Muscles
SPSS – Statistical Package for the Social Sciences
SUP – Stand Up Paddle Boarding
SUPSA – Stand Up Paddle Surfing Australia
TC – Total Cholesterol
Tri – Triglycerides
QL – Quadratus Lumborum
QoL – Quality of Life
VL – Vastus Lateralis
VMO – Vastus Medialis Oblique
\( \dot{V}O_2\text{max} \) – Maximal Oxygen Consumption
\( \dot{V}O_2\text{peak} \) – Peak Oxygen Consumption
WHO – World Health Organisation
100% square – A square drawn encompassing all data points
Declaration by Author

This thesis is submitted to Bond University in fulfilment of the requirements of the degree of Doctor of Philosophy. This thesis represents my own original work towards this research degree and contains no material which has been previously submitted for a degree or diploma at this University or any other institution, except where due acknowledgement is made.

I have clearly stated the contribution of others to my thesis as a whole, including statistical assistance, data analysis, significant technical procedures, professional editorial advice, and any other original work used or reported in my thesis. The content of my thesis is the result of work I have carried out since the commencement of my research higher degree candidature and does not include material which to a substantial extent has been submitted for the award of any other degree or diploma of a university of institution of higher learning.

Ben Schram
PhD Candidate
Declaration of Co-Authored Works

The authors listed below have all approved inclusion and publication of the manuscripts contained within this thesis. Relative contributions are provided for each study.

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