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**Biomechanics of stationary exercise: An option  
for weight management**

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# **Abstract**

Children carrying excess mass have difficulty performing exercises requiring whole body movement with horizontal displacement, such as walking and running. While previous research strongly suggests that overweight children adapt their gait to accommodate for moving excess mass horizontally, very little research has investigated the biomechanical characteristics of simple exercises that focus on vertical displacement, such as stationary exercise. In addition, aquatic exercise has not been considered as an alternative solution for this population. Therefore, the purpose of this thesis was to compare the biomechanical differences between aquatic- and land-based stationary exercises in normal-weight and overweight children.

## **Methods**

This thesis involved four parts; literature review, technical note, biomechanics of land- and aquatic-based stationary exercise. The literature review includes a summary about the prevalence of paediatric obesity and its related physical dysfunction, as well as the drafted literature review manuscript on biomechanical differences in exercises overground and within shallow water. It is followed by a technical note study to examine the accuracy of the camera setup by comparing the angular kinematics collected using a recreational, low-cost sports video camera (GoPro, Inc) and commercial inertial motion sensors, in both land and water environments. Following the validation study, there are two cross-sectional studies that investigate the differences in lower extremity kinematics, spatiotemporal parameters, rate of perceived exertion (RPE) and muscle activation patterns, in normal-weight and overweight children during water- and land-based stationary exercises.

## **Results**

The literature review revealed that the previous aquatic biomechanical research is limited to aquatic gait in adults and elderly people. The lack of aquatic research in children is of great concern, as aquatic sports provide a low weight bearing activity that diminishes the likelihood of injuries in children and provides a solid foundation for physically activity throughout the lifespan.

We demonstrated that the GoPro camera derived angular velocity measurements underwater and in air are accurate when compared to data from inertial sensors and known motion of the clock's second hand and a driven limb segment model. Thus, the accuracy of thesis protocol was established.

The findings of the two cross-sectional studies demonstrated that children with excess body mass experienced significantly greater RPE and muscle activation with more extended joints during land-based stationary exercises. However, these differences diminished between groups in water with a lower RPE in overweight children and a more upright posture for both groups.

## **Conclusions**

These findings suggested that children with excess body mass may adopt a more active neuromuscular strategy and a more upright posture in order to provide greater stability and propulsion during land-based stationary exercises. Higher RPE scores could indicate a greater level of difficulty and lack of enjoyment when performing stationary exercise on land. However, these differences did not exist in water. Thus, these findings support stationary exercises in water as a desirable way to reduce functional differences and subsequently promote physical activity in overweight children.

# Preface

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# Table of Contents

<b>Abstract</b> .....	<b>i</b>
Methods .....	i
Results.....	ii
Conclusions.....	ii
<b>Preface</b> .....	<b>iii</b>
<b>Chapter 1: Introduction</b> .....	<b>1</b>
Introduction.....	1
Thesis structure and general research aims .....	4
Chapter 1: Introduction .....	5
Chapter 2: Literature Review .....	5
Chapter 3: Technical Note .....	5
Chapter 4: Stationary exercises in overweight and normal-weight children .....	6
Chapter 5: Kinematic comparison of aquatic –and land-based stationary exercises in overweight and normal-weight children .....	6
Chapter 6: Conclusion.....	6
<b>Chapter 2: Literature review</b> .....	<b>7</b>
Part 1: Summary of the prevalence of paediatric obesity, its relation to physical dysfunction and the association between obesity and physical activity .....	7
Prevalence of child obesity .....	7
Physical dysfunction of obesity .....	8
Association between obesity and physical activity/sedentary behaviour.....	11
Part 2: Biomechanical properties of shallow water aquatic exercise: a review of literature .....	12
Abstract.....	12
Introduction.....	13
Biomechanics of walking in water.....	16
Biomechanics of running in water .....	34
Biomechanics of walking backward in water .....	35
Biomechanics of non-gait exercises in water.....	38
Conclusions.....	41
Part 3: Why is aquatic exercise good for obese children? .....	42
<b>Chapter 3: Two-dimensional comparison of GoPro camera video     analysis system with inertial motion sensors for underwater and     land applications</b> .....	<b>44</b>

Abstract .....	44
Introduction.....	44
Methods .....	46
Statistical analysis.....	51
Results.....	51
Discussion and implications .....	56
Conclusion .....	57
<b>Chapter 4: Stationary exercises in overweight and normal-weight children.....</b>	<b>58</b>
Abstract.....	58
Introduction.....	59
Methods .....	62
Participants.....	62
Familiarization .....	63
Equipment setup and data collection .....	64
Experimental Protocol.....	67
Kinematic and EMG data processing.....	68
Statistical analysis.....	71
Results.....	71
Heart rate and RPE.....	71
Kinematics .....	74
EMG.....	76
Discussion.....	80
Conclusion .....	83
Statement of contribution to doctoral thesis containing publications .....	84
<b>Chapter 5: Kinematic comparison of aquatic –and land-based stationary exercises in overweight and normal-weight children..</b>	<b>85</b>
Abstract.....	85
Introduction.....	86
Methods .....	89
Results.....	93
Discussion.....	104
Conclusion .....	107
Practical Implications.....	108
Acknowledgments.....	108
Statement of contribution to doctoral thesis containing publications .....	109
<b>Chapter 6: Conclusion.....</b>	<b>110</b>

<b>References .....</b>	<b>113</b>
<b>Appendix A .....</b>	<b>138</b>
<b>Appendix B .....</b>	<b>140</b>
<b>Appendix C .....</b>	<b>142</b>
<b>Appendix D .....</b>	<b>145</b>
<b>Appendix E .....</b>	<b>146</b>
<b>Appendix F.....</b>	<b>148</b>



## List of Tables

Table 2.1. Overview studies of shallow water walking forward/backward and running .....	21
Table 3.1. GoPro camera settings. ....	47
Table 3.2. Mean (SD) angular velocity for markers and inertial motion sensors and clock's second hand, and cross-correlation analysis between angular velocity of sensors and markers in air and underwater conditions.....	54
Table 4.1. Mean ( $\pm$ SD) values for Heart Rate (60%) and Rating of Perceived Exertion scale (Borg's scale).....	73
Table 4.2. Mean ( $\pm$ SD) values for Range of motion of the ankle, knee and hip joints for stationary exercises.....	75
Table 4.3. Mean ranks of muscles' sequencing examined in the normal-weight and overweight groups during stationary exercise.....	79
Table 5.1. Values for Heart Rate (60%), Rating of Perceived Exertion scale (Borg's scale) and cadence (steps per min) for both groups and environments.....	95
Table 5.2. Means (SD) for peak sagittal plane angular displacement of lower extremity joints during stationary exercises. ....	99

# List of Figures

Figure 2.1: Biomechanical changes that occur when running underwater, compared to overground. Variables increased (up arrow), decreased (down arrow), remained unchanged (=), or had contradictory results (?) within the research.....33

Figure 3.1: (A) Camera setup. (B) Chessboard used for 2D plate calibration. (C) An analogue clock with reflective markers attached to the tail of the clock's second hand. (D) Fixed markers and sensors along the leg model.....50

Figure 3.2: Measured angular velocity on the leg model of the inertial motion sensor (continued-line) and markers (dashed-line) in air and underwater conditions. ....52

Figure 3.3: Measured angular velocity on the clock's second hand in air (dashed-line) and underwater (continued-line). ....55

Figure 4.1: Positions of the EMG electrodes and markers.....66

Figure 4.2: Schematic of: A) Stationary running; B) Frontal kick and; C) Butt Kick phases. The percentage of phase duration for each activity is represented by means  $\pm$  standard deviations within the grey bars.....70

Figure 4.3: EMG activation pattern of rectus femoris (RF), vastus lateralis (VL), gastrocnemius medialis (GAS-M), gastrocnemius lateralis (GAS-L), tibialis anterior (TA) and biceps femoris (BF) between normal weight (NW) and overweight (OW) groups (Gr) during different stationary exercises (Exe). Different letters indicate significant differences between exercises:  $b > a$ ; \* indicates significant differences between groups.....77

Figure 5.1: Comparison of phases during SR, FK, and BK cycles (%). \*Significant differences between environments ( $P < .05$ ). BK indicates butt kick; FK, frontal kick; SR, stationary running.....97

Figure 5.2: Differences in angular kinematics of lower extremities during SR, FK, and BK. Angular position (A, B, and C) and angular velocity (D, E, and F) are presented at ankle (A and D), knee (B and E), and hip (C and F) joints. \*Significant differences between groups ( $P < .05$ ). \*\*Significant differences between environments ( $P < .05$ ). BK indicates butt kick; FK, frontal kick; SR, stationary running..... 101

Figure 5.3: Typical hip-knee-ankle plot and means (SD) of the surface areas during stationary exercise phases at submaximal intensity. .... 103