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FACULTEIT GENEESKUNDE EN LEVENSWETENSCHAPPEN

master in de revalidatiewetenschappen en de kinesitherapie

Masterproef

The Impact of a Voluntary Behaviour Change on Peak Oxygen Uptake and the Ventilatory Thresholds in Sedentary People: An Explorative Trial
This trial is part of a larger study project: "Sedentarism project"

Promotor :
Prof. dr. Dominique HANSEN

Nele Willems

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie

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Acknowledgement

This Master thesis was written in context of the Master's degree program Rehabilitation Sciences and Physiotherapy at Hasselt University. I would like to thank my promotor Prof. dr. D. Hansen for giving me the opportunity to setup my own research project. I would also like to thank the following persons for their support and contribution to the measurements that were conducted in line of this study: Mrs. A. Bogaers, Dr. C. Burtin, Drs. C. Keytsman, Drs. K. Verboven, and two first Master students Emmy Eysermans and Veerle Van Oeckel who assisted with some of the baseline measurements. This study would not have been possible without the contribution of the laboratory personnel of the Jessa Hospital (Hasselt), who conducted the blood analyses for this study and the REVAL study centre (Diepenbeek), where the measurements took place.

I would like to thank the University of Hasselt for all the opportunities I received during my five year education at this institution.

Finally I would like to thank all my friends and family who supported me throughout my higher education and the rest of my life.

Kukkelbosstraat 54 3590 Diepenbeek, 06/06/2017 N.W.

Research context

Since our modern society is increasingly characterised by sedentary pursuits - in our occupational as well as in our private lives - this study, which attempts to evaluate the effect of sedentary behaviour on the cardiorespiratory fitness, seems highly relevant, because of the direct link between cardiorespiratory fitness and mortality. So far several studies have concluded that sitting during prolonged periods of time has a negative impact on health. Since the number of employees, between 20 and 65 years old, who are engaged in a sedentary job, is growing - due to our modern societal and job requirements - a clear understanding of how these sedentary pursuits relate to health in these individuals is becoming important and emerging.

Over the past several years this topic has received growing attention from policymakers and employers, since maintaining employees in good health is an important aim in decreasing work absenteeism, increasing job satisfaction and thereby avoiding their possible negative economic consequences.

The current explorative study was conducted as part of a larger study project of the University of Hasselt (UHasselt), namely: "Sedentarism Project", which will provide a longitudinal follow-up of sedentary subjects. During this longitudinal study data will be collected on musculoskeletal, cardiorespiratory, cardio-metabolic, and body composition outcomes, as well as objective measurement of the participants activity by means of accelerometers. This year a cross-sectional study was conducted in first year students of the UHasselt and in the following years, these participants will be longitudinally followed-up.

This explorative study forms a side project, for which I proposed the design. This project was proposed because the impact of sedentarism on peak oxygen consumption ($VO_{2\ peak}$) was expected to be greater in the working population as opposed to a far younger student population. The investigated student population comprised mainly first year students in rehabilitation sciences and physiotherapy, who still have active classes and tests (i.e. swimming - breaststroke and crawl - and running 10 kilometres). The design was a repeated measures design which evaluated the impact of a two month voluntary behaviour change on cardiorespiratory fitness, while maintaining a sedentary job. I recruited the participants for this study. Data acquisition was conducted by me, for the CPET I received instructions and help

from Prof. dr. D. Hansen, Drs. C. Keytsman, and Drs. K. Verboven. All DEXA scans and blood samples were performed by Mrs. A. Bogaers. Data processing was mostly carried out by me, for analysis of the accelerometer data I received help from Dr. C. Burtin. Academic writing was conducted by me.

Abstract

Background: In our modern society employees (20-65 years) are increasingly subjected to sedentary jobs. Besides these highly sedentary jobs our leisure time is increasingly characterized by sedentary pursuits. A clear understanding of how sedentary behaviour is related to health is becoming important and emerging.

Objectives: To determine the impact of sedentary behaviour during vocational and leisure time on peak oxygen consumption ($VO_{2\ peak}$) and the first and second ventilatory threshold (VT1 and VT2) in healthy subjects. To evaluate if a voluntary increase in the physical activity (PA) level, though remaining a sedentary job, has a significant impact on $VO_{2\ peak}$ and the ventilatory thresholds.

Participants: Six healthy subjects (1 female), (20-65 years; *M* = 46.17, *SD* = 18.13), who were at least two years occupationally active or following higher education (≥ 20 hours/week).

Methods: Participant were measured twice, separated by two months. During these measurements body composition, blood lipid profile and glycaemic control, as well as blood pressure and resting heart rate were assessed. All participants underwent a maximal cardiopulmonary exercise test and wore an accelerometer (3 times, during 7 days). Primary outcomes were $VO_{2\ peak}$, and ventilatory thresholds (VT1 and VT2). Descriptive statistics were provided. Baseline and follow-up measurements were compared by means of paired t-tests and Wilcoxon Signed-Ranks Tests for paired samples. Bivariate and multiple linear regression analyses were conducted to investigate the cross-sectional associations between the primary outcomes and accelerometer derived measures of PA.

Results: There was a significant increase in the VT2 at two months (p = .015; p = .043). Cross-sectional analysis revealed a significant association between the VT1 and light physical activity (LIPA) (r = .82; p =.022 in min/day and r = .91; p = .007 as %), vigorous PA (r = .76, p = .041 in min/day and r = .75, p = .043 as %) and percentage of time spent sedentary (r = -.86; p = .014), at baseline but not at follow-up.

Conclusion: Findings suggest beneficial effects of a voluntary behaviour change on cardiorespiratory fitness. Cross-sectional analyses found relations at baseline for VT1 and LIPA, vigorous PA and % sedentary time, but not at follow-up. Future studies containing larger samples are needed to verify these results.

Introduction

Our modern society is characterised by increasing sedentary pursuits, in our private, as well as in our occupational lives. Because of the rapid technological developments in the past century (Church et al., 2011), there has been a shift from many physically demanding domestic tasks to physically less demanding household appliances (Brownson, Boehmer, & Luke, 2005), and leisure time pursuits have evolved from more active to more sedentary pursuits such as television viewing, reading a book or using the computer (Brownson et al., 2005). Several studies have concluded that sitting for a prolonged time has a negative impact on health. Van der Ploeg et al. (van der Ploeg, Chey, Korda, Banks, & Bauman, 2012) reported that prolonged sitting is a risk factor for greater all-cause mortality, independent of habitual physical activity (PA), body mass index (BMI), age, race, and gender. These findings were consistent for healthy people as well as for people with pre-existent cardiovascular or metabolic disease (Dunstan, Howard, Healy, & Owen, 2012; Katzmarzyk, Church, Craig, & Bouchard, 2009). According to ACSM recommendations "adults should be active for at least 30 minutes on most days of the week, usually interpreted as five days of the week" (Church & Blair, 2009). However, adults who meet the public health recommendations for PA can still compromise their metabolic health when they sit during prolonged periods of the day (Owen, Healy, Matthews, & Dunstan, 2010). Individuals who accumulate at least 150 minutes of moderate to vigorous physical activity (MVPA) a week, but who spent the rest of the day meanly sitting, still experience significant negative consequences on their health. In fact a dose-response relationship exists between television time, and waist-circumference, systolic blood pressure, 2-hour plasma glucose, fasting plasma glucose, triglycerides, and HDL-cholesterol concentration (Owen et al., 2010).

This study will focus on the impact of sedentary behaviour during vocational pursuits and leisure time on the peak oxygen uptake ($VO_{2\ peak}$) and ventilatory thresholds in healthy individuals. This specific association has not been studied before. Furthermore $VO_{2\ peak}$ has an important prognostic value, since it is deemed to be an indicator of survival. Higher $VO_{2\ peak}$ values are associated with increased longevity.(Lee, Artero, Sui, & Blair, 2010; Myers et al., 2002). This explorative study will compare two measures of the same individuals, one before and one after an increase in the leisure time PA, while remaining the same sedentary vocational activity. The expected changes are small due to the short time interval over which

they will be measured. Changes, due to an increase in leisure time physical activity, are expected to be more pronounced in the most sedentary subjects at baseline (Warburton, Nicol, & Bredin, 2006).

Methods

Participants

Participants were prospectively recruited from 2nd of February 2017 until 17th of February 2017. Since this was an explorative trial there was no pre-set quota of participants to be reached. Participants were recruited by means of word of mouth, e-mail and flyers shared on social media (Facebook). Participants were eligible if they spent most of their days in sedentary pursuits both vocationally and in their leisure time. Inclusion criteria were: age between 20-65 years old; being at least two years occupationally active or following at least two years a higher education (at least 20 hours per week) in a job/study which entails at least 6 hours spent sitting per day - at least one month before participation in the study-; being - both vocationally and in their leisure time - highly sedentary and being motivated to make a behaviour change towards more leisure time PA on their own. Exclusion criteria were: being pregnant; having diabetes mellitus type 1 or 2; having coronary artery disease, or any condition which precludes a maximal exercise test. Al participants signed the informed consent before participation in the study. This study was conducted in context of a larger study project: "Sedentary Healthy Behaviour" from the University of Hasselt (UHasselt) which was approved by the UHasselt Ethics Committee for Medical Ethics and the Review Committee of the Jessa Hospital (Hasselt) (SHEBA project, B243201630226, 9/12/16; *Appendix 3*).

Procedure

Participants were a first time invited to the *Rehabilitation Research Centre (REVAL)* (University campus Diepenbeek, Agoralaan (building A), 3590 Diepenbeek, Belgium) from 7th of February 2017 until 28th of February 2017. During this visit, which took place between 8 and 11 AM, participants received a consent form, which they read and signed before the study began. First participants underwent a Dual Energy X-ray Absorptiometry (DEXA) scan (Delphi W (S/N 70331) Hologic Series)(Prior et al., 1997), to measure body composition: total fat mass (FM) and fat free mass (FFM) - with exception of the head -, as well as the FM and FFM per segment, likewise measures of bone mineral density (BMD) were obtained and the fat mass index (FMI)

and fat free mass index (FFMI) were calculated (Schutz, Kyle, & Pichard, 2002). Body mass (BM) and body height were measured before undergoing the DEXA scan. BM was measured to the nearest 0.1 kg on a mechanical personal scale (seca 762, Hamburg, Germany), while the participant was only wearing his/her underwear. Body height was measured to the nearest 0.1 centimetre, via a calibrated stadiometer, with the participant standing erect, feet together and looking straight ahead. Secondly, participants underwent a blood sampling, for which they had to be in fasted state to measure blood lipid profile and glucose and insulin concentrations. Two vials were collected, one containing Ethylenediaminetetraacetic acid (EDTA) to prevent blood coagulation and one for serum analysis. After the measurements the blood samples were transported to the clinical laboratory of the Jessa hospital - campus Virga Jesse- (Stadsomvaart 11, 3500 Hasselt, Belgium) for analysis. Both the blood sampling and the DEXA scan were carried out by an experienced nurse. Subsequently blood pressure and heart rate were measured simultaneously (Panasonic: Diagnostec Blood Pressure Monitor EW-BU15, Middle East & Africa FZE). Three consecutive measurements were conducted with the participant in a supine position, after being at least 5 minutes in this position. Blood pressure and heart rate were measured with an upper arm blood pressure monitor (Panasonic: Diagnostec Blood Pressure Monitor EW-BU15, Middle East & Africa FZE) which was placed around the left upper arm. Waist circumference was measured with a standardised measuring tape (Seca 201, Hamburg, Germany). During this procedure, the participant stood erect with the feet together, the examiner palpated the lower rib and the top of the iliac crest, waist circumference was measured in the middle between these two bony landmarks during a normal expiration. This procedure was conducted twice. If both values differed substantially a third measurement was conducted. After these measurements the participants were offered a standardised breakfast consisting of two soft sandwiches, one orange juice carton ('Happy day' 20 cl) and 25 grams of jam ('De Ruijter, Kleintjes extra jam'). Participants who were on daily medication were asked to take their medication at this time. During the breakfast participants were asked to fill out some questionnaires. The International Physical Activity Questionnaire (IPAQ) self-administration form for the "last 7 days" was administered, to evaluate their PA over several domains in the past 7 days (Craig et al., 2003). Thirty minutes after the participants received their breakfast, they were invited to undergo a maximal cardiopulmonary exercise test (CPET) on a cycle ergometer (eBike Basic, General Electric GmbH, Bitz, Germany)(Hansen, Dendale, Berger, & Meeusen, 2007). Before the test a resting

electrocardiogram (ECG) was made (Custo med GmbH, Ottobrunn, Germany). During the test there was a continuous ECG monitoring of the participant. $VO_{2\ peak}$, the peak heart rate (HR_{peak}), peak workload (W_{peak}), peak respiratory exchange ratio (RER_{peak}) and the ventilatory thresholds were determined. The first ventilatory threshold (VT1) was expressed as the volume of oxygen uptake versus the amount of carbon dioxide exhaled - in litre per minute (l/min) - (VO_2/VCO_2), the V-slope method (Beaver, Wasserman, & Whipp, 1986). The second ventilatory threshold (VT2) was determined by the expiratory volume (VE) with respect to carbon dioxide output (VCO_2) during CPET (VE/VCO_2), the value for VT2 was expressed in VO_2 in l/min (Davis et al., 2006; Meyer, Lucia, Earnest, & Kindermann, 2005; Neder & Stein, 2006). Ventilatory thresholds, $VO_{2\ peak}$ and RER_{peak} were calculated by the CPET software (MetaSoft, CORTEX Biophysik GmbH, Leipzig, Germany). The pulmonary gas exchange analysis was conducted with a Jaeger Oxycon device (Erich Jaeger, GmbH, Germany). Participants had to ride till exhaustion and maintain a pace of 70 revolutions per minute (rpm), if they failed to maintain 60 rpm the test was stopped. Male participants started the test at 50 Watt (W) with an increment of 25 W each minute till exhaustion was reached, for females this was 40 W and 20 W respectively (Bishop, Jenkins, & Mackinnon, 1998). If a respiratory exchange ratio (RER) of >1.10 was recorded, this was considered an indication of a maximal test. After the CPET, the participants received a triaxial accelerometer (ActiGraph GT3X) (ActiGraph GT3X, actigraphcorp, Pensacola, FL, USA)(Carr & Mahar, 2012; Kozey-Keadle, Libertine, Lyden, Staudenmayer, & Freedson, 2011) which they had to wear, around their waist, for the following 7 days, after the tests. Participants were instructed to wear the accelerometer around their waist with a belt and the device in line with the anterior superior iliac spine of their dominant leg. The participants had to wear the device during their waking hours. After the participants returned their accelerometer, the collected data were analysed (ActiLife, actigraphcorp, Pensacola, FL, USA). The chosen cut-off points to classify activities of different intensities were according to the Freedson Adult Algorithm (Freedson, Melanson, & Sirard, 1998), which were also used in previous studies. As such, sedentary time was defined as the time spent with activity registration below 100 counts per minute (cpm)(Brocklebank, Falconer, Page, Perry, & Cooper, 2015), light physical activity (LIPA) as 100 – 1951 cpm and moderate to vigorous physical activity (MVPA) as at least 1952 cpm (Healy et al., 2008). In previous studies a valid day usually contained at least 10 hours of wear time, and most studies required a minimum of 4 such valid days for inclusion in the analysis (Pedisic & Bauman, 2015).

For the purpose of the current study a day was considered valid if at least 10 hours of wear time were registered. A minimum of 5 such valid days, of which at least one weekend day, was required for inclusion in analysis. Finally participants also received a food diary, in which they were asked to register everything they ate and drank during three days, of which one weekend day. In this way data was collected of both week and weekend days. Recordings of the food diary were analysed via the website of the Dutch Food Composition Database (NEVO) (http://nevo-online.rivm.nl/), when brand name products were reported, the specific food tables were consulted. After one week participants were asked to return to the REVAL to hand in the accelerometer and the food diary. One month after the initial tests the participants were contacted for a second accelerometer trial. This trial consisted again of 7 monitoring days, on which they had to wear the device analogous to the first trial. After 7 days they returned the accelerometer. Two months after the initial tests, from 14th of April until 28th of April, the participants underwent all tests for a second time. Data obtained during these follow-up tests were analysed and compared to the first measurements.

Outcome measures

The primary outcome measures of this study were measures of cardiorespiratory fitness (CRF): the $VO_{2\ peak}$ and the ventilatory thresholds. All three primary outcome measures reflected cardiorespiratory endurance capacity, where higher values represented a greater cardiorespiratory endurance capacity. Secondary outcome measures of this study were the accelerometer data, the IPAQ - questionnaire for physical activity of the last 7 days - , the body composition: FMI, FFMI and percentage body fat (%BF), FM and FFM per body segment (upper limb, lower limb and trunk) and bone mineral density expressed by the Z-score, blood lipid profile and glycaemic control - as determined via fasting blood sampling- , blood pressure and waist circumference.

Intervention

Participants were asked to increase their habitual level of PA during the two months following the baseline measurements, while maintaining their sedentary job. To do this they did not receive a guide or schema. Participants were free to choose how they increased their level of PA, in this way they were deemed more likely to maintain their increased level of PA after the study had ended.

Data-analysis

The statistical analysis program SPSS (IBM SPSS Statistics, IBM Corporation, NY, USA) was used for statistical analyses. Baseline characteristics and the sample characteristics after two months were expressed as mean ± standard deviation (SD). Pre- and post-measurements were compared in the total sample by means of paired t-test and by means of the non-parametric Wilcoxon Signed-Ranks Test for paired samples due to the small study sample. Level of significance was set at a *p*-value of $\alpha < .05$ (two-tailed). Before the t-test was conducted the assumptions for parametric tests were checked. The normal distribution of the sample parameters was assessed by means of the Kolmogorov-Smirnov and Shapiro-Wilk analyses, homoscedasticity and normality of the residuals were evaluated by means of a scatter plot and histograms for regression analyses. The null hypothesis for the comparison tests (the paired t-test and the Wilcoxon Signed-Ranks Test for paired samples) was that there would be no difference between the means of the pre- and post-measurements ($\mu\Delta = 0$). The alternative hypothesis was that there would be a difference between the means of the pre- and post-measurements ($\mu\Delta \neq 0$). Moreover it was expected that the post-measurements would give rise to higher means as compared to the pre-measurements for the CRF outcome measures. Cross-sectional relations between the accelerometer derived measures of PA and the primary outcomes were analysed by means of bivariate and multiple linear regression. These analyses were conducted on pre- and post-measurements separately and correlations between pairs of variables of these datasets were compared. Outcomes were reported as coefficient of determination (r^2 for bivariate linear regression, and R^2 for multiple linear regression) and Pearson Correlation coefficients (r), each supported by the *p*-value of the corresponding test of significance. Via multiple linear regression analyses, an assessment was made of the independent contribution of each independent variable to predicting the value of the dependent variable. For this purpose, values of each independent variable's part correlation with the dependent variable were reported. Level of significance was set at a *p*-value of $\alpha < .05$ (two-tailed), *p*-values for Pearson correlation were one-tailed.

Results

Participants

Participants were all highly sedentary during at least one month before inclusion in the study. A total of 10 subjects signed up for participation in the study. Three subjects did not meet de set inclusion criteria and were excluded before conducting any measurements. A total of 7 participants were invited for an initial baseline measurement. After baseline measurements one subject was excluded, based on not meeting the set criteria for job related sedentary time. Thus 6 participants remained and constituted the study sample *(figure 1)*.

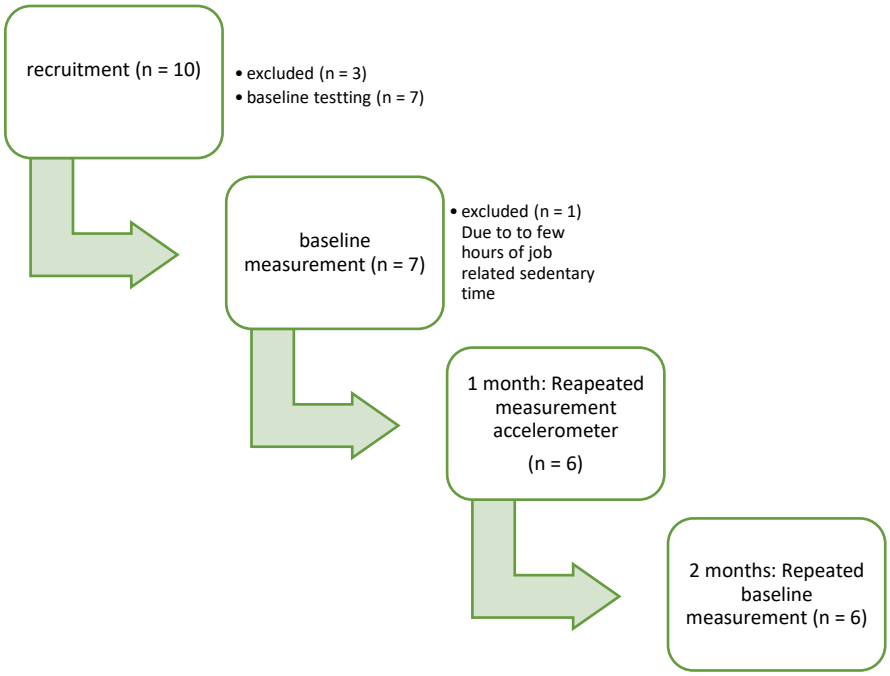

Figure 1: Study design

Of these 6 participants two were in their twenties while the other four participants were between 55 and 60 years old at time of inclusion in the study (*M* = 46.17, *SD* = 18.126). Participants spent on average 9.8 hours per day in sedentary behaviour at baseline (*M* = 588.12 min/day, *SD* = 39.66; *M* = 66%, *SD* = 6.71). For analysis of the baseline characteristics the reader is referred to *Appendix 1 Table A*.

Changes due to a two month voluntary increase in physical activity

Based on a pairwise comparison of the pre- and post-outcome measurements no significant changes could be detected in the primary outcome measures. (*Table B Appendix 1, Figure 2*). However, on analysis of the raw data there appeared to be a measurement error in the follow-

up measurement of the CRF of one participant. After excluding this participant from analyses significant increases in CRF were revealed after a two month voluntary increase in PA level in sedentary subjects (*Table 1, Figure 3*). A two month voluntary increase in PA resulted in significant increases in absolute $VO_{2\ peak}$ *(t*(4) = -2.88, *p* = .045), relative $VO_{2\ peak}$ (*t*(4) = -3.16, *p* = .034), percentage of predicted $VO_{2\ peak}$ (*t*(4) = -3.18, *p* = .034) and VT2 (*t*(4) = -4.13, *p* = .015) in subjects with a sedentary job. In VT1 no significant increase could be demonstrated (*t*(4) = -.94, *p* = .402). These results were attenuated when analyses were conducted with the Wilcoxon Signed-Ranks Test, rendering only the increase in VT2 significant (*z* = -2.02, *p* = .043). With marginally significant increases in absolute and relative $VO_{2\ peak}$ (*z* = -1.75, *p* = .080) and percentage of predicted $VO_{2\ peak}$ (*z* = -1.76, *p* = .078). In VT1 no significant increase could be demonstrated (*z* = -.94, *p* = .345).

For figures on the changes in primary outcomes per participant see *Appendix 2, Figures 1-8*.

The secondary outcome measures demonstrated significant decreases in the BMI, (*t*(5) = 2.64, *p* = .046; *z* = -1.99, *p* = .046) and the fat mass of the upper limb (FMUL) (*t*(5) = 3.09, *p* = .027; *z* = -2.20, *p* = .028) , body mass showed a marginally significant decrease (*t*(5) = 2.24, *p* = .076; *z* = -1.73, *p* = .084). There was a significant decrease in the amount of kilocalories ingested (*t*(5) = 2.52, *p* = .053; *z* = -1.99, *p* = .046), however not in the amount of kilojoules (*t*(5) = 1.75, *p* = .141; *z* = -1.57, *p* = .116). There were significant increases in the HR_{peak} (*t*(5) = -3.76, *p* = .013; *z* = -2.00, *p* = .045), the number of steps per day (*t*(5) = -3.38, *p* = .020; *z* = -2.20, *p* = .028), measured by an accelerometer. Based on the comparison of the IPAQ results at baseline and after two months, there was mainly a change in the leisure time PA (*t*(5) = -2.01, *p* = .100; £*z* = -1.99, *p* = .046), and not in the vocational PA. Furthermore, there were significant increases in the total amount of PA (*t*(5) = -2.86, *p* = .035; *z* = -2.20, *p* = .028) and vigorous PA (*t*(5) = -1.83, *p* = .127; *z* = -1.99, *p* = .046) in MET's per week. For an overview of the mean accelerometer data, expressed as percentage, per measurement period see *Appendix 2, Figures 9-11.* See *Appendix 1, Table B* to evaluate the changes in primary and secondary outcome measures (n = 6).

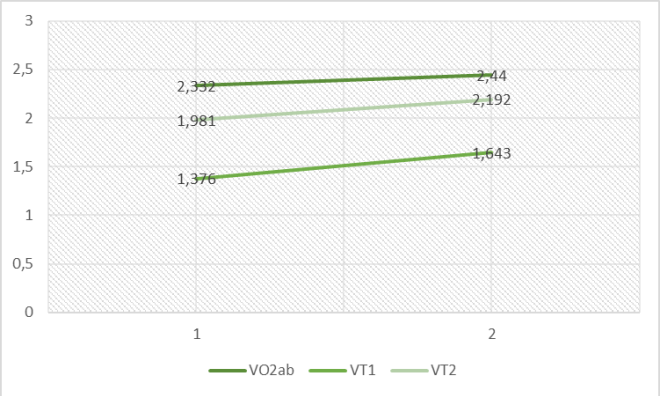

Figure 2: Comparison of Primary Outcomes (n = 6) at Baseline (1) and after Two Months (2);
VO2ab, Absolute $VO_{2\ peak}$; VT1, first ventilatory threshold; VT2, second ventilatory threshold.

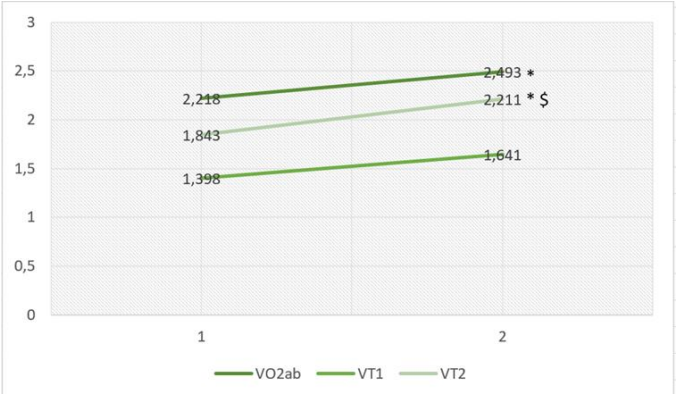

Figure 3: Comparison of Primary Outcomes (n = 5) at Baseline (1) and after Two Months (2);
** p< .05 on paired t-test; $ p< .05 on Wilcoxon Signed-Ranks Test for paired samples; VO2ab, Absolute VO2 peak; VT1, first ventilatory threshold; VT2, second ventilatory threshold*

Table 1: Paired Comparison of Pre- and Post- Measurements of the Primary Outcomes Measures (n=5).

Measurement	Mean pre (± SD)	Mean post (± SD)	p- value t-test for paired samples	p- value Wilcoxon Signed-Ranks Test for paired samples
$VO_{2\ peak}$ (l/min)	2.33 (± 0,55)	2.49 (± 0.39)	.045*	.080
$VO_{2\ peak}$ (ml/min/kg)	33.17 (± 5.12)	36.60 (± 3.91)	.034*	.080
$VO_{2\ peak}$ % predicted	96 (± 21.03)	106 (± 19.89)	.034*	.078
VT1 (VO_2/VCO_2) (l/min)	1.38 (± 0.48)	1.64 (± 0.33)	.402	.345
VT2 (VE/VCO_2) (l/min)	1.98 (± 0.52)	2.21 (± 0.28)	.015*	.043*

**p <.05 (two-tailed)*
Values are presented as mean ± standard deviation (SD). $VO_{2\ peak}$, peak oxygen consumption; VT1, the first ventilatory threshold; VT2, the second ventilatory threshold; VO_2, oxygen uptake, VCO_2, carbon dioxide output; VE, expiratory volume; l/min, litre per minute; ml/min/kg, millilitre per minute per kilogram body mass.

Cross-sectional analysis of data

Bivariate Correlation and Regression

Regression analyses for the relations between the different accelerometer derived measures of physical activity and the absolute value of $VO_{2\ peak}$, VT1 and VT2 demonstrated significant correlations at baseline for VT1 with the average time spent in LIPA ($r(4) = .82$, $p = .022$ with

r^2 = .68, $F(1,4)$ = 8.44, p = .044), in vigorous PA ($r(4)$ = .76, p = .041 with r^2 = .57, $F(1,4)$ = 5.30, p = .083), and the % of time spent in LIPA ($r(4)$ = .91, p = .007 with r^2 = .82, $F(1,4)$ = 18.01, p = .013), spent sedentary ($r(4)$ = -.86, p = .014 with r^2 = .74, $F(1,4)$ = 11.44, p = .028) and spent in vigorous PA ($r(4)$ = .75, p = .043 with r^2 = .56, $F(1,4)$ = 5.14, p = .086) (*Table 2*). No significant correlations could be demonstrated after a two month voluntary increase in physical activity (*Table C and D Appendix 1*).

Table 2: Linear Regression Analysis – Baseline (n = 6).

	$VO_{2\ peak}$ (l/min)			
	Pearson Correlation	*p*-value (1-tailed)	*r*-square	*p*-value (2-tailed)
Number steps/day	.273	.301	.074	.601
Sedentary (min/day)	-.374	.233	.140	.466
% Sedentary	-.225	.334	.051	.668
MVPA (min/day)	-.133	.401	.018	.802
Moderate PA (min/day)	-.127	.405	.016	.811
% Moderate	-.275	.299	.076	.598
Vigorous PA (min/day)	-.016	.488	.000	.976
% Vigorous	-.022	.483	.000	.967
LIPA (min/day)	.192	.358	.037	.716
% LIPA	.326	.264	.106	.528
	VT1 (l/min)			
	Pearson Correlation	*p*-value (1-tailed)	*r*-square	*p*-value (2-tailed)
Number steps/day	.559	.124	.313	.249
Sedentary (min/day)	-.493	.160	.243	.320
% Sedentary	-.861	.014*	.741	.028*
MVPA (min/day)	.502	.155	.252	.310
Moderate PA (min/day)	.090	.432	.008	.865
% Moderate	-.076	.443	.006	.886
Vigorous PA (min/day)	.755	.041*	.570	.083
% Vigorous	.750	.043*	.562	.086
LIPA (min/day)	.824	.022*	.678	.044*
% LIPA	.905	.007*	.818	.013*
	VT2 (l/min)			
	Pearson Correlation	*p*-value (1-tailed)	*r*-square	*p*-value (2-tailed)
Number steps/day	.633	.089	.400	.178
Sedentary (min/day)	-.239	.324	.057	.649
% Sedentary	-.536	.137	.287	.273
MVPA (min/day)	.255	.313	.065	.626
Moderate PA (min/day)	.168	.375	.028	.751
% Moderate	.010	.493	.000	.986
Vigorous PA (min/day)	.166	.376	.028	.753

% Vigorous	.160	.381	.026	.762
LIPA (min/day)	.521	.145	.271	.290
% LIPA	.592	.108	.350	.216

**p< .05*

r-square, the coefficient of determination; $VO_{2\ peak}$, the peak oxygen consumption; VT1, the first ventilatory threshold; VT2, the second ventilatory threshold; MVPA, moderate to vigorous physical activity; PA, physical activity; LIPA, light physical activity; l/min, litres per minute; min/day, minutes per day.

Multiple Regression and Correlation

Analyses for the simultaneous effects of different accelerometer derived outcomes on the $VO_{2\ peak}$, VT1 and VT2 revealed, at baseline, only significant correlations with VT1 (*Tables 3a and 3b*). There was no significant model for the simultaneous effects when the accelerometer derived measures of PA were expressed in min/day (*Appendix 1, Table G*). When they were expressed in percentages, a marginally significant model was found. The value of R^2 was .997 (adjusted R^2 was .98), which was marginally significant, F (4,1) = 72.47, $MS_{residual}$ = .004, p = .088, the *SEE* was .06. Although each independent variable alone, with exception of the percentage of time spent in moderate PA, correlated significantly with VT1 (*Table 3b*), none accounted for a significant amount of the unique variance of VT1 (*Table 4*). Analyses of data after a two month voluntary increase in PA, could not demonstrate any significant correlations (*Tables J-Q, Appendix 1*).

Table 3a: Baseline Variables in the Multiple Regression Analysis: Pearson Correlation of Variables in the Analysis (n = 6).

	$VO_{2\ peak}$ (l/min)	**VT1 (l/min)**	**VT2 (l/min)**	**Number steps/day**	**Sedentary (min/day)**	**MVPA (min/day)**	**LIPA (min/day)**
$VO_{2\ peak}$ (l/min)	1.000	1.000	1.000				
Number steps/day	.273 (.301)	.559 (.124)	.633 (.089)	1.000			
Sedentary (min/day)	-.374 (.233)	-.493 (.160)	-.239 (.324)	.325 (.265)	1.000		
MVPA (min/day)	-.133 (.401)	.502 (.155)	.255 (.313)	.804 (.027*)	.248 (.318)	1.000	
LIPA (min/day)	.192 (.358)	.824 (.022*)	.521 (.145)	.751 (.043*)	-.236 (.326)	.861 (.014*)	1.000
Mean (± SD)	2.33 (± 0,55)	1.38 (± 0.48)	1.98 (± 0.52)	7241.60 (± 2175.07)	588.12 (± 39.66)	31.84 (± 14.45)	267.62 (± 72.43)

**p<.05 (1-tailed), p-value in parentheses*

Values are presented as Pearson Correlation Coefficient and as mean ± standard deviation (SD). $VO_{2\ peak}$, peak oxygen consumption; VT1, the first ventilatory threshold; VT2, the second ventilatory threshold; l/min, litre per minute; min/day, minutes per day; PA, physical activity; LIPA, light physical activity; MVPA, moderate to vigorous physical activity.

Table 3b: Baseline Variables in the Multiple Regression Analysis: Pearson Correlation of Variables in the Analysis (n = 6).

	$VO_{2\ peak}$ (l/min)	**Sedentary (%)**	**Moderate (%)**	**LIPA (%)**
$VO_{2\ peak}$ (l/min)	1.000			
Sedentary (%)	-.225 (.334)	1.000		
Moderate (%)	-.275 (.299)	-.415 (.207)	1.000	
LIPA (%)	.326 (.264)	-.986 (.000*)	.287 (.291)	1.000
Mean (± SD)	2.33 (± 0,55)	66.49 (± 6.71)	3.02 (± 1.35)	29.96 (± 5.90)

	VT1 (l/min)	***VT2 (l/min)***	***Sedentary (%)***	***Moderate (%)***	***Vigorous (%)***	***LIPA (%)***
VT1 (l/min)	1.000	1.000				
Sedentary (%)	-.861 (.014*)	-.536 (.137)	1.000			
Moderate (%)	-.076 (.443)	.010 (.493)	-.415 (.207)	1.000		
Vigorous (%)	.750 (.043*)	.160 (.381)	-.465 (.176)	-.338 (.256)	1.000	
LIPA (%)	.905 (.007*)	.592 (.108)	-.986 (.000*)	.287 (.291)	.473 (.171)	1.000
Mean (± SD)	1.38 (± 0.48)	1.98 (± 0.52)			0.47 (±0.79)	

**p<.05 (1-tailed), p-value in parentheses*

Values are presented as Pearson Correlation Coefficient and as mean ± standard deviation (SD). $VO_{2\ peak}$, peak oxygen consumption; VT1, the first ventilatory threshold; VT2, the second ventilatory threshold; l/min, litre per minute; PA, physical activity; LIPA, light physical activity

Table 4: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis (n = 6)

VT1 (l/min)	**Semipartial *r***	**beta**	**t (2)**	***p*-value (2-tailed)**
Sedentary %	.120	9.708	2.046	.289
Moderate %	.107	1.804	1.817	.320
Vigorous %	.146	1.490	2.495	.243
LIPA%	.132	9.255	2.249	.266

p-value (two-tailed)

beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity.

Discussion

This study revealed an increase in $VO_{2\ peak}$ and VT2 after a voluntary increase in habitual PA during two months, in previously sedentary subjects. The mean increase in $VO_{2\ peak}$ corresponded with 0.98 Metabolic Equivalents (MET's). An increase of 1 MET has been shown to correspond with a 13% - 16% reduction in the risk of all-cause and cardiovascular disease (CVD) mortality, irrespective of age, gender, coronary risk factors, smoking status, aberrant exercise electrocardiogram, follow-up duration, selected instrument to determine CRF and exercise test method (Lee et al., 2010; Myers et al., 2002). A 1 MET increase in $VO_{2\ peak}$, was found to be equivalent to a 7 cm, 5 mmHg and 1mmol/l decrease in waist circumference, systolic blood pressure, concentration of triglycerides (in men) and fasting plasma glucose, respectively, and a 0.2mmol/l increase in HDL-cholesterol concentration (Lee et al., 2010). Thus the amelioration in CRF after a two month voluntary increase in habitual PA seemed not only statistically significant but also clinically relevant. The increase in $VO_{2\ peak}$ ranged from 1.43 MET's to 2.29 MET's (*Table R, Appendix 1*). One participant demonstrated a reduced CRF (-0.29 MET's), however this was deemed not to be significant. Another participant was excluded based on a supposed measurement error with follow-up CPET at two months. Measurements of this participant demonstrated, despite an increased W_{peak} (from 275 W to 300 W) and HR_{peak} (from 156 bpm to 162 bpm), a decrease in CRF. The relative $VO_{2\ peak}$ of this participant decreased form 41 ml/min/kg to 31 ml/min/kg. This discrepancy was believed to be due to an ill-fitting mask during the CPET, thereby precluding a proper gas exchange analysis. Of the other participants the lowest increase in $VO_{2\ peak}$ was found in the eldest participant, with the second highest relative $VO_{2\ peak}$ at baseline (Heath, Hagberg, Ehsani, & Holloszy, 1981). The youngest participant, who was also the most sedentary participant at baseline (Warburton et al., 2006), demonstrated the highest increase in CRF. This participant had the lowest baseline CRF, was the only female in the sample and has known idiopathic scoliosis (Cobb angle of 24°), which might have had an impact on her exercise capacity (Mohammadi, Akbari, Sarrafzadeh, & Moradi, 2014; Shen, Lin, Luo, & Xiao, 2016). In the present study a significant increase was demonstrated in VT2, but not in VT1. This was not in accordance to earlier studies, that typically showed increases in VT1 in reaction to training. A higher intensity of training was found to be necessary to obtain larger increases in $VO_{2\ max}$ and VT2 (Meyer et al., 2005), however this seemed to be in contrast to the findings of the present

study. Both VT1 and VT2 have been demonstrated to be valid in competitive athletes, sedentary subjects and patients (Meyer et al., 2005). Both VT1 and VT2 may be expressed as a % of the $VO_{2\ peak}$ and represent, in part, the degree in which a person is accustomed to endurance exercise and the level of CRF. In healthy sedentary subjects the VT1 varies on average between 50% and 58% of $VO_{2\ peak}$ and is rarely found higher than 60% of $VO_{2\ peak}$. In subjects who met the ACSM guidelines for PA, VT1 was on average 66% of $VO_{2\ peak.}$ (Bergstrom et al., 2013; Davis, Storer, & Caiozzo, 1997; Habedank et al., 1998). In older subjects (> 55 years) however, the VT1 as percentage of $VO_{2\ peak}$ is often found to be higher. This suggests that the age-dependent decrease in absolute $VO_{2\ peak}$ is partly compensated by the increase in the % of $VO_{2\ peak}$ at which the VT1 occurs (Meyer et al., 2005). In the present study the mean VT1 at baseline was 61% of $VO_{2\ peak}$, this higher value, relative to earlier studies in sedentary subjects, might reflect age-related changes since four participants were 55 years or older at baseline. At follow-up this value increased to 68% of $VO_{2\ peak}$. The VT2 in healthy untrained individuals is typically reported to be 70-84% of $VO_{2\ peak}$ (Bergstrom et al., 2013). In the present study the mean VT2 at baseline was 84%, at follow-up this increased to 91% of $VO_{2\ peak}$. Both VT1 and VT2 were estimated by the CPET software which might have led to a systematic overestimation. After two months the accelerometer data only demonstrated a significant increase in the number of steps per day. This was in contrast to the self-reported data of the IPAQ, which demonstrated significant increases in total PA, leisure time PA and vigorous PA. However the IPAQ is a subjective measure and thus prone to over- or underestimation (*Figures 12-13, Appendix 2*). Compared to the accelerometer data there seemed to be in general an underestimation of the time spent being sedentary. However this was only significant at follow-up (p = .010; p = .028), and not at baseline (p = .136; p = .116) (*Figure 14, Appendix 2*). This discrepancy might be explained by the inability of waist mounted accelerometers to register activities such as riding a bike (Pedisic & Bauman, 2015). Since most participants increased their level of PA by cycling more, the accelerometer might have underestimated the level of PA in these participants.

In a second part of this study the cross-sectional associations between outcomes of CRF and accelerometer derived measures of PA were investigated. A correlation between the percentage of time spent sedentary and VT1 was found. However, none of the accelerometer derived measures of PA seemed to account for the variance in VT1. The lack of significance of

these semipartial correlations might be due to the small sample size. Correlations were only found to be significant at baseline, but not at follow-up. The lack of significant associations at two months might be explained by the larger violations in the distributional assumptions at this time and by the smaller sample size, after exclusion of one participant. The found inverse correlation between percentage of time spent sedentary and the VT1, as measure of CRF was in line with the study of Kulinski et al., which included 2223 participants (12-49 years), without known heart disease and found inverse associations between sedentary behaviour and cardiorespiratory fitness, that were independent of exercise activity. In this study the $VO_{2\ max}$ was estimated from the measured heart rate during a sub-maximal treadmill test. Participants wore an uniaxial accelerometer (ActiGraph 7164), on their right hip during all waking hours for 7 consecutive days, to measure their habitual PA (Kulinski et al., 2014). The study of Kulinski et al. differed from the present study in sample size and composition, measurement methodology and outcomes. However both studies indicate an inverse association between sedentary time and cardiorespiratory fitness. The fact that the present study was not able to reveal a significant association with other measures of cardiorespiratory fitness (i.e. the absolute $VO_{2\ peak}$ and VT2) might be due to the small sample size.

Strengths

This was to my knowledge the first study to investigate the impact of a sedentary lifestyle on CRF by using objective measures of $VO_{2\ peak,}$ VT1 and VT2 derived from a maximal CPET and to investigate the effects of a two month increase in habitual PA, without imposing an exercise program on the participants. Several criterion standard tests were used in this study, of which the DEXA-scan (Prior et al., 1997), CPET (Davis et al., 2006), fasting blood sampling and triaxial accelerometers to determine the habitual level of PA (Carr & Mahar, 2012; Kozey-Keadle et al., 2011). A prerequisite to participate in this study was being motivated to make a behaviour change towards less sedentary time. Despite this, several participants reported that participation in this study formed an additional incentive to be more active, since they were curious to see if their efforts would lead to measurable changes after only two months. Due to this fact an important part of the studies premeditation was already a success, since participants were motivated to maintain a more active lifestyle. Whether this can be maintained over a longer period and whether this effect is also present in larger samples, remains to be investigated in future studies.

Limitations

Findings and analyses of this study were limited due to the small sample size and the short period of follow-up, longer periods of follow-up are required to investigate whether the observed changes, after a two month increase in habitual PA, can be maintained. The participants in this study were volunteers, which increases the likelihood of a self-selection bias, since the sampling method consisted of a convenience or accidental sample, which might limit the generalisability of the study results (Portney and Watkins, 2009). Data in this study were collected and analysed by the same person, this failure in blinding might have biased the interpretation of the data. A last limitation was the loss of several blood samples, only three samples were available at follow-up, which precluded finding any significant changes in glycaemic control or blood lipid profile.

Recommendations for future research

Future studies, with larger study samples and longer periods of follow-up are needed to verify these results. Additional research is needed to investigate whether a voluntary behaviour change (i.e. reducing sedentary time), can be maintained during longer periods of time, and which parameters of health are first and most impacted by this change. Future studies, should also investigate the cross-sectional associations between objectively measured outcomes of PA and objectively measured outcomes of CRF (i.e. $VO_{2\ peak}$, VT1 and VT2) by means of a CPET, in healthy sedentary, occupationally active subjects.

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Appendices

Appendix 1 : Tables

Appendix 2 : Figures

Appendix 3: Ethics Committee documents

Appendix 1 : Tables

Baseline characteristics

Table A: Baseline Characteristics of the Participants (n=6).

Characteristics	**Mean (± SD)**	**Minimum**	**Maximum**
Age (years)	46.17 (± 18.13)	20	60
Male	83%	1 female	5 males
Smokers	0		
Body mass (kg)	69.75 (± 10.19)	57.0	88.0
Height (m)	1.74 (± 0.08)	1.60	1.82
BMI (kg/m²)	23.05 (± 2.19)	20.14	26.68
Waist circumference (cm)	85.50 (± 10.56)	73.5	101.5
Systolic blood pressure (mmHg)	133.00 (± 14.29)	114.33	153.33
Diastolic blood pressure (mmHg)	82.55 (± 8.24)	74.33	96.00
Resting hart rate (bpm)	56.83 (± 14.81)	42.00	84.67
Resting rate pressure product (mmHg)	7443.25 (± 1419.44)	6076.14	9680.32
Blood sampling (n=4)			
Fasting glucose (mg/dl)	88.50 (± 10.54)	81	104
Fasting insulin (pmol/l)	66.75 (± 21.09)	40	86
Total cholesterol (mg/dl)	199.75 (± 10.97)	190	212
LDL-cholesterol (mg/dl)	118.75 (± 4.35)	115	125

HDL-cholesterol (mg/dl)	65.50 (± 9.47)	52	73
Triglycerides (mg/dl)	108.25 (± 23.81)	78	134
DEXA scan- body composition (n=6)			
Fat free mass index (kg/m²)	16.59 (± 1.66)	13.91	18.50
Fat mass index (kg/m²)	5.29 (± 1.87)	2.63	7.57
Fat free mass upper limb (g)	5392.30 (± 1458.78)	2873.0	6941.5
Fat free mass lower limb (g)	15661.30 (± 2333.46)	11470.2	17764.2
Fat free mass trunk (g)	25829.73 (± 4756.06)	18262.7	32238.3
Fat mass upper limb (g)	1755.92 (± 673.30)	836.5	2697.7
Fat mass lower limb (g)	4497.77 (± 1713.55)	3142.4	7900.5
Fat mass trunk (g)	8522.33 (± 3794.18)	3774.4	14198.1
% body fat	23 (± 7.43)	13	34
Bone mineral density (Z-score)	-0.12 (± 0.71)	-1.1	0.9
Cardiopulmonary exercise test (n=6)			
$VO_{2\ peak}$ (l/min)	2.33 (± 0.55)	1.43	2.91
$VO_{2\ peak}$ (ml/min/kg)	33.17 (± 5.12)	25	41
$VO_{2\ peak}$ % predicted	95.67 (± 21.03)	65	117
VT1 (VO_2/VCO_2) (l/min)	1.38 (± 0.48)	0.87	2.08
VT2 (VE/VCO_2) (l/min)	1.98 (± 0.52)	1.11	2.67

W_{peak} (W)	234.17 (± 36.11)	180	275
HR_{peak} (bpm)	161.83 (± 15.15)	142	183
$HR_{recovery}$ (bpm) (n=5)	138.00 (± 20.43)	118	169
RER_{peak}	1.26 (± 0.06)	1.15	1.31
Energy intake (n=6)			
Total KJ	31023.16 (± 6255.65)	24459.57	39828.92
Total kcal	7518.03 (± 1535.62)	5820.77	9511.65
Mean kcal/day	2506.01 (± 511.87)	1940.26	3170.55
Mean kcal/day derived from carbohydrates	1122.38 (± 290.20)	861.41	1511.20
Mean kcal/day derived from proteins	396.77 (± 32.85)	335.26	423.70
Mean kcal/day derived from fat	949.25 (± 473.07)	588.36	1869.11
Mean kcal/day derived from alcohol	79.45 (± 91.61)	0.00	206.27
Accelerometer data (n=6)			
Total wear time (minutes)	6220.67 (± 623.68)	5275	6986
Mean wear time (min/day)	888.57 (± 89.19)	753.57	998.00
% wear time	62 (± 6.18)	52	69
Average step count per day	7241.60 (± 2175.07)	4384.71	9423.29
Sedentary time (min/day)	588.12 (± 39.66)	526.43	638.57

% sedentary time	66 (± 6.71)	56	74
MVPA (min/day)	31.84 (± 14.45)	10.29	52.86
Moderate (min/day)	19.98 (± 11.59)	5.72	36.57
% moderate	3 (± 1.34)	1	5
Vigorous (min/day)	4.65 (± 7.92)	0.00	20.43
% vigorous	0 (± 0.79)	0	2
Very vigorous (min/day)	0.48 (± 1.17)	0.00	2.86
% very vigorous	0 (± 0.11)	0	0
LIPA (min/day)	267.62 (± 72.43)	185.00	378.00
% LIPA	30 (± 5.90)	22	38
IPAQ (last 7 days) (n=6)			
Total PA MET-min/week	2249.83 (± 1858.97)	146	5630
Moderate MET-min/week	823.33 (± 1062.86)	0	2760
Total Walking MET min/week	1086.50 (± 1426.86)	0	3750
Total Vigorous MET-min/week	333.33 (± 313.60)	0	800
Average time spent sitting on a weekday	560.00 (± 220.18)	180	840
Average time spent sitting on a weekend day	360.00 (± 214.66)	120	720
IPAQ PA category low	67% (4 participants)		
IPAQ PA category moderate	33% (2 participants)		
IPAQ PA category high	0%		

Values are presented as mean ± standard deviation (SD). BMI, Body mass index; LDL-cholesterol, low density lipoprotein cholesterol; HDL-cholesterol, high density lipoprotein cholesterol; DEXA, Dual-energy X-ray absorptiometry; $VO_{2\ peak}$, peak oxygen consumption; VT1, the first ventilatory threshold; VT2, the second ventilatory threshold; W_{peak}, the power output expressed in Watt; HR_{peak}, the peak heart rate reached; RER_{peak}, the peak respiratory exchange ratio, this is the respiratory exchange ratio which correlates with the $VO_{2\ peak}$; MVPA, moderate to vigorous physical activity; LIPA, light physical activity; IPAQ, international physical activity questionnaire; MET, Metabolic Equivalent of Task; PA, physical activity; kg, kilograms; m, meters; kg/m^2, kilograms per meter squared; mmHg, Millimetre of mercury; bpm, beats per minute; mg/dl, milligrams per decilitre; pmol/l, picomole per litre; g, grams; l/min, litre per minute; ml/min/kg, millilitre per minute per kilogram; VO_2, oxygen uptake; VCO2, carbon dioxide output; VE, expiratory volume, expired volume; kcal, kilocalories; KJ, kilo joules; min, minutes.

Changes due to a two month voluntary increase in physical activity

Table B: Paired Comparison of Pre- and Post-Measurements (n=6).

Measurement	**Mean pre (± SD)**	**Mean post (± SD)**	**p- value t-test for paired samples**	**p- value Wilcoxon Signed-Ranks Test for paired samples**
Body mass (kg)	69.75 (± 10.19)	68.75 (± 10.16)	.076	.084
BMI (kg/m^2)	23.05 (± 2.19)	22.69 (± 2.04)	.046*	.046*
SBP (mmHg)	133.00 (± 14.29)	128.78 (± 14.57)	.439	.599
DBP (mmHg)	82.55 (± 8.24)	78.56 (± 9.37)	.120	.173
Resting HR (bpm)	56.83 (± 14.81)	56.11 (± 11.22)	.821	.753
RPP (mmHg)	7443.25 (± 1419.44)	7264.23 (± 1837.50)	/	.463
Waist circumference (cm)	85.50 (± 10.55)	83.42 (± 10.19)	.468	.500
Blood sampling (n=3)				
Fasting glucose (mg/dl)	88.50 (± 10.54)	96.33 (± 14.98)	.074	.109
Fasting insulin (pmol/l)	66.75 (± 21.09)	38.33 (± 5.51)	.115	.109
Total cholesterol (mg/dl)	199.75 (± 10.97)	202.33 (± 33.71)	.967	1,000

LDL-cholesterol (mg/dl)	118.75 (± 4.35)	118.67 (± 18.75)	.962	1,000
HDL-cholesterol (mg/dl)	65.50 (± 9.47)	64.67 (± 11.02)	.497	.414
Triglycerides (mg/dl)	108.25 (± 23.81)	95.33 (± 25.54)	.124	.109
DEXA scan- body composition (n=6)				
Fat free mass (g)	46885.00 (± 8405.72)	46839.85 (± 8636.08)	.934	.917
Fat mass (g)	14775.48 (± 4908.11)	14549.83 (± 5013.62)	.696	.917
FFMI (kg/m²)	16.59 (± 1.66)	16.45 (± 1.41)	.442	.463
FMI (kg/m²)	5.29 (± 1.87)	5.18 (± 1.73)	.598	.917
BMD (z-score)	-0.12 (± 0.71)	-0.18 (± 0.80)	.501	.459
FFMUL	5392.30 (± 1458.78)	5188.67 (± 1158.30)	.188	.249
FFMLL	15661.30 (± 2333.46)	15873.63 (± 2265.62)	.365	.345
FFMTrunk	25829.73 (± 4756.060)	25379.67 (± 4754.29)	.447	.345
FMUL	1755.92 (± 673.30)	1581.08 (± 562.08)	.027*	.028*
FMLL	4497.77 (± 1713.55)	4435.72 (± 1442.62)	.772	.753
FMTrunk	8522.33 (± 3794.18)	8533.03 (± 4094.07)	.975	.753
% BF	23 (± 7.43)	23 (± 6.66)	.764	.917
Cardiopulmonary exercise test (n=6)				
$VO_{2\ peak}$ (l/min)	2.33 (± 0.55)	2.44 (± 0.37)	.586	.463
$VO_{2\ peak}$ (ml/min/kg)	33.17 (± 5.12)	35.67 (± 4.18)	.415	.463

$VO_{2\ peak}$ % predicted	95.67 (± 21.03)	101.67 (± 20.23)	.463	.462
VT1 (VO_2/VCO_2) (l/min)	1.38 (± 0.478)	1.64 (± 0.30)	.267	.249
VT2 (VE/VCO_2) (l/min)	1.98 (± 0.52)	2.19 (± 0.25)	.276	.249
W_{peak} (W)	234.17 (± 36.11)	245.83 (± 33.23)	.078	.102
HR_{peak} (bpm)	161.83 (± 15.15)	165.83 (± 13.50)	.013*	.045*
$HR_{recovery}$ (bpm)	138.00 (± 20.43)	133.67 (± 20.84)	.615	.893
RER_{peak}	1.26 (± 0.06)	1.21 (± 0.09)	.182	.206
Energy intake (n=6)				
Total KJ	31023.16 (± 6255.65)	27741.91 (± 9212.13)	.141	.116
Total kcal	7518.03 (± 1535.62)	6533.34 (± 2139.65)	*.053*	.046*
Mean kcal/day	2506.01 (± 511.87)	2177.78 (± 713.22)	*.053*	.046*
Mean intake of carbohydrates/day (g)	283.93 (± 69.84)	234.09 (± 86.99)	*.055*	.075
Mean kcal/day derived from carbohydrates	1122.38 (± 290.20)	936.34 (± 347.98)	.074	.075
Mean intake of fats/day (g)	105.47 (± 52.56)	80.63 (± 29.47)	.176	.075
Mean kcal/day derived from fat	949.25 (± 473.07)	725.65 (± 265.25)	.176	.075
Mean intake of proteins/day (g)	99.19 (± 8.21)	93.07 (± 30.60)	.599	.463
Mean kcal/day derived from proteins	396.77 (± 32.85)	372.28 (± 122.41)	.599	.463
Mean intake of alcohol/day (g)	11.36 (± 13.09)	15.54 (± 11.79)	/	.225
Mean kcal/day derived from alcohol	79.49 (± 91.61)	108.81 (± 82.55)	/	.225

Average pieces of fruit/day	1.42 (± 0.66)	0.94 (± 0.80)	.300	.225
Mean amount of vegetables/day (g)	145.17 (± 92.17)	106.83 (± 51.64)	.137	.173
Mean amount of meats/day (g)	101.67 (± 58.41)	88.50 (± 55.37)	.563	.463
Accelerometer data (n=6)				
Total wear time (minutes)	6220.67 (± 623.68)	6270.83 (± 899.40)	/	.753
Mean wear time (min/day)	888.57 (± 89.19)	895.84 (± 128.49)	/	.753
% wear time	62 (± 6.18)	62 (± 8.93)	/	.753
Average step count per day	7241.59 (± 2175.07)	8762.10 (± 2758.75)	.020*	.028*
Sedentary time (min/day)	588.12 (± 39.66)	582.02 (± 121.18)	.873	.345
% sedentary time	66 (± 6.71)	65 (± 9.16)	.520	.345
MVPA (min/day)	31.84 (± 14.45)	39.14 (± 20.52)	.203	.173
Moderate (min/day)	27.19 (± 14.13)	34.07 (± 20.03)	.222	.249
% moderate	3 (± 1.35)	4 (± 2.11)	.331	.293
Vigorous (min/day)	4.65 (± 7.92)	5.07 (± 10.83)	.779	.893
% vigorous	0 (± 0.79)	1 (± 1.19)	.690	.893
Very vigorous (min/day)	0.48 (± 1.17)	4.03 (± 9.72)	/	.180
% very vigorous	00 (± 0.11)	1 (± 1.21)	/	.180
LIPA (min/day)	267.62 (± 72.43)	270.64 (± 88.18)	/	.753
% LIPA	30 (± 5.90)	30 (± 8.88)	/	.753

IPAQ (last 7 days) (n=6)				
Total PA MET-min/week	2249.83 (± 1858.97)	7951.83 (± 5670.59)	.035*	.028*
Total Work MET	171.67 (± 420.50)	729.50 (± 1645.70)	/	.180
Total Transport MET	457.50 (± 1041.90)	1181 (± 1648.25)	/	.345
Total Household/ Garden MET	390 (± 592.45)	1155 (± 1269.64)	/	.080
Total Leisure time MET	1230.67 (± 1102.84)	4886.33 (± 5384.64)	.100	.046*
Total Walking MET	1086.50 (± 1426.86)	1181.83 (± 1429.45)	.918	1,000
Moderate MET	823.33 (± 1062.86)	1920 (± 2007.89)	.107	.116
Total Vigorous MET	333.33 (± 313.60)	4850 (± 6270.90)	.127	.046*
Average time spent sitting on a weekday	560 (± 220.18)	495 (± 205.89)	.163	.136
Average time spent sitting on a weekend day	360 (± 214.66)	353.33 (± 173.28)	.915	.786

**p < .05 (two-tailed)*

In italic: trend towards significance

/: data not normally distributed

Values are presented as mean ± standard deviation (SD). BMI, Body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate; RPP, rate pressure product; LDL-cholesterol, low density lipoprotein cholesterol; HDL-cholesterol, high density lipoprotein cholesterol; DEXA, Dual-energy X-ray absorptiometry; FFMI, fat free mass index; FMI, fat mass index; BMD, bone mineral density; FFMUL, fat free mass upper limb; FFMLL, fat free mass lower limb; FFMTrunk, fat free mass trunk; FMUL, fat mass upper limb; FMLL, fat mass lower limb; FMTrunk, fat mass trunk; % BF, percentage body fat; $VO_{2\,peak}$, peak oxygen consumption; VT1, the first ventilatory threshold; VT2, the second ventilatory threshold; W_{peak}, the power output expressed in Watt; HR_{peak}, the peak heart rate reached; RER_{peak}, the peak respiratory exchange ratio, this is the respiratory exchange ratio which correlates with the $VO2_{peak}$; KJ, kilo joules; kcal, kilocalories; MVPA, moderate to vigorous physical activity; LIPA, light physical activity; PA, physical activity; kg, kilograms; m, meters; kg/m^2, kilograms per meter squared; cm, centimetres; mmHg, millimetre of mercury; bpm, beats per minute; mg/dl, milligrams per decilitre; pmol/l, picomole per litre; g, grams; l/min, litre per minute; ml/min/kg, millilitre per minute per kilogram; VO_2, oxygen uptake; VCO_2, carbon dioxide output; VE, ventilation, expired volume; W, Watt; min/day, minutes per day; min/week, minutes per week; MET, Metabolic Equivalent of Task .

Cross-sectional analysis of data

Bivariate Correlation and Regression

Table C: Linear Regression Analysis – At Two Months (n = 6).

		$VO_{2\ peak}$ (l/min)		
	Pearson Correlation	*p*-value (1-tailed)	*r*-square	*p*-value (2-tailed)
Number steps/day	-.069	.449	.005	.897
Sedentary (min/day)	.002	.498	.000	.996
% Sedentary	-.163	.379	.027	.758
MVPA (min/day)	-.229	.331	.052	.663
Moderate PA (min/day)	-.392	.221	.154	.442
% Moderate	-.565	.122	.319	.243
% LIPA	.208	.346	.043	.693
		VT1 (l/min)		
	Pearson Correlation	*p*-value (1-tailed)	*r*-square	*p*-value (2-tailed)
Number steps/day	-.012	.491	.000	.981
Sedentary (min/day)	.322	.267	.103	.534
% Sedentary	-.183	.364	.034	.728
MVPA (min/day)	.095	.429	.009	.858
Moderate PA (min/day)	.265	.306	.070	.612
% Moderate	.065	.451	.004	.902
% LIPA	.153	.386	.023	.772
		VT2 (l/min)		
	Pearson Correlation	*p*-value (1-tailed)	*r*-square	*p*-value (2-tailed)
Number steps/day	-.005	.496	.000	.992
Sedentary (min/day)	-.173	.371	.030	.743
% Sedentary	-.364	.239	.132	.479
MVPA (min/day)	-.157	.383	.025	.767
Moderate PA (min/day)	-.278	.297	.077	.593
% Moderate	-.464	.177	.215	.354
% LIPA	.424	.201	.180	.402

r-square, the coefficient of determination; VO2 peak, the peak oxygen consumption; VT1, the first ventilatory threshold; VT2, the second ventilatory threshold; MVPA, moderate to vigorous physical activity; PA, physical activity; LIPA, light physical activity; l/min, litres per minute; min/day, minutes per day.

Time spent in LIPA, vigorous and very vigorous activity per day and corresponding percentages (except for LIPA) were not included in the test due to not meeting the assumptions of normality and/or homoscedasticity.

Table D: Linear Regression Analysis – At Two Months (n = 5).

		$VO_{2\ peak}$ (l/min)		
	Pearson Correlation	*p*-value (1-tailed)	*r*-square	*p*-value (2-tailed)
Number steps/day	.103	.435	.011	.869
Sedentary (min/day)	-.002	.499	.000	.998
% Sedentary	-.260	.336	.068	.672
MVPA (min/day)	-.278	.325	.078	.650
Moderate PA (min/day)	-.418	.242	.175	.484
% Moderate	-.599	.143	.359	.286
LIPA (min/day)	.286	.320	.082	.641
% LIPA	.337	.290	.113	.580
		VT1 (l/min)		
	Pearson Correlation	*p*-value (1-tailed)	*r*-square	*p*-value (2-tailed)
Number steps/day	-.021	.487	.000	.973
Sedentary (min/day)	.322	.299	.104	.598
% Sedentary	-.184	.383	.034	.767
MVPA (min/day)	.096	.439	.009	.877
Moderate PA (min/day)	.265	.333	.070	.667
% Moderate	.065	.459	.004	.917
LIPA (min/day)	.349	.282	.122	.564
% LIPA	.155	.402	.024	.803
		VT2 (l/min)		
	Pearson Correlation	*p*-value (1-tailed)	*r*-square	*p*-value (2-tailed)
Number steps/day	.085	.446	.007	.892
Sedentary (min/day)	-.178	.387	.032	.774
% Sedentary	-.419	.241	.175	.483
MVPA (min/day)	-.177	.388	.031	.776
Moderate PA (min/day)	-.283	.323	.080	.645
% Moderate	-.470	.212	.221	.425
LIPA (min/day)	.420	.241	.177	.481
% LIPA	.500	.195	.250	.391

r-square, the coefficient of determination; VO2 peak, the peak oxygen consumption; VT1, the first ventilatory threshold; VT2, the second ventilatory threshold; MVPA, moderate to vigorous physical activity; PA, physical activity; LIPA, light physical activity; l/min, litres per minute; min/day, minutes per day.

Time spent in vigorous and very vigorous activity per day and corresponding percentages were not included in the test due to not meeting the assumptions of normality and/or homoscedasticity.

Multiple Regression and Correlation

Baseline data:

Table E: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis at Baseline (n = 6).

$VO_{2\ peak}$ *(l/min)*	**Semipartial *r***	**beta**	**t (1)**	***p*-value**
Number steps/day	.299	3.034	.555	.677
Sedentary (min/day)	-.212	-3.176	-.394	.761
MVPA (min/day)	.126	2.543	.234	.854
LIPA (min/day)	-.177	-5.027	-.329	.798

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity; min/day, minutes per day.

The value R^2 was .710 (adjusted R^2 was -.448), which was not significant, F (4,1) = .613, $MS_{residual}$ = .441, p = .729. The standard error of estimate was .66.

Table F: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis at Baseline (n = 6).

$VO_{2\ peak}$ *(l/min)*	**Semipartial *r***	**beta**	**t (2)**	***p*-value**
Sedentary %	.472	5.110	.922	.454
Moderate %	.180	.340	.352	.758
LIPA%	.512	5.297	1.000	.422

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity.

The value R^2 was .477 (adjusted R^2 was -.309), which was not significant, F (3,2) = .607, $MS_{residual}$ = .398, p = .671. The standard error of estimate was .63.

Table G: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis (n = 6).

VT1 (l/min)	**Semipartial *r***	**beta**	**t (1)**	***p*-value (2-tailed)**
Number steps/day	-.257	-2.611	-1.021	.493
Sedentary (min/day)	.281	4.206	1.114	.466
MVPA (min/day)	-.325	-6.559	-1.289	.420
LIPA (min/day)	.332	9.426	1.317	.413

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity; min/day, minutes per day.

The value of R^2 was .937 (adjusted R^2 was .683), which was not significant, $F(4,1) = 3.69$, $MS_{residual} = .072$, $p = .370$. The standard error of the estimate was .27.

Table H: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis at Baseline (n = 6).

VT2 (l/min)	**Semipartial *r***	**beta**	**t (1)**	***p*-value**
Number steps/day	.373	3.791	1.037	.488
Sedentary (min/day)	-.273	-4.093	-.758	.587
MVPA(min/day)	.203	4.092	.562	.674
LIPA (min/day)	-.240	-6.818	-.666	.626

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity; min/day, minutes per day.

The value R^2 was .870 (adjusted R^2 was .352), which was not significant, $F(4,1) = 1.68$, $MS_{residual} = .175$, $p = .517$. The standard error of estimate was .42.

Table I: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis at Baseline (n = 6).

VT2 (l/min)	**Semipartial *r***	**beta**	**t (2)**	***p*-value**
Sedentary %	-.055	-4.421	-.074	.953
Moderate %	-.076	-1.293	-.104	.934
Vigorous %	-.092	-.933	-.124	.921
LIPA%	-.042	-2.956	-.057	.964

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity.

The value R^2 was .458 (adjusted R^2 was -1.709), which was not significant, F (4,1) = .211, $MS_{residual}$ = .732, p = .905. The standard error of estimate was .86.

Data at two months:

Table J: Variables at Two Months in the Multiple Regression Analysis: Pearson Correlation of Variables in the Analysis (n = 5).

	$VO_{2\ peak}$ (l/min)	**VT1 (l/min)**	**VT2 (l/min)**	**Sedentary (min/day)**	**MVPA (min/day)**	**Moderate PA (min/day)**	**LIPA (min/day)**
$VO_{2\ peak}$ (l/min)	1.000	1.000	1.000				
Sedentary (min/day)	/	.322 (.299)	-.178 (.387)				
MVPA (min/day)	-.278 (.325)	/	/	/	1.000		
Moderate PA (min/day)	-.418 (.242)	.265 (.333)	-.283 (.323)	-.168 (.394)	.861 (.030*)	1.000	
LIPA (min/day)	.286 (.320)	.349 (.282)	.420 (.241)	-.448 (.225)	.800 (*.052*)	.622 (.131)	1.000
Mean (± SD)	2.49 (± 0.39)	1.64 (± 0.33)	2.21 (± 0.28)	582.60 (± 135.48)	39.88 (± 22.85)	34.06 (± 22.39)	259.83 (± 94.04)

**p<.05 (one-tailed), p-value in parentheses*
Values are presented as Pearson Correlation Coefficient and as mean ± standard deviation (SD). VO2 peak, peak oxygen consumption; VT1, the first ventilatory threshold; VT2, the second ventilatory threshold; l/min, litre per minute; min/day, minutes per day; PA, physical activity; LIPA, light physical activity; MVPA, moderate to vigorous physical activity.

Table K: Variables at Two Months in the Multiple Regression Analysis: Pearson Correlation of Variables in the Analysis (n = 5).

	$VO_{2\ peak}$ (l/min)	***VT1 (l/min)***	***VT2 (l/min)***	**Sedentary (%)**	**Moderate PA (%)**	**LIPA (%)**
$VO_{2\ peak}$ (l/min)	1.000	1.000	1.000			
Sedentary (%)	-.260	-.184	-.419	1.000		
	(.336)	(.383)	(.241)			
Moderate PA (%)	-.599	.065	-.470	-.447	1.000	
	(.143)	(.459)	(.212)	(.225)		
LIPA	.337	.155	.500	-.984	.327	1.000
(%)	(.290)	(.402)	(.195)	(.001*)	(.296)	
Mean	2.49	1.64	2.21	65.92	3.62	29.11
(± SD)	(± 0.39)	(± 0.33)	(± 0.28)	(± 10.01)	(± 2.36)	(± 9.55)

**p<.05 (one-tailed), p-value in parentheses*
Values are presented as Pearson Correlation Coefficient and as mean ± standard deviation (SD). VO2 peak, peak oxygen consumption; VT1, the first ventilatory threshold; VT2, the second ventilatory threshold; l/min, litre per minute; PA, physical activity; LIPA, light physical activity.

Table L: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis at Two Months (n = 5).

$VO_{2\ peak}$ (l/min)	**Semipartial *r***	**beta**	**t (1)**	***p*-value**
MVPA (min/day)	-.407	-1.072	-.974	.508
Moderate (min/day)	-.166	-.336	-.399	.759
LIPA (min/day)	.791	1.352	1.894	.309

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity; min/day, minutes per day; MVPA, moderate to vigorous physical activity.

The value R^2 was .826 (adjusted R^2 was .302), which was not significant, F (3,1) = 1.578, $MS_{residual}$ = .105, p = .516. The standard error of estimate was .32.

Table M: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis at Two Months (n = 5).

$VO_{2\ peak}$ *(l/min)*	**Semipartial *r***	**beta**	**t (2)**	***p*-value**
Sedentary %	-.240	-1.988	-.464	.724
Moderate %	-.681	-1.073	-1.318	.413
LIPA%	-.162	-1.268	-.313	.807

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity.

The value R^2 was .733 (adjusted R^2 was -.067), which was not significant, F (3,1) = .916, $MS_{residual}$ = .160, p = .627. The standard error of estimate was .40.

Table N: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis at Two Months (n = 5).

VT1 (l/min)	**Semipartial *r***	**beta**	**t (1)**	***p*-value**
Sedentary (min/day)	.532	.602	.691	.615
Moderate (min/day)	-.024	-.031	-.031	.980
LIPA (min/day)	.447	.638	.582	.665

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity; min/day, minutes per day.

The value R^2 was .408 (adjusted R^2 was -1.366), which was not significant, F (3,1) = .230, $MS_{residual}$ = .260, p = .872. The standard error of estimate was .51.

Table O: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis at Two Months (n = 5).

VT1 (l/min)	**Semipartial *r***	**beta**	**t (2)**	***p*-value**
Sedentary %	-.247	-2.047	-.258	.839
Moderate %	-.173	-.272	-.180	.886
LIPA%	-.225	-1.770	-.236	.853

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity.

The value R^2 was .085 (adjusted R^2 was -2.659), which was not significant, F (3,1) = .031, $MS_{residual}$ = .403, p = .989. The standard error of estimate was .63.

Table P: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis at Two Months (n = 5).

VT2 (l/min)	**Semipartial *r***	**beta**	**t (1)**	***p*-value**
Sedentary (min/day)	.122	.138	.213	.866
Moderate (min/day)	-.705	-.911	-1.233	.434
LIPA (min/day)	.735	1.048	1.287	.421

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity; min/day, minutes per day.

The value R^2 was .673 (adjusted R^2 was -.307), which was not significant, F (3,1) = .687, $MS_{residual}$ = .101, p = .686. The standard error of estimate was .32.

Table Q: Semipartial r Values and Beta Values together with Significance Tests for Independent Variables in the Multiple Regression Analysis at Two Months (n = 5).

VT2 (l/min)	**Semipartial *r***	**beta**	**t (2)**	***p*-value**
Sedentary %	-.130	-1.082	-.245	.847
Moderate %	-.546	-.861	-1.026	.492
LIPA%	-.036	-.283	-.068	.957

p-value (two-tailed)
beta, Standerdized Coefficients; t, t-test (degrees of freedom); VT1, the first ventilatory threshold; LIPA, light physical activity.

The value R^2 was .716 (adjusted R^2 was -.135), which was not significant, F (3,1) = .84, $MS_{residual}$ = .088, p = .65. The standard error of estimate was .30.

Discussion

Table R: Increase in cardiorespiratory fitness in Metabolic Equivalents

	$VO_{2\ peak}$	Pre	Post	MET-value
Mean *	l/min	2.33	2.49	0.98
(± SD)		(± 0.55)	(± 0.39)	
	ml/min/kg	33.17	36.60	
		(± 5.12)	(± 3.91)	
Participant 1	l/min	2.12	2.47	1.71
	ml/min/kg	32	38	
Participant 2	l/min	1.43	1.84	2.29
	ml/min/kg	25	33	
Participant 3	l/min	2.25	2.68	2
	ml/min/kg	34	41	
Participant 4	l/min	2.91	2.82	-0.29
	ml/min/kg	33	32	
Participant 5	*l/min*	*2.90*	*2.18*	*-2.86*
	ml/min/kg	*41*	*31*	
Participant 6	l/min	2.38	2.66	1.43
	ml/min/kg	34	39	

In italic: participant 5 excluded based on measurement error.

** Mean: after exclusion of 5th participant.*

$VO_{2\ peak}$, peak oxygen uptake; MET, Metabolic Equivalent of Task; pre, measurements at baseline; post, measurements after a two month voluntary increase in physical activity; SD, standard deviation; l/min, litres per minute oxygen uptake; ml/min/kg, millilitres oxygen uptake per minute per kilogram body mass.

Appendix 2: Figures

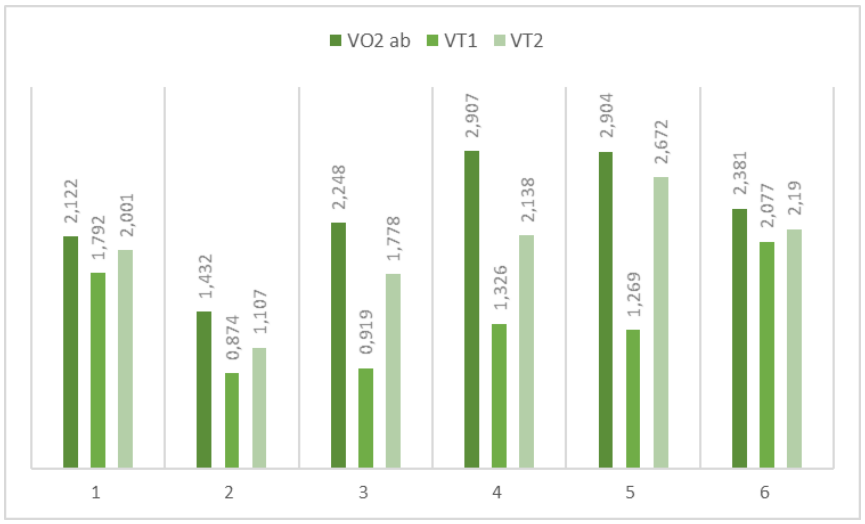

Figure 1: Comparison of the Primary Outcomes at Baseline in the 6 participants; VO2ab, Absolute $VO_{2\,peak}$; VT1, first ventilatory threshold; VT2, second ventilatory threshold

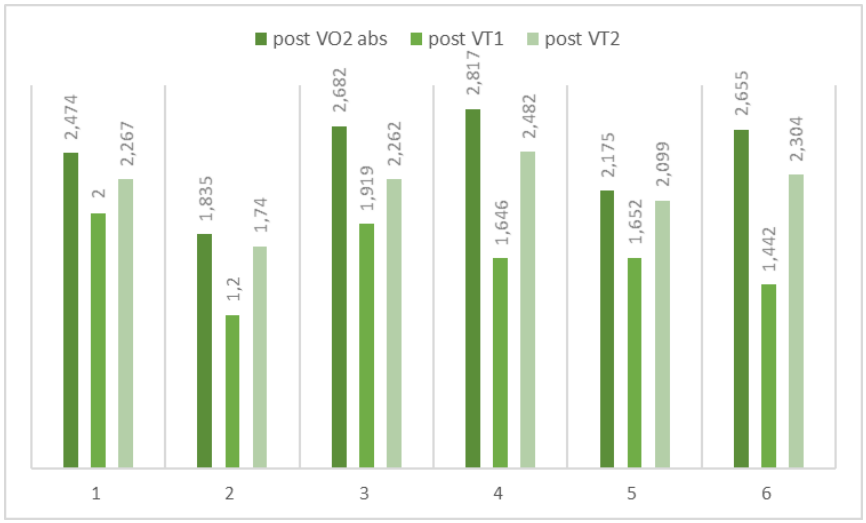

Figure 2: Comparison of the Primary Outcomes at Two Months in the 6 participants; VO2ab, Absolute $VO_{2\,peak}$; VT1, first ventilatory threshold; VT2, second ventilatory threshold

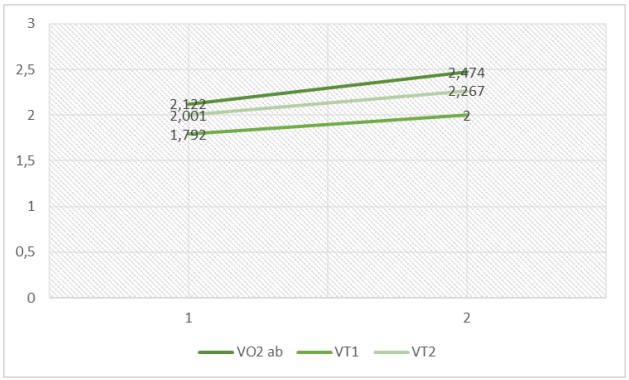

Figure 3: Comparison of Primary Outcomes of participant 1 at Baseline (1) and after Two Months (2); VO2ab, Absolute $VO_{2\,peak}$; VT1, first ventilatory threshold; VT2, second ventilatory threshold

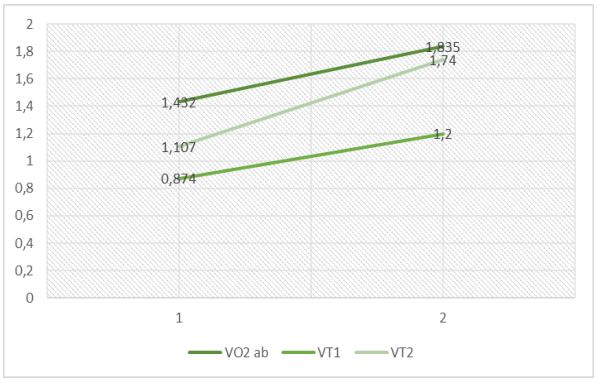

Figure 4: Comparison of Primary Outcomes of participant 2 at Baseline (1) and after Two Months (2); VO2ab, Absolute $VO_{2\,peak}$; VT1, first ventilatory threshold; VT2, second ventilatory threshold

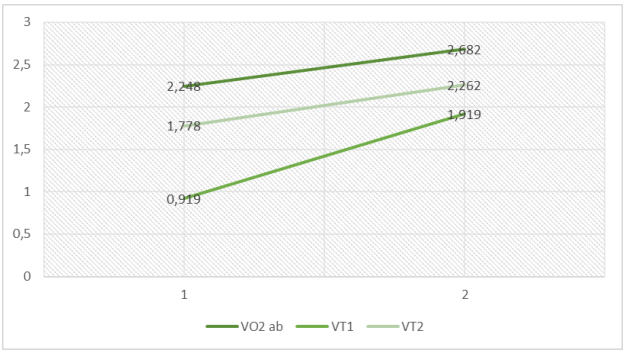

Figure 5: Comparison of Primary Outcomes of participant 3 at Baseline (1) and after Two Months (2); VO2ab, Absolute $VO_{2\,peak}$; VT1, first ventilatory threshold; VT2, second ventilatory threshold

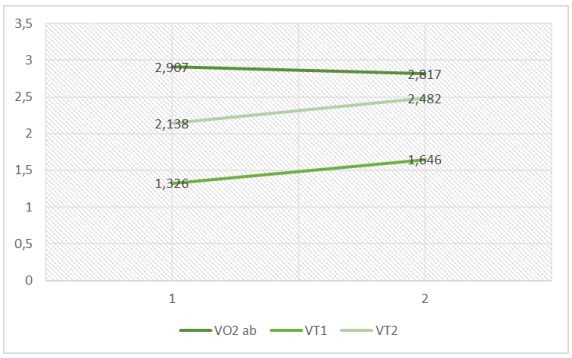

Figure 6: Comparison of Primary Outcomes of participant 4 at Baseline (1) and after Two Months (2); VO2ab, Absolute $VO_{2\,peak}$; VT1, first ventilatory threshold; VT2, second ventilatory threshold

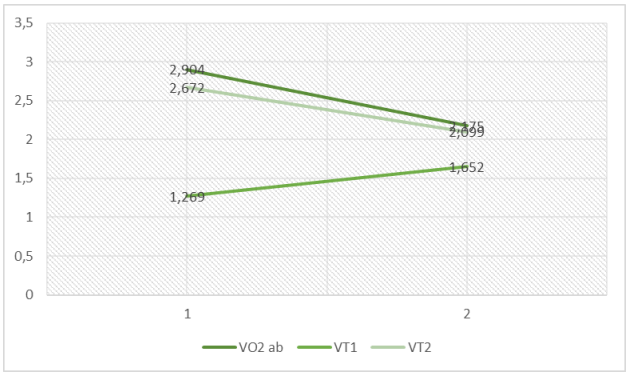

Figure 7: Comparison of Primary Outcomes of participant 5 at Baseline (1) and after Two Months (2); VO2ab, Absolute $VO_{2\,peak}$; VT1, first ventilatory threshold; VT2, second ventilatory threshold

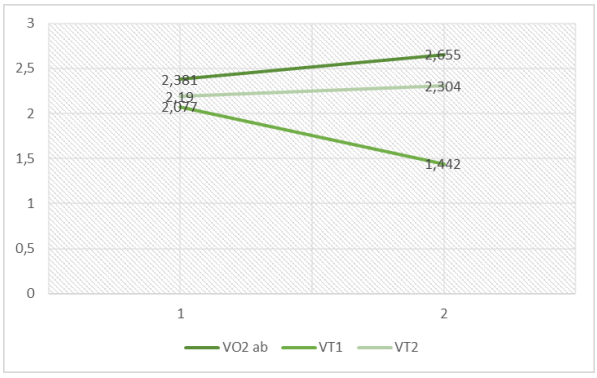

Figure 8: Comparison of Primary Outcomes of participant 6 at Baseline (1) and after Two Months (2); VO2ab, Absolute $VO_{2\,peak}$; VT1, first ventilatory threshold; VT2, second ventilatory threshold

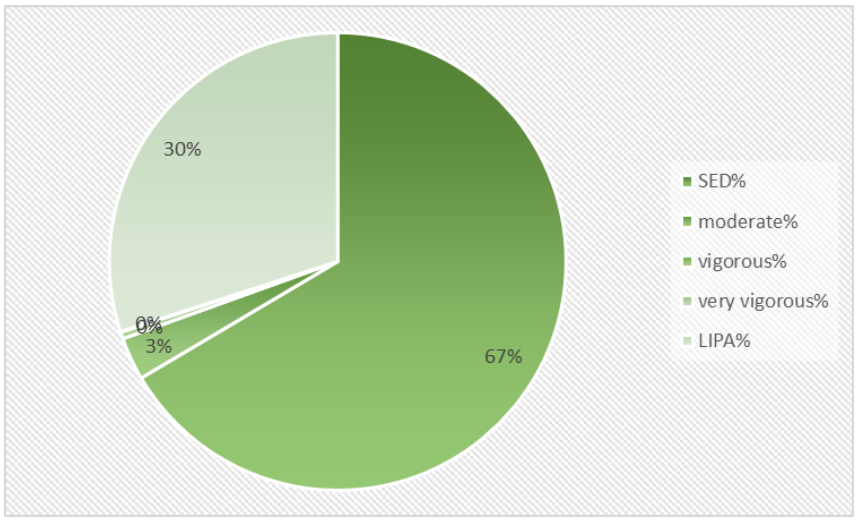

Figure 9: Accelerometer data in % -Baseline;
SED, sedentary; LIPA, light physical activity

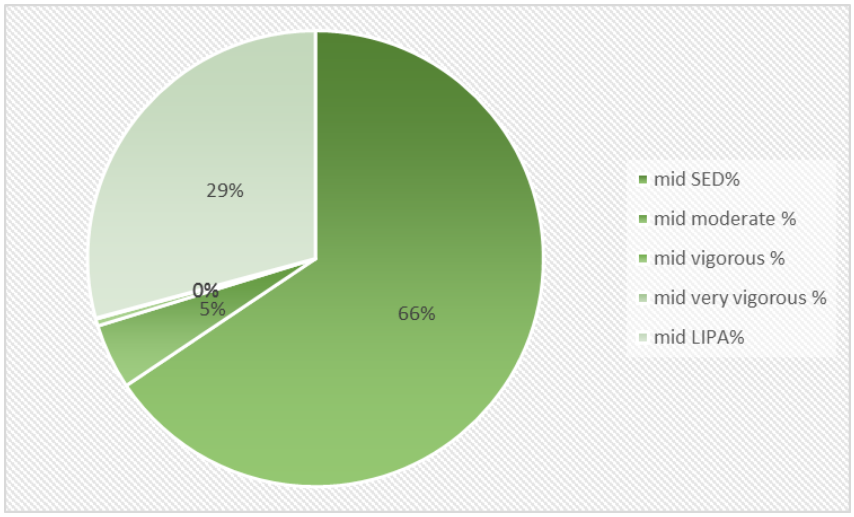

Figure 10: Accelerometer data in % - at One Month;
SED, sedentary; LIPA, light physical activity

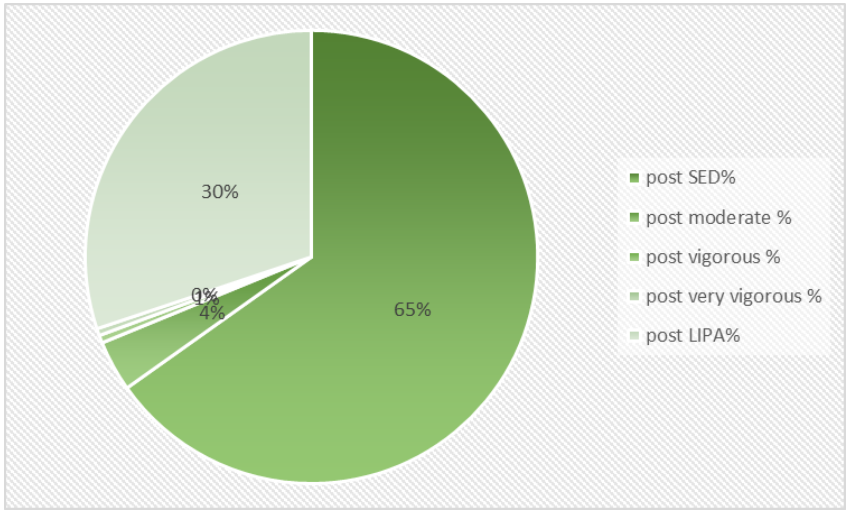

Figure 11: Accelerometer data in % - at Two Months;
SED, sedentary; LIPA, light physical activity

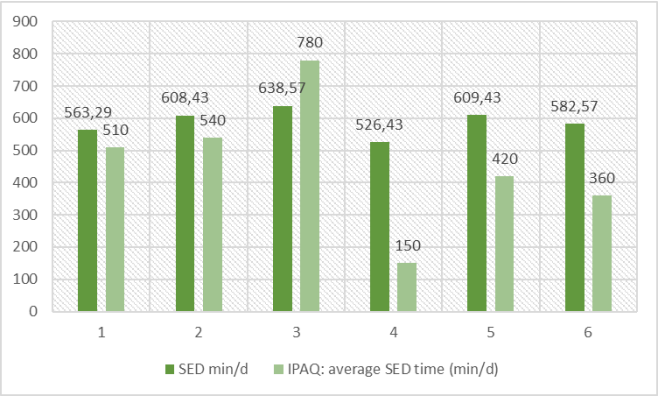

Figure 12: Comparison Accelerometer derived and Self-reported SED time – Baseline;
SED, sedentary; IPAQ, international physical activity questionnaire; min/d, minutes per day

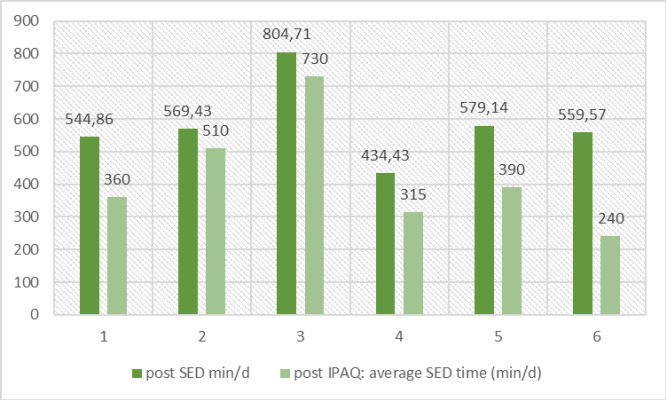

Figure 13: Comparison Accelerometer derived and Self-reported SED time – at Two Months;
SED, sedentary; IPAQ, international physical activity questionnaire; min/d, minutes per day

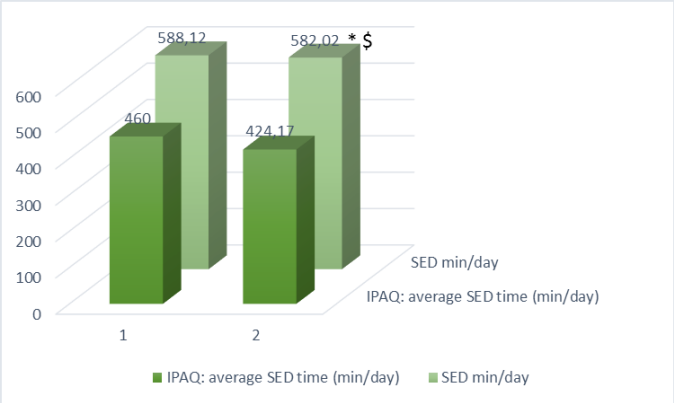

Figure 14: Comparison Accelerometer derived and Self-reported SED time ;
**p = .010 t-test*
$ p = .028 Wilcoxon Signed-Ranks Test
SED, sedentary; IPAQ, international physical activity questionnaire; min/d, minutes per day

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jessa
ZIEKENHUIS

Ethische Toetsingscommissie

ADVIESFORMULIER

- ■ studieprotocol
- □ amendement protocol
- □ medical need program

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ONS KENMERK
16.107/reva16.11

Hasselt, 21 november 2016

Titel protocol: Gezond Bewegingsgedrag bij Sedentaire Beroepen – **SHEBA**
Protocolnummer:
Belgisch registratien°: B243201630226
Onderzoeker: Annick Timmermans
Dominique Hansen

VOORLOPIG ADVIES ETHISCHE TOETSINGSCOMMISSIE JESSA

Geachte collega,

De Ethische Toetsingscommissie van het Jessa Ziekenhuis heeft het hierboven vermeld protocol bestudeerd. Volgende documenten met betrekking tot het protocol kwamen aan bod:

- ■ indieningsbrief, dd. 26/10/2016
- ■ aanvraagformulier
- ■ patiënteninformatie en –toestemmingsformulier, versie oktober 2016
- ■ protocol en protocol synopsis, versie oktober 2016
- ■ patiëntenvragenlijsten
- ■ verzekeringsattest

Het advies van de Ethische Toetsingscommissie luidt dat de studie ethisch verantwoord is, mits rekening gehouden wordt met volgende opmerkingen:

- Gelieve het adres van de opdrachtgever te vermelden in het informatieformulier, UHasselt, Martelarenlaan 42, 3500 Hasselt.
- In het protocol dient men te specificeren hoe de aanpak van verschillende groepen zal gebeuren. Advies over bijv. gezonde voeding, ... wordt best per beroepsgroep aangepast.

Hieronder vindt u bijkomende motivering van het advies in het kader van de wet inzake experimenten op de menselijke persoon (template FAGG).

		JA	NEE	NVT
1	**Maatschappelijke waarde**			
1.1	De beoogde doelgroep is goed afgelijnd.	■	□	□
2	**Wetenschappelijke validiteit**			
2.1	De onderzoeker en zijn/haar medewerkers zijn professioneel competent.	■	□	□

2.2	De faciliteiten en infrastructuur waarbinnen het onderzoek plaatsvindt, zijn adequaat.	☒	☐	☐
2.3	Het onderzoek is wetenschappelijk onderbouwd.	☒	☐	☐
2.4	Het onderzoek heeft een correct statistisch design.	☒	☐	☐
2.5	Het onderzoek draagt bij tot de kennis eigen aan de uitoefening van de gezondheidszorgberoepen.	☒	☐	☐
2.6	Het onderzoek draagt potentieel bij tot een betere gezondheidszorg voor de beoogde doelgroep (onmiddellijk of in de toekomst).	☒	☐	☐
2.7	Tijdens het onderzoek krijgen de deelnemers de standaard medische zorg.	☒	☐	☐
2.8	Indien er een placebogroep is dan is dit methodologisch absoluut noodzakelijk en ethisch aanvaardbaar.	☐	☐	☒
2.9	Indien het een gerandomiseerde studie betreft, is er geen verschil tussen de behandelwijzen in de verschillende armen[1].	☐	☐	☒
3	**Correcte deelnemerselectie**			
3.1	De onderzoekspopulatie is op een wetenschappelijk verantwoorde wijze gekozen binnen het kader van het onderzoek.	☒	☐	☐
3.2	De onderzoekspopulatie is zo gekozen dat het risico voor de deelnemers minimaal is.	☒	☐	☐
3.3	Duidelijke maatregelen worden genomen om de bijzonder kwetsbare groepen te beschermen.	☐	☐	☒
3.4	De potentiële fysische, psychologische, sociale en economische risico's van het onderzoek voor de individuele deelnemers zijn in de mate van het mogelijke gekwantificeerd en de probabiliteit van het voorkomen ervan, gegeven de beschikbare data, in overweging genomen.	☐	☐	☒
4	**Informatie- en toestemmingsformulier**			
4.1	De informatie is volledig en in een begrijpelijke taal weergegeven	☒	☐	☐
4.2	Een korte en in een duidelijke taal opgestelde samenvatting van maximaal vier A4 pagina's is bij het geïnformeerde toestemmingsformulier gevoegd.	☒	☐	☐
4.3	De onderzoeker verbindt er zich toe informatie zowel mondeling als schriftelijk mee te delen.	☒	☐	☐
4.4	Het geïnformeerde toestemmingsformulier vermeldt de eventuele gezondheidseffecten op de partner en de omgeving van de deelnemer aan het onderzoek, met de voorzorgsmaatregelen die daaromtrent moeten worden genomen.	☐	☐	☒
4.5	Het geïnformeerde toestemmingsformulier vermeldt dat een potentiële deelnemer kan weigeren om aan het onderzoek deel te nemen, of op elk moment uit het onderzoek kan stappen zonder enig gevolg voor de relatie met de gezondheidszorgbeoefenaar	☒	☐	☐

[1] Hiermee wordt bedoeld dat er, wat de baten-risico verhouding betreft, geen verschil mag zijn tussen de verschillende armen.

4.6	Indien de potentiële voordelen voor een patiënt kleiner zijn dan de nadelen, dan is er een ethisch gerechtvaardigde reden, en wordt dit gecommuniceerd aan de patiënt.	☐	☐	☒
4.7	Indien er geen potentieel voordeel is voor een vrijwilliger, zijn de risico's beperkt en ethisch aanvaardbaar, en wordt dit gecommuniceerd aan de vrijwilliger.	☐	☐	☒
5	**Specifieke studiepopulaties**			
5.1	Bij inclusie van minderjarigen: * de toestemming van de ouders of van de voogd wordt verkregen * een aangepast ICF wordt opgesteld * de uitdrukkelijke wil van de deelnemer zal worden onderzocht en nageleefd * er is een rechtstreeks verband met de klinische toestand van de minderjarige of het experiment kan enkel op minderjarigen worden uitgevoerd * het experiment houdt enig direct voordeel in voor de groep van patiënten.	☐	☐	☒
5.2	Bij inclusie van meerderjarigen die onbekwaam zijn hun toestemming te verlenen: * de toestemming van de wettelijke vertegenwoordiger wordt verkregen * de uitdrukkellijke wil van de deelnemer zal worden onderzocht en nageleefd * er is een rechtstreeks verband met een levensbedreigende of gezondheidsondermijnende klinische toestand waarin de deelnemer verkeert * de risico's voor de deelnemer zijn niet buiten verhouding ten aanzien van het voor die persoon verhoopte voordeel	☐	☐	☒
5.3	In het geval van hoogdringendheid waarbij de toestemming van de deelnemer niet kan verkregen worden: * er is een rechtstreeks verband met een levensbedreigende of gezondheidsondermijnende klinische toestand waarin de deelnemer verkeert * de toestemming van de deelnemer of zijn vertegenwoordiger zal bekomen worden van zodra het mogelijk is	☐	☐	☒
6	**Respect voor deelnemers**			
6.1	Na beëindiging van het onderzoek en in het geval de studiemedicatie therapeutisch voordelig is voor de deelnemer en de studiemedicatie geen goedgekeurd equivalent heeft op de markt, bezorgt de sponsor de studiemedicatie aan de deelnemer zolang deze medicatie nog niet op de markt is of tot de ontwikkeling wordt gestopt	☐	☐	☒
6.2	In het geval van codering van de gegevens van de deelnemers is gekend wie verantwoordelijk is voor de codering en het beheer ervan	☒	☐	☐
6.3	De manier waarop deelnemers worden gerekruteerd en geselecteerd, is aanvaardbaar.	☒	☐	☐
7	**Verzekering**			
7.1	Er is een "no-fault" verzekering afgesloten	☒	☐	☐
7.2	De regels en bedragen voor compensatie en/of schadevergoeding wanneer een deelnemer ten gevolge van een experiment letsel oploopt of overlijdt, zijn aanvaardbaar	☒	☐	☐
8	**Financiële regelingen**			

8.1	Vergoedingen aan de deelnemer – indien van toepassing – zijn proportioneel	☐	☐	☐
8.2	Bij commerciële studies is de onderzoeker onafhankelijk van de opdrachtgever.	☐	☐	☐
8.3	Betalingen en vergoedingen aan de onderzoeker zijn proportioneel	☐	☐	☐
8.4	De overeenkomst(en) tussen de opdrachtgever en de locatie(s) zijn aanvaardbaar	☐	☐	☐

Graag ontvangen wij de gewijzigde documenten (MET track changes), waarna er een definitieve goedkeuring van de Ethische Toetsingscommissie zal gegeven worden.

In haar advies heeft de Ethische Toetsingscommissie rekening gehouden met de adviezen van UHasselt.

De Ethische Toetsingscommissie is georganiseerd en handelt volgens de richtlijnen van GCP/ICH.

Na het uitbrengen van het advies over het initieel dossier door de Ethische Toetsingscommissie, kan er gedurende 3 maanden geen amendement voor het toevoegen van een nieuwe onderzoekslocatie worden ingediend.

De Ethische Toetsingscommissie vraagt aan de onderzoeker op de hoogte te worden gehouden van:

- *het verloop van de studie.*
- *eventuele wijzigingen in het studieprotocol, het informed consent, ... Amendementen moeten worden goedgekeurd door de commissie.*
- *het einde van de studie (einddatum, aantal behandelde patiënten, eventuele complicaties en mijn globale indruk).*
- *eventuele publicaties.*

In bijlage vindt u de ledenlijst van de Ethische Toetsingscommissie.

Met vriendelijke groeten,

Ter goedkeuring,

Dr. Koen Magerman
Voorzitter Ethische Toetsingscommissie
Jessa Ziekenhuis

21 november 2016

Leden Ethische Toetsingscommissie 2016
Dr. Koen Magerman, voorzitter – klinisch bioloog
Dr. Brigitte Maes, secretaris – klinisch biologe
Dr. Johan Vanwalleghem, ondervoorzitter – nefroloog
Dr. Ruth Achten – anatoom-patholoog en master in biostatistiek
Mevr. Mieke Bieghs – apotheek
Mevr. Inge Dreesen - apotheek
Mevr. Nathalie Cardinaels – psychologe
Mevr. Aleksandra Czesak – verpleegkundige
Mevr. Petra De Smet – ethicus, master in de filosofie en geloofswetenschappen
Mevr. Katrien Jaemers – management assistant
Dr. Herman Kuppers – huisarts
Mevr. Hilde Maes – hoofdverpleegkundige
Mevr. Fabienne Mertens – hoofdverpleegkundige
Dr. Bjorn Stessel – anesthesist
Dhr. Pros Vanhelmont – jurist
Dr. Pascal Vranckx – cardioloog

Auteursrechtelijke overeenkomst

Ik/wij verlenen het wereldwijde auteursrecht voor de ingediende eindverhandeling:
**The Impact of a Voluntary Behaviour Change on Peak Oxygen Uptake and the Ventilatory Thresholds in Sedentary People: An Explorative Trial
This trial is part of a larger study project: "Sedentarism project"**

Richting: **master in de revalidatiewetenschappen en de kinesitherapie-revalidatiewetenschappen en kinesitherapie bij musculoskeletale aandoeningen**
Jaar: **2017**

in alle mogelijke mediaformaten, - bestaande en in de toekomst te ontwikkelen - , aan de Universiteit Hasselt.

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Universiteit Hasselt zal mij als auteur(s) van de eindverhandeling identificeren en zal geen wijzigingen aanbrengen aan de eindverhandeling, uitgezonderd deze toegelaten door deze overeenkomst.

Voor akkoord,

Willems, Nele