Faculteit Revalidatiewetenschappen

master in de revalidatiewetenschappen en de kinesitherapie

Masterthesis

The effect of wearing a weight vest during walking on the energy consumption in adults with obesity

Lore Huijers
Helena Vermeersch

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie, afstudeerrichting revalidatiewetenschappen en kinesitherapie bij musculoskeletale aandoeningen

PROMOTOR :
Prof. dr. Dominique HANSEN

2018
2019

UHASSELT
KNOWLEDGE IN ACTION

www.uhasselt.be
Universiteit Hasselt
Campus Hasselt:
Martelarenlaan 42 | 3500 Hasselt
Campus Diepenbeek:
Agoralaan Gebouw D | 3590 Diepenbeek

Faculteit Revalidatiewetenschappen

master in de revalidatiewetenschappen en de kinesitherapie

Masterthesis

The effect of wearing a weight vest during walking on the energy consumption in adults with obesity

Lore Huijers
Helena Vermeersch

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie, afstudeerrichting revalidatiewetenschappen en kinesitherapie bij musculoskeletale aandoeningen

PROMOTOR :
Prof. dr. Dominique HANSEN

Acknowledgement

First and foremost, we would like to thank promotor Prof. Dr. Hansen Dominique for guiding this thesis. We could always contact him when we had questions. He also gave us the chance to give a presentation in the ReGo (Rehabilitation and Health Center) in Hasselt with the aim of finding subjects. Furthermore, we thank Dr. Verboven Kenneth for his guidance and assistance throughout the conduct of the study and his help during the entire process of our thesis. He helped us with the planning of the tests and our urgent questions and gave us useful feedback.

Next, we would like to express our sincere gratitude to the owners of REVAL (Rehabilitation Research Center) in Diepenbeek for their test availability and equipment. We also want to thank the subjects that took part in our study.

Last but not least, we want to thank our family and friends for their support.

Hamont, 03/05/2019 L.H.

Herk de stad, 03/05/2019 H.V.

Context

The subject of this master's thesis is people suffering from obesity and is situated within the research field of "rehabilitation of internal disorders". The increasing prevalence of obesity is a worldwide health concern, because excessive weight gain causes an increased risk for several diseases, most notably cardiovascular diseases, diabetes and cancers (4-6,10,11). Additionally, increased obesity rates lead to large health problems and economic burdens all over the world (9).

Strategies to reduce obesity have focused on weight management by healthy diets and physical activity (12). Strength training, endurance training and the combination of the two are training forms that may be used as a part of a weight loss program to improve health (1). Research has found that high levels of exercise (> 250 minutes/week) achieved greater weight loss. For the obese population, however, those levels are difficult to achieve or sustain (2,3). A possible solution could be to increase the intensity of the exercise instead of the duration, by adding weight. More intense exercise will probably lead to a higher energy consumption and more fat loss after some time of intervention. Consequently, less hours of physical activity will be necessary to achieve the same weight losses, which can also have a positive influence on the compliance. Previous research has already shown that walking with additional weight (a backpack or weighted vest for example) will lead to an increase in energy consumption in the healthy population (7,8). But still there is a lack of studies with additional weight in the obese population. Therefore, the aim of this study is to investigate the effect of a weighted vest during walking on the energy consumption in adults with obesity.

The research question was set up by the two master's students from Hasselt University, specialised in musculoskeletal rehabilitation sciences and physiotherapy, in cooperation with Prof. Dr. Hansen Dominique. Thereafter, the research protocol was drawn up by the students in consultation with their promotor. The students were responsible for the recruitment of the subjects. All the tests were taken by the two students. They have tested the subjects in December 2018 and January 2019. One student (L.H.) conducted the tests from February 2019 and placed the data in an Excel file. The data-analysis and the writing of the article were carried out by both students. The other student (H.V) has written the acknowledgement and the context and added the finishing touches.

Reference list

1. Beavers KM, Ambrosius WT, Rejeski WJ, Burdette JH, Walkup MP, Sheedy JL et al. Effect of exercise type during intentional weight loss on body composition in older adults with obesity. *Obesity* (silver spring). 2017; 25 (11): 1823-1829.
2. Catenacci VA and Wyatt HR. The role of physical activity in producing and maintaining weight loss. *Nat clin pract endocrinol metab*. 2007; 3(7): 518-529.
3. Donelly JE, Blair SN, Jakicic JM, Manore MM, Rankin JW, Smith BK et al. American college of sports medicine position stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Med sci sports exerc.* 2009; 41(2):459-471.
4. Engin A. The definition and prevalence of obesity and metabolic syndrome. *Obesity and lipotoxicity, advances in experimental medicine and biology.* 2017; 960: 1-17.
5. Ginter E and Simko V. Becoming overweight: Is there a health risk? *Bratislavske Lékařské Listy.* 2014; 115: 527–531.
6. Lu Y, Hajifathalian K, Ezzati M, Woodward M, Rimm EB, Danaei G. Metabolic mediators of the effects of body-mass index, overweight, and obesity on coronary heart disease and stroke: a pooled analysis of 97 prospective cohorts with 1.8 million participants. *Lancet.* 2014; 383: 970-983
7. Puthoff ML, Darter BJ, Nielsen DH, Yack HJ. The effect of weighted vest walking on metabolic responses and ground reaction forces. *Med sci sports exerc*. 2006; 38 (4), 746-52.
8. Quesada PM, Mengelkoch LJ, Hale RC, Simons SR. Biomechanical and metabolic effects of varying backpack loading on simulated marching. *Ergonomics*. 2000; 43(3), 29.
9. Rtveladze K, Marsh T, Barquera S, Sanchez Romero LM, Levy D, Melendez G et al. Obesity prevalence in Mexico: Impact on health and economic burden. *Public Health Nutrition.* 2014; 17: 233–239.
10. Twells LK, Gregory DM, Reddigan J and Midodzi WK. Current and predicted prevalence of obesity in Canada: A trend analysis. *CMAJ Open*. 2014; 2: E18–E26.
11. Wang YC, McPherson K, Marsh T, Gortmaker SL and Brown M. Health and economic burden of the projected obesity trends in the USA and the UK. *Lancet*. 2011; 378: 815–825.
12. Wiklund P. The role of physical activity and exercise in obesity and weight management: Time for critical appraisal. *J of Sport Health Sci*. 2016; 5 (2), 151-154.

THE EFFECT OF WEARING A WEIGHTED VEST DURING WALKING ON THE ENERGY CONSUMPTION IN ADULTS WITH OBESITY

Master thesis part two

Lore Huijers & Helena Vermeersch

Promotor: Prof Dr. Hansen Dominique

Hasselt University

Highlights:

1. Increasing speed (3, 4, 5 km/h) and wearing a weighted vest of 15% of the body mass significantly increased the oxygen consumption, energy consumption, heart rate, relative exercise intensity (percentage of the maximum heart rate) and carbohydrate oxidation during walking in adults with obesity.
2. The increase in energy consumption by wearing a weighted vest is significantly greater at a speed of 5 km/h than at 3 km/h during walking in adults with obesity.
3. Wearing a weighted vest can cause discomfort at the level of the hip, back and shoulders during walking in adults with obesity.

Table of contents

1 Abstract

Objectives: This study investigates how oxygen consumption, energy consumption, respiratory-exchange ratio, heart rate, relative exercise intensity (percentage of the maximum heart rate), perception of exertion and discomfort were affected by wearing a weighted vest of 15% of the body mass (BM) during treadmill walking at three different speeds (3, 4, 5 km/h) in adults with obesity.

Methods: A group of 18 subjects (aged 49.2 ± 10.1 yr) walked 10 minutes on a treadmill at three different speeds (3, 4 and 5 km/h) respectively, once with a weighted vest (15% BM) and once without. Dependent variables were oxygen consumption, energy consumption, respiratory-exchange ratio, heart rate, relative exercise intensity, substrate selection, perception of exertion and discomfort.

Results: The oxygen consumption ($p < 0.01$), energy consumption ($p < 0.01$), heart rate ($p < 0.01$), relative exercise intensity ($p < 0.01$) and carbohydrate oxidation ($p < 0.05$) were significantly higher during walking with a weighted vest of 15% BM than without a weighted vest and significantly increased with increasing speed (3, 4, 5 km/h). Wearing the weighted vest had no significant effect on the RER at 3 and 4 km/h and on the fat oxidation at all speeds. The increase in energy consumption by wearing the weighted vest is significantly greater at a speed of 5 km/h (22%) than at 3 km/h (17%) ($p < 0.01$), but not than at 4 km/h (19%). Additionally, the weighted vest could cause discomfort at the level of the hip, back and shoulders.

Conclusion: The weighted vest of 15% BM provides a higher energy consumption with the largest benefit at a speed of 5 km/h in adults with obesity. This offers opportunities for walking programs to lose weight in the future, taking possible discomfort into account.

Key words: OVERWEIGHT, OBESITY, WEIGHTED VEST, WALKING, OXYGEN CONSUMPTION, ENERGY CONSUMPTION, DISCOMFORT

2 Introduction

Worldwide, the prevalence of overweight and obesity is increasing rapidly. The World Health Organization (WHO) estimated that in 2016, about 13% of the world's adult population was obese (BMI ≥ 30 kg/m²) and even between 39-40% was overweight (BMI 25.0-29.9 kg/m²). Overweight and obesity are important risk factors for a wide range of chronic diseases, including cardiovascular diseases, type 2 diabetes, several types of cancer and all-cause mortality (2-6,19,21,37). A change of lifestyle, where one strives for a healthy diet and sufficient physical activity to lose weight, is an important goal for adults with obesity (22).

The amount of physical activity of moderate intensity needed for a significant effect on weight loss is 250 minutes of exercise a week in adults with overweight or obesity. In case of physical activity below 250 minutes a week, only minimal weight losses were observed (16). This large amount of physical activity is difficult to maintain on the long term (10,16). It would be beneficial if a more intense training could achieve the same or a greater weight loss within a smaller amount of time. To increase the intensity of the activity, and thus the energy consumption during the activity, additional weight can be added (29,30).

Previous research shows that walking with additional weight (backpack or weighted vest) leads to an increase in energy consumption in a non-obese healthy population. The amount of mass used as additional weight was highly variable in previous research, ranging from 10% to 30% of body mass (BM) (29,30). Generally, wearing additional weight of 15% BM ensures a significantly higher energy consumption during walking than without additional weight (29,30). Available evidence covering this topic is currently limited to cross-sectional studies of the healthy population. Consequently, there is a lack of cross-sectional research regarding the effects of using additional weight during an exercise in an overweight and obese population. It is also important to keep in mind that, in general, the obese population has more orthopaedic problems (27). The prevalence of significant knee, hip and back pain increases with increased levels of BMI (1). For this reason, it is necessary to question their discomfort when an external load is added.

This study will investigate how wearing a weighted vest during walking on a treadmill influences the energy consumption in adults with obesity. The changes in the dependent variables (oxygen consumption (VO_2), energy consumption, respiratory-exchange ratio (RER), heart rate (HR), relative exercise intensity ($\%HR_{max}$), fat and carbohydrate (CHO) oxidation, perception of exertion and discomfort) were examined at three walking speeds (3, 4 and 5 km/h) under two conditions (without and with weighted vest of 15% BM). The hypothesis is that the dependent variables will be higher during walking with a weighted vest compared to walking without a weighted vest, and that the variables will increase with an increasing speed.

3 Aim study

3.1 Research question

What is the effect of wearing a weighted vest of 15% BM during walking at 3, 4 and 5 km/h on the energy consumption in adults with obesity?

3.2 Hypothesis

The energy consumption will be higher during walking with a weighted vest of 15% BM compared to walking without a weighted vest and will increase with an increasing speed.

4 Method

4.1 Design

This study has a cross-sectional two-factor repeated measures design. The subjects underwent two tests, one with and one without a weighted vest, on separate days (with a minimum of two days in between). The order of the test condition was randomly assigned for each subject by sealed envelopes. No blinding of subjects or assessors has been used. The tests were performed and administrated at REVAL (Rehabilitation Research Center) in Diepenbeek.

4.2 Participants

18 subjects (12 men and 6 women) with established abdominal obesity (based on waist circumference > 102 cm and > 88 cm, respectively) and an age between 18 and 65 years were included in this study. When the subject was pregnant or has acute/chronic neurological, respiratory, cardiovascular, psychologic, musculoskeletal and/or orthopaedic problems the subject was excluded. An increased cardiovascular risk profile was allowed. The subjects were recruited via the ongoing study 'Fat tissue cavitation and the effects on body composition and cardiometabolic risk in obese individuals' and via advertisements on social media and in the central region of Limburg, Belgium. Their demographics were recorded, a health history questionnaire was completed and the informed consent was signed prior to the testing.

4.3 Ethical approval

This study is approved by the Medical Ethics Committee of the Hasselt University. The approval is encoded as B9115201836154 and is included in the appendix.

4.4 Intervention

During the two test moments, the subjects had to walk 30 minutes on a treadmill (Technogym) at three walking speeds (3, 4 and 5 km/h) under two conditions (without and with a weighted vest of 15% BM) (29, 30). The treadmill was inclined with 1% to simulate outdoor walking (23). Wearing or not wearing a weighted vest and the speed were the independent variables. Dependent variables were energy consumption, VO_2, RER, HR, $\%HR_{max}$, CHO oxidation, fat oxidation, perception of exertion and discomfort. The two tests, one with and one without weighted vest, were performed on separate days (with a minimum of two days in between) to limit the effects of fatigue (29). The subjects underwent the two tests at the same time of the day, so they could eat the same on both days in the last four hours before the start of the test. At first, the subjects' characteristics (age, body mass, height, BMI, waist-hip circumference and ratio) were asked and measured. The body mass was used to determine the mass for the weighted vest, which was 15% BM. The weighted vest could range from 0.4 kg up to 10 kg. The weighted vest without weight in its pouches weighed 0.4 kg, while the eight free weights weighed 1.2 kg. When a subject had a body mass higher than 66 kg, a second weighted vest was used, supplemented with a number of free weights based on the body mass of the subject. This protocol was followed by the single measurement of the resting metabolism while the subjects were lying on a table for 10 minutes (11). Finally, the walking test could start.

4.5 Outcome measures

The pulmonary gas exchange (VO_2, VCO_2 and RER) was monitored continuously during rest and during the walking effort with ergospirometry (Metalyzer 2, Cortex medical, Leipzig, Germany). Based on the mean measurement in the five last minutes, the energy consumption was calculated with the formula: 3.94 VO_2 + 1.11 VCO_2 (36) and the substrate selection was determined with the following formulas: CHO (g/min) = (4.55 x VCO_2) - (3.21 x VO_2) and fat (g/min) = (1.67 x VO_2) - (1.67 x VCO_2) (28). The HR was also continuously monitored during the exercise with a heart rate monitor (Polar) around the chest. The HR_{max} was estimated by the formula 220-age (17). The relative exercise intensity was determined by (HR/HR_{max}) x 100 (35). Also, the heart rate and %HR_{max} were based on the mean measurement in the five last minutes. The subjects were questioned about the degree of discomfort after each block of 10 minutes at a certain speed by means of a numerical rating scale (NRS) (22) and a body map (14,25,32). The subjects situated their experienced discomfort on the body map and indicated the amount with the 11-numeric questionnaire, where 10 stands for excruciating discomfort and 0 for no discomfort at all. If a score of 7 (severe pain) or more was indicated, the test would be aborted (22). The perception of exertion would be questioned after the last block using the BORG RPE-scale (31). The subjects had to give a score between 6 and 20, where 6 stands for 'very light' and 20 for 'maximum exhaustion'.

4.5.1 Baseline characteristics

At the start of the study the baseline data such as gender, age, body mass, height, BMI, waist-hip circumference and ratio were collected.

4.5.2 Primary outcomes

The primary outcome is the pulmonary gas exchange and the calculated energy consumption.

4.5.3 Secondary outcomes

The secondary outcomes are all the other parameters measured or calculated, namely: the RER, the substrate selection (fat and CHO oxidation), the relative exercise intensity (%HR_{max}), the HR, and the perceived discomfort and exertion.

4.6 Data analysis

The data was analysed with JMP pro 14.1.0. An assumption of normality was assessed with the Shapiro-Wilk test. The dependent variables were analysed using a full-factorial mixed model for the two factors (speed (3 levels) and vest (2 levels)). Where a significant main or interaction effect was noted, the Matched-Pairs t-test was used to evaluate the differences between the vest and speed conditions, respectively, of variables that were normally distributes. The non-parametric Wilcoxon signed-rank test was used for the differences of variables that were not normally distributed. The correlation between the weight, BMI, age, gender and energy consumption for a certain weighted vest condition at different speeds was assessed by pairwise correlations. Significance was accepted at the level of $p < 0.05$.

One subject had no rest measurement and three subjects had no data of the heart rate during rest because of a malfunction of the heart rate monitor. The missing data has not been taken into the analysis.

5 Results

5.1 Baseline characteristics

The means of the baseline characteristics are illustrated in table 1. Eighteen subjects between 27 and 63 years old participated in this study (Table 1). The BMI of the subjects was between 26.6 and 39.7 kg/m^2, the mean body mass was 93.6 kg and the mean weight of the weighted vest was 14.0 kg (Table 1.).

TABLE 1.
Subjects' baseline characteristics

Number of subjects	18 (12 men, 6 women)
Age (yr)	49.2 ± 10.1
Body mass (kg)	93.6 ± 15.6
Height (cm)	173.8 ± 11.6
BMI (kg/m^2)	30.9 ± 3.9
HR_{max} (beats/min)	171 ± 10
Waist circumference (cm)	105.0 ± 9.8
Hip circumference (cm)	109.7 ± 8.7
Waist-hip ratio	1.0 ± 0.1
Weighted vest (kg)	14.0 ± 2.3

Data are means ± SD

5.2 Resting measurements

The mean energy consumption in rest was 1.64 ± 0.36 kcal/min. The mean heart rate in rest was 59 ± 9 beats/min (data not shown).

5.3 Metabolic response measurements

The metabolic responses (energy consumption, oxygen consumption and RER) during walking with and without weighted vest are displayed in table 2. Significant vest ($p_{vest} < 0.01$), speed ($p_{speed} < 0.01$) and interaction effects ($p_{speed\ x\ vest} < 0.01$) were found for the oxygen and energy consumption. This is not the case for the RER, where only a speed effect was found ($p_{speed} < 0.01$) (data not shown). The energy consumption was significantly higher during walking with a weighted vest than without a weighted vest within the same speed condition ($p < 0.01$) (Table 2, Figure 1). The increase in energy consumption by wearing a weighted vest is significantly greater at a speed of 5 km/h (22%) than at 3 km/h (17%) ($p < 0.01$), but not than at 4 km/h (19%) (Table 2, Figure 1). As the speed increased, the energy consumption increased significantly within the same vest condition ($p < 0.01$) (Table 2, Figure 2). Also, the oxygen consumption was significantly higher during walking with a weighted vest than without a weighted vest within the same speed condition ($p < 0.01$) (Table 2). As the speed increased, the oxygen consumption increased significantly within the same vest condition ($p < 0.01$) (Table 2). The RER was only significantly higher during walking with a weighted vest than without a weighted vest at 5 km/h ($p < 0.05$) (Table 2). As the speed increased, the RER increased significantly within the same vest condition ($p < 0.01$) (Table 2). The vest effect on the energy consumption at 5 km/h was positively correlated with the body mass ($r=0.50$, $p < 0.05$). Gender, BMI or age were not related to energy consumption (data not shown).

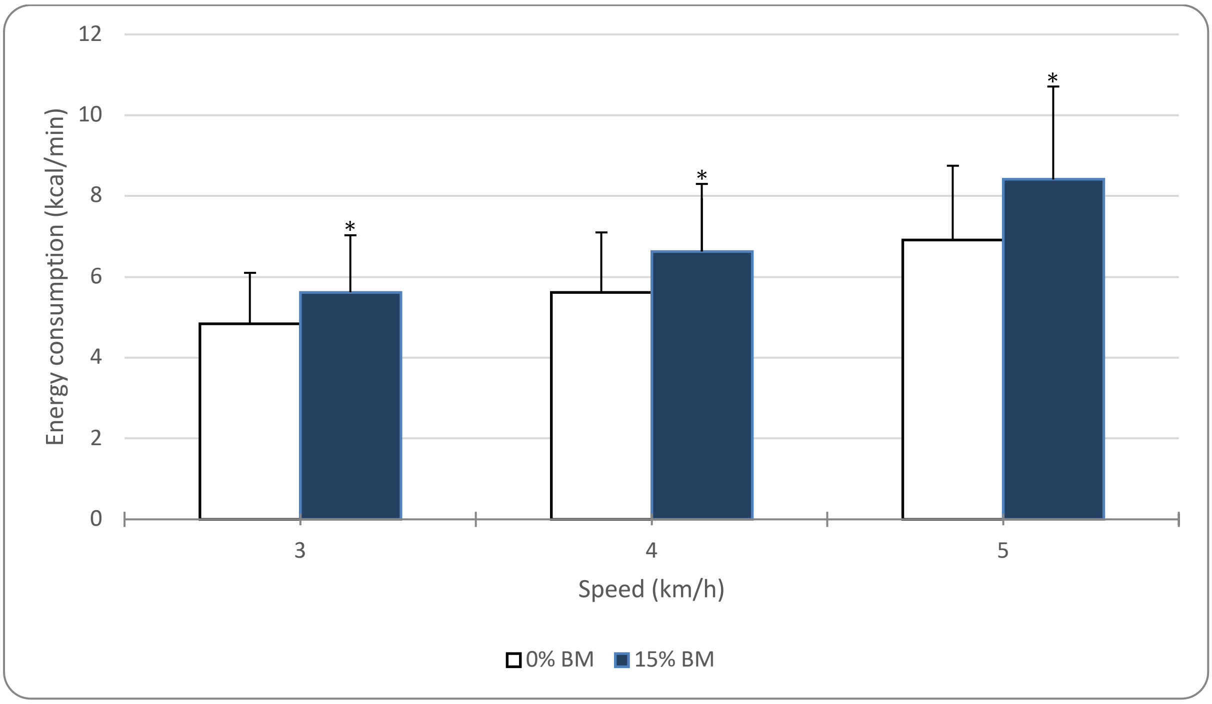


FIGURE 1. *Means (+ SD) of the energy consumption for each weighted vest condition (0%, 15% BM) within a speed condition (3, 4, 5 km/h).* * Significantly different from 0% BM: $p < 0.01$.

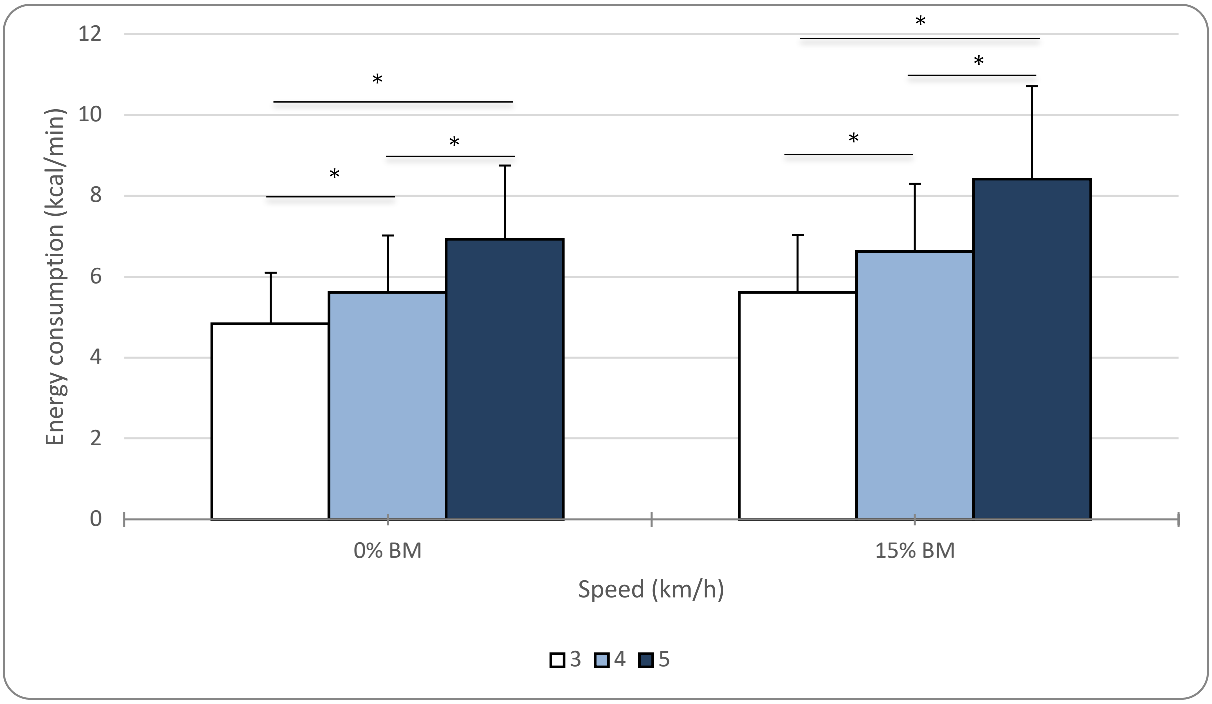


FIGURE 2. *Means (+ SD) of the energy consumption for each speed condition (3, 4, 5 km/h) within a weighted vest condition (0%, 15% BM).* * Significantly different from other speed condition: $p < 0.01$.

5.4 Cardiopulmonary response measurements

The cardiopulmonary responses (HR and $\%HR_{max}$) during walking with and without a weighted vest are displayed in table 2. Significant vest ($P_{vest} < 0.01$), speed ($p_{speed} < 0.01$) and interaction effects ($p_{speed\ x\ vest} < 0.01$) were found for the HR and $\%HR_{max}$ (data not shown). The HR and $\%HR_{max}$ were significantly higher during walking with a weighted vest than without a weighted vest within the same speed condition ($p < 0.01$) (Table 2). As the speed increased, the HR and $\%HR_{max}$ increased significantly within the same vest condition ($p < 0.01$) (Table 2).

5.5 Substrate selection

The substrate selection (CHO oxidation and fat oxidation) during walking with and without a weighted vest are displayed in table 2. Significant speed ($p_{speed} < 0.01$), vest ($p_{vest} < 0.01$) and interaction effects ($p_{speed\ x\ vest} <0.01$) were found for the CHO oxidation. Only a significant speed effect was found for the fat oxidation ($P_{speed} < 0.01$) (data not shown). The CHO oxidation was significantly higher during walking with a weighted vest than without a weighted vest within the same speed condition ($p < 0.05$) (Table 2). As the speed increased, the CHO oxidation increased significantly within the same vest condition ($p < 0.05$) (Table 2). The fat oxidation only increased significantly with increasing speed from 4 to 5 km/h during walking without a vest ($p < 0.01$) (Table 2).

TABLE 2.

Effects of vest weight (0% BM, 15% BM) at each walking speed (3, 4, 5 km/h) on cardiopulmonary measurements and substrate selection

Condition		Energy consumption (kcal/min)	VO_2 (l/min)	RER	Heart rate (beats/min)	Relative exercise intensity (%HR_{max})	CHO oxidation (g/min)	Fat oxidation (g/min)
3 km/h								
	0 %BM	4.84 ± 1.26	1.00 ± 0.26	0.80 ± 0.06	83 ± 11	49 ± 6	0.43 ± 0.34	0.34 ± 0.12
	15%BM	5.62 ± 1.41**	1.16 ± 0.30**	0.82 ± 0.05	90 ± 12**	53 ± 7**	0.56 ± 0.21*	0.34 ± 0.15
4 km/h								
	0 %BM	5.61 ± 1.49††	1.15 ± 0.30††	0.82 ± 0.05††	90 ± 13††	53 ± 8††	0.64 ± 0.40†	0.33 ± 0.10
	15%BM	6.63 ± 1.67**††	1.36 ±0.34**††	0.83 ± 0.05††	98 ± 13**††	57 ± 8**††	0.78 ± 0.31*†	0.39 ± 0.14
5 km/h								
	0 %BM	6.92 ± 1.83††	1.42 ± 0.37††	0.84 ± 0.06††	99 ± 17††	58 ± 9††	0.88 ± 0.52†	0.38 ± 0.14†
	15%BM	8.41 ± 2.30**††	1.72 ± 0.47**††	0.86 ± 0.04**††	112 ± 18**††	66 ± 11**††	1.23 ± 0.53*†	0.39 ± 0.15

Values are means ± SD. BM, body mass; VO_2, oxygen consumption; RER, respiratory-exchange ratio; HR, heart rate; HR_{max}, maximum heart rate; CHO, carbohydrate

Significantly different from 0% BM within the same speed condition: *$p < 0.05$, **$p < 0.01$

Significantly different from the previous speed condition within the same vest condition: †$p < 0.05$, †† $p < 0.01$

5.6 Subjective measurement of discomfort and exertion

The location and pain score of their perceived discomfort during walking with and without a vest are displayed in table 3. When subjects walked without a weighted vest, none of them reported any pain, with exception of one. This subject reported pain in the hip at the speed of 3 and 4 km/h. The complaints that occurred while walking with a weighted vest were usually about pain at the height of the shoulders. Wearing a weighted vest caused increased discomfort in the shoulders of six subjects. In addition, four subjects experienced discomfort in the hip, three in the lower back and three in the upper back during walking with a weighted vest (Table 3).

The BORG-RPE score gives a rate of perceived exertion for the effort at 5 km/h for walking with and without a weighted vest. The mean score was 9 (ranging from 6 to 13) for walking without a weighted vest and 11 (ranging from 9 to 16) for with a weighted vest (data not shown).

TABLE 3.
Effects of vest weight (0% BM, 15% BM) at each walking speed on subjective measurements of pain and discomfort

Condition	Pain and discomfort (location and NRS score)		
	Location (number of persons)	**Main score**	**Range**
3 km/h			
0% BM	Hip (1)	2	2
15% BM	Hip (4)	3	2-3
	Shoulders (5)	3	1-6
	Lower back (3)	3	5
	Upper back (3)	4	2-6
4 km/h			
0% BM	Hip (1)	1	1
15% BM	Hip (4)	1	1-3
	Shoulders (5)	3	1-6
	Lower back (3)	3	5
	Upper back (3)	5	2-6
5 km/h			
0% BM	/	/	/
15% BM	Hip (2)	2	3-6
	Shoulders (6)	3	1-6
	Lower back (3)	5	6
	Upper back (3)	5	2-6

BM, body mass

6 Discussion

6.1 Importance of the study

As previously mentioned, obesity is a worldwide problem. Therefore, a lot of research has been done to improve weight loss by exercise programs in this population. Puthoff has shown the effect of a weighted vest of 10-15-20% BM on the energy consumption during walking in a non-obese healthy population (29). This is the first study to investigate the effect of the weighted vest on the energy consumption in adults with obesity.

6.2 Main findings of the study

The major finding of the study was that walking with a weighted vest of 15% BM at a speed of 5 km/h has the most beneficial effect on the energy consumption in adults with obesity. Additionally, the interaction effect between vest and speed must be considered. It can be noted that the increase of energy consumption, induced by wearing a weighted vest, was significantly higher at 5 km/h (22%) than at 3 km/h (17%), but without significant effect compared to 4 km/h (19%). This confirms that most benefit of the weighted vest can be achieved at 5 km/h. Another finding of the study is that all conditions required a low to moderate effort in the aerobic training zone and were therefore suitable for the obese population as well. These findings are based on the 'exercise intensity and training zones' suggested by Vanhees (35). The mean relative exercise intensity for walking without a weighted vest at 5 km/h and with a weighted vest at 4 and 5 km/h was moderate, ranging from 57 ± 8 to 66 ± 11 $\%HR_{max}$. In those three situations, people were improving their aerobic capacity more. All the other conditions were low efforts, ranging from 49 ± 6 to 53 ± 7 $\%HR_{max}$. This can be confirmed by the RER. In all conditions, the RER remains below 1.00-1.13 (13), from which can be deduced that the efforts did not come close to a maximum effort. Then, the speed and weighted vest only had a significant influence on the CHO oxidation. No clear explanation can be given why the fat oxidation only significantly increases between 4-5 km/h for the condition without weighted vest. The last finding of the study was that not every subject experienced discomfort during the tests with and without weighted vest. The highest score that was given on the NRPS during walking with a weighted vest was 6, which means that no one experienced the discomfort as severe (22). The BORG RPE-score also shows that the degree of discomfort does not cause a high perception of exertion (35). Therefore, it seems possible to execute the exercise with a weighted vest for a longer period or several times.

6.3 Consistency and inconsistency in comparison to other studies

This is the first study to investigate the effect of a weighted vest on the energy consumption in the obese population. However, research has already shown the effect of additional weight in healthy persons on various outcomes. Additional weight has been added to exercise in various forms such as a backpack (30), a box in the hands (8,18) and weights strapped on the feet (26). Also, different forms of exercise have been used such as running (25,12), stair climbing (7) and a military training program (33).

Considering these differences, the results are difficult to compare with this study. Only Puthoff investigated the effect of walking on a treadmill with a weighted vest (10-15-20 %BM) on the oxygen consumption in healthy persons. Moreover, the differences in the design of the study must be taken in to account: they did not walk ten minutes at the same speed, but four minutes (range 3.20 - 6.44 km/h). The results of Puthoff's study are comparable with this study. Both studies showed that the VO_2 and the $\%HR_{max}$ were significant higher during walking with a weighted vest of 15% BM than without a weighted vest. Puthoff added that a weighted vest of 20% BM had significant more effect than a weighted vest of 15% BM.

6.4 Limitations of the study

This study has certain limitations. One limitation is the difference in characteristics among the subjects. There were twice as many men as women and, based on the BMI, the degree of obesity ranged from overweight (25.0–29.9 kg/m^2) till obese class 2 or severe obesity (35.0–39.9 kg/m^2) (15). This is because waist circumference was used to include subjects with abdominal obesity. The waist circumference is highly correlated with BMI, which is normally used, but gives more information about the abdominal/visceral fat and therefore their cardiovascular risk profile (20,21,34,39). Another limitation of the study lies within the fact that the maximum heart rate was estimated by the formula 220-age. A more correct way to determine that value would be a maximum exercise test. That test could also have said something about the condition of the test subject. In some cases, it was necessary to wear two weighted vests, because one weighted vest could not reach a weight of 15% BM. This meant that the second weighted vest could not always be closed and that the weight was not properly distributed over the body. Furthermore, a part of the subjects also participated in a different study, a 12-week training program. The two test moments were separated by two days to limit the effects of fatigue caused by the previous test moment (29). However, the training moments of the other study could have influenced the results of this study. In addition, it was not possible to standardize the nutrition before testing, because it was not possible to test everyone at the same time of the day. To avoid nutritional differences within a subject, the subject had to eat the same four hours before the first and the second test moment. However, this still does not fully ensure that the diet could not have influenced the results. Moreover, only one weight condition was tested. According to Quesada and Puthoff, a weighted vest of 20% and 30% BM was significantly more effective on the VO2 than 15% BM in a non-obese healthy population. Because the obese population has a lower level of fitness than the healthy population, the lowest weight of the weighted vest that led to a significant increase of the VO_2 was chosen. Finally, there was one outlier in the dataset. This subject showed a larger increase in metabolic and cardiopulmonary response as result to the added weight or speed, assuming there occurred no measurements errors. These data could have influenced the results of the statistical processing.

6.5 Implications clinical practice and future

The main goal of the obese population is to lose excessive fat mass. As a weighted vest is combined with exercise training, this might be a more effective training method. Further research should focus on the effect of wearing a weighted vest of 15% BM during a training program. Therefore, it could be interesting to investigate the effect on the energy consumption and body composition after an intervention period. In case the added value of a weighted vest is demonstrated, further research must follow to compare different doses, frequencies and durations to obtain the most ideal exercise program to lose fat mass. Because wearing a weighted vest of 15% BM increases the loading on the skeletal system during walking, a possible increased risk of injury (29) and perception of discomfort should be considered.

7 Conclusion

Wearing a weighted vest of 15% BM during walking at 3, 4 and 5 km/h provides a higher energy consumption compared to walking without wearing a weighted vest in adults with obesity. A weighted vest of 15% BM provides the largest benefit at a speed of 5 km/h. However, the weighted vest caused discomfort at the hip, back and shoulders. It can be concluded that the weighted vest offers opportunities for walking programs to lose weight in the future, but the possible discomfort must be kept in mind.

8 Reference list

1. Andersen RE, Crespo CJ, Barltlett SJ, Bathon JM, Fontaine KR. Relationships between body weight gain and significant knee, hip and back pain in older Americans. *Obes Res*. 2003; 11(10): 1159-62.
2. Aune D, Greenwood DC, Chan DS, Vieira AR, Navarro Rosenblatt DA, Cade JE, et al. Body mass index, abdominal fatness and pancreatic cancer risk: a systematic review and non-linear dose-response meta-analysis of prospective studies. *Ann Oncol.* 2012; 23(4), 843–52.
3. Aune D, Navarro Rosenblatt DA, Chan DS, Abar L, Vingeliene S, Vieira AR, et al. Anthropometric factors and ovarian cancer risk: a systematic review and nonlinear dose-response meta-analysis of prospective studies. *Int J Cancer*. 2015; 136 (8), 1888–98.
4. Aune D, Navarro Rosenblatt DA, Chan DS, Vingeliene S, Abar L, Vieira AR, et al. Anthropometric factors and endometrial cancer risk: a systematic review and dose-response meta-analysis of prospective studies. *Ann Oncol.* 2015; 26, 1635–48.
5. Aune D, Sen A, Norat T, Janszky I, Romundstad P, Tonstad S et al. Body mass index, abdominal fatness and heart failure incidence and mortality: a systematic review and dose-response meta-analysis of prospective studies. *Circulation.* 2016; 133, 639–49
6. Aune D, Sen A, Prasad M, Norat T, Janszky I, Tonstad S et al. BMI and all cause mortality: systematic review and non-linear dose-response meta-analysis of 230 cohort studies with 3.74 million deaths among 30.3 million participants. *BMJ.* 2016; 353, i2156.
7. Bean JF, Herman S, Kiely DK, Frey IC, Leveille SG, Fielding RA et al. Increased velocity Exercise Specific to Task (InVEST) training: a pilot study exploring effects on leg power, balance, and mobility in community-dwelling older women. *Journal of the American Geriatrics Society*. 2004; 52(5), 799-804.
8. Bhambhani Y, Buckley S, Maikala R. Physiological and biomechanical responses
9. during treadmill walking with graded loads. *European journal of applied physiology.* 1997; 76, 544-551.
10. Catenacci VA and Wyatt HR. The role of physical activity in producing and maintaining weight loss. *Nat clin pract endocrinol metab.* 2007; 3(7): 518-529.

11. Compher C, Frankenfield D, Keim N, Roth-Yousey L, evidence analysis working group. Best Practice Methods to Apply to Measurement of Resting Metabolic Rate in Adults: A Systematic Review. *J am diet assoc*. 2006; 106(6): 881-903.
12. Cureton KJ, Evans BW, Johnson SM et al. Effect of experimental alterations in excess weight on aerobic capacity and distance running performance. *Medicine and science in sports and exercise.* 1978;10(3), 194–9.
13. Deuster PA, PhD, MPH, Heled PhD Yuval. Chapter 41- Testing for maximal aerobic power. *The sports medicine resource manual*. 2008; 520-528.
14. Devroey C, Jonkers I, De Becker A, Lenaerts G, Spaepen A. Evaluation of the effect of backpack load and position during standing and walking using biomechanical, physiological and subjective measures. *Ergonomics*. 2009; 50(5): 728-742.
15. Dixon JB, Zimmet P, Alberti KG, Rubino F and International Diabetes Federation Taskforce on Epidemiology and Prevention. Bariatric surgery: An IDF statement for obese Type 2 diabetes. *Arquivos Brasileiros de Endocrinologia e Metabologia*. 2011; 55: 367–382.
16. Donnelly JE, Blair SN, Jakicic JM, Manore MM, Rankin JW, Smith BK, et al. American college of sports medicine position stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Med sci in sports exerc*. 2009; 41(2):459-471.
17. Fox SM, Haskell WL. The exercise stress test: needs for standardization. In: *Eliakim M, Neufeld HN, editors. Cardiology: Current Topics and Progress. New York: Academic Press.* 1970;149–54.
18. Gao, ZG, Sun SQ, Goonetilleke RS, Chow DHK. Effect of an on-hip load-carrying belt on physiological and perceptual responses during bimanual anterior load carriage. *Applied ergonomics.* 2016; 55, 133-137.
19. Global BMI Mortality Collaboration, Angelantonio ED, Bhupathiraju ShN, Gao P, Wormser D, Body-mass index and allcause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. *Lancet*. 2016; 388:776–86.
20. Goh LGH, Dhaliwal SS, Welborn TA, Lee AH and Della PR. Ethnicity and the association between anthropometric indices of obesity and cardiovascular risk in women: A cross-sectional study. *BMJ open*. 2014; 4: e004702.

21. Guh DP, Zhang W, Bansback N, Amarsi Z, Birmingham CL, Anis AH. The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. *BMC Public Health.* 2009; 9:88.
22. Hjermstad MJ, Fayers PM, Haugen DF, Caraceni A, Hanks GW, Loge JH et al. Studies comparing Numerical Rating Scales, Verbal Rating Scales, and Visual Analogue Scales for assessment of pain intensity in adults: a systematic literature review. *J pain symptom manage*. 2011; 41(6): 1073-93.
23. Jones AM, Doust JH. A 1% Treadmill Grade Most Accurately Reflects the Energetic Cost of Outdoor Running. *Journal of Sports Science*. 1996; 14(4): 321-7.
24. Leitzmann MF, Moore SC, Koster A, Harris TB, Park Y, Hollenbeck A, et al. Waist circumference as compared with Body-Mass Index in predicting mortality from specific causes. *PLoS One.* 2011; 6(4):e18582.
25. Macias BR, Groppo ER, Bawa M, Tran Cao HS, Lee B, Pedowitz RA et al. Lower body negative pressure treadmill exercise is more comfortable and produces similar physiological responses as weighted vest exercise. *International journal of spots medicine*.2007; 28(6): 501-5.
26. Martin PE. Mechanical and physiological responses to lower extremity loading during running. *Medicine and science in sports and exercise.* 1985; 17(4), 427–33.
27. Obalum DC, Fiberesima F, Eyesan SU, Ogo CN, Nzew C, Mijinyawa M. A review of obesity and orthopaedic surgery the critical issues. *Niger postgrad med J.* 2012; 19(3):175-80.
28. Purge P, Lehismets P, Jürimäe J. A nem method for the measurement of maximal fat oxidation: a pilot study. *Acta kinesiologiae universitatis Tartuensis.* 2014; 20, 90-99.
29. Puthoff ML, Darter BJ, Nielsen DH, Yack HJ. The effect of weighted vest walking on metabolic responses and ground reaction forces. *Med sci sports exerc.* 2006; 38 (4), 746-52.
30. Quesada PM, Mengelkoch LJ, Hale RC, Simons SR. Biomechanical and metabolic effects of varying backpack loading on simulated marching. *Ergonomics.* 2000; 43(3), 29.
31. Scherr J, Wolfarth B, Christle JW, Pressler A, Wagenpfeil S, Halle M. Associations between Borg's rating of perceived exertion and physiological measures of exercise intensity. *Eur J appl Physiol*. 2013; 113(1): 147-55.

32. Simpson KM, Munro BJ, Steele JR. Effect of load mass on posture, heart rate and subjective responses of recreational female hikers to prolonged load carriage. *Applied Ergonomics.* 2011; 42(3), 403–10.
33. Swain DP, Ringleb SI, Naik DN Butowicz CM. Effect of training with and without a load on military fitness tests and marksmanship. *Journal of strength and conditioning research*. 2011; 25(7),1857-65.
34. Tran NTT, Blizzard CL, Luong KN, Truong NLV, Tran BQ, Otahal P, et al. The importance of waist circumference and body mass index in cross-sectional relationships with risk of cardiovascular disease in Vietnam. *Plos One.* 2018; 13(5): e0198202. 3-309.
35. Vanhees L, Geladas N, Hansen D, Kouidi E, Niebauer J, Reiner Z, et al. Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health in individuals with cardiovascular risk factors: recommendations from the EACPR (Part II). *Eur J Prev Cardiol.* 2012; 19(5) 1005–33.
36. Weir V., J.B. New methods for calculating metabolic rate with special reference to protein metabolism. *J. physiol*. 1949; 109, 1-9.
37. Whitlock G, Lewington S, Sherliker P, Clarke R, Emberson J, Halsey J et al. Body-mass index and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. *Lancet*. 2009; 373, 1083–96.
38. Wiklund P. The role of physical activity and exercise in obesity and weight management: Time for critical appraisal. J of Sport Health Sci. 2016; 5 (2), 151-154.
39. Zazai R, Wilms B, Ernst B, Thurnheer M, Schultes B. Waist circumference and related anthropometric indices are associated with metabolic traits in severely obese subjects. *Obes Surg*. 2014; 24 (5):777-82.

Appendix

Study design

Ethical approval

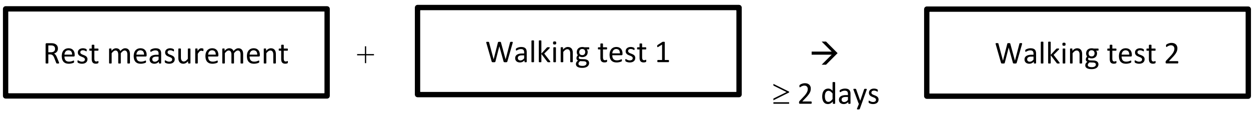
Screening questionnaire

Food questionnaire

Measuring instrument: body map + NRS

Measuring instrument: Borg RPE-scale

Study design



Ethical approval

www.uhasselt.be
Campus Hasselt | Martelarenlaan 42 | BE-3500 Hasselt
Campus Diepenbeek | Agoralaan gebouw D | BE-3590 Diepenbeek
T + 32(0)11 26 81 11 | E-mail: info@uhasselt.be

UHASSELT
KNOWLEDGE IN ACTION

Definitief gunstig advies
Amendement 1

Faculteit Geneeskunde en Levenswetenschappen
Comité voor Medische Ethiek
Voorzitter: prof. dr. Ivo Lambrichts
Secretariaat: Marleen Missotten
Tel.: 011 26 85 02
Fax: 011 26 85 99
E-mail: cme@uhasselt.be

ons kenmerk	uw kenmerk	Diepenbeek
CME2018/008		20/11/2018

Titel protocol	**Ultrasoon-geïnduceerde vetweefsel cavitatie: effect op cardiometabool risico en lichaamssamenstelling bij personen met obesitas.**
Nummer protocol	
Opdrachtgever	Universiteit Hasselt
Eudractnummer	NVT
Belgisch nummer	**B9115201836154**
Onderzoeker	Prof. dr. Dominique Hansen, dr. Kenneth Verboven

Geachte collega,

Op 12 april 2018 keurde het CME UHasselt het bovenvermelde dossier definitief goed.

Op 19 november 2018 werd een amendement ingediend:

Het betreft een toevoeging van een éénmalige wandeltest (met of zonder gewichtsvest) waarbij het energieverbruik zal worden gemeten. De meting zal worden uitgevoerd op een moment tijdens de interventie

Het gunstig advies betreft de volgende documenten:
- Protocol versie 11/11/2018
- Informatie- en toestemmingsformulier versie 3, dd 11/11/2018.

Het ethisch comité heeft geen bezwaren tegen de wijzigingen en keurt het amendement goed.

Het Comité voor Medische Ethiek van UHasselt handelt volgens de geldende richtlijnen van de 'International Conference of Harmonization (ICH) Good Clinical Practice (GCP)' en volgens alle geldende en van toepassing zijnde wetten en reglementen.

Met oprechte hoogachting,

Prof. dr. Ivo Lambrichts
Voorzitter Comité voor Medische Ethiek

Cc:

FAGG – Research & Development department, Victor Hortaplein 40, bus 40, 1060 Brussel

Screening questionnaire

Indien u interesse heeft in het onderzoek dat is omschreven in de informatie brochure, wilt u dan zo vriendelijk zijn deze screeningsvragenlijst volledig in te vullen en aan ons te retourneren.
Uw identiteit en uw deelname aan deze studie wordt strikt vertrouwelijk behandeld.

Proefpersooncode (in te vullen door de onderzoeker):

Persoonlijke gegevens

Voor- + achternaam: …………………………………………………………………..

Roepnaam:………………………………………………………………………………..

Adres: ………………………………………………………………………………………..

Postcode en plaats: ………………………………………………………………………….

Tel Thuis: …………………………………………………………..........…………………….

Tel GSM: ………………………………………………………………………………….

E-mail: ……………………………………………………………………………………

Geboortedatum: ……………………………………………………………………….

Geslacht: ❑ man

❑ vrouw

Naam van uw huisarts/behandelende arts: ……………………………………….

Adres: ………………………………………………………………………………

Tel.: ……………………………………………………………………..……………

Gezondheid

1. Bent u op dit moment in goede gezondheid: ❑ ja ❑ nee
2. Bent u de laatste tijd nog opgenomen geweest in het ziekenhuis? ❑ ja ❑ nee

   Zo ja, reden:..………………………………………………

3. Bent u onder medische behandeling: ❑ ja ❑ nee

   Zo ja, bij huisarts/specialist:..……………………………….

   Reden:........………………………………………………

4. Heeft een arts ooit een van onderstaande ziekten bij u geconstateerd?
   - Type 1 of 2 diabetes (ouderdomssuikerziekte) ❑ ja ❑ nee
   - Stollingsziekten of veneuze trombose ❑ ja ❑ nee
   - Hoge bloeddruk ❑ ja ❑ nee
   - Hartinfarct of andere hart- en vaataandoeningen ❑ ja ❑ nee
   - Nierziekten ❑ ja ❑ nee

- Chronische ontstekingen (vb. artritis, flebitis, dermatitis) ❑ ja ❑ nee
- Leverziekten ❑ ja ❑ nee
- Problemen met uw schildklier ❑ ja ❑ nee
- Ziekte met een levensverwachting minder dan 5 jaar ❑ ja ❑ nee
- Hersen- of zenuwaandoeningen ❑ ja ❑ nee
- Osteoporose ❑ ja ❑ nee
- Epilepsie ❑ ja ❑ nee

5. Bent u allergisch? ❑ ja ❑ nee

    Zo ja, voor wat?..

6. Draagt u een pacemaker of defibrillator ? ❑ ja ❑ nee
7. Heeft u de afgelopen 3 maanden een stabiel lichaamsgewicht? ❑ ja ❑ nee
8. Bent u op dit moment aan het afvallen (dieet / meer sporten)? ❑ ja ❑ nee
9. Bent u momenteel zwanger of plant u een zwangerschap in de komende 6 maanden? ❑ ja ❑ nee
10. Heeft u in de afgelopen 6 maanden een botbreuk gehad? ❑ ja ❑ nee
11. Draagt u een (metale) prothese? ❑ ja ❑ nee

    Zo ja, waar? …………………………………………………………….

Medicatie

12. Gebruikt u medicatie? ❑ ja ❑ nee

    Zo ja, kunt u hier details over geven? (welke medicatie, reden van gebruik, merk, dosis, periode)

    ……………………………………………………………………………..

    ……………………………………………………………………………..

    ……………………………………………………………………………..

Beweging

13. Heeft u wel eens moeite met bewegen, zoals fietsen of traplopen? ❑ ja ❑ nee

    Zo ja, waarom?…………………………………………………………….

14. Doet u aan sport? ❑ ja ❑ nee

    Zo ja, welke sport en hoeveel uur per week?………………………………

    ……………………………………………………………………………..

Lengte en gewicht

15. Wat is uw lengte? ………………………………meter
16. Wat is uw gewicht? ……………………………kg

Diversen

17. Doet u op dit moment mee aan een ander onderzoek? ❑ ja ❑ nee

    Zo ja, wat voor soort onderzoek is dat en wat is de naam van de onderzoeker?

    ……………………………………………………………………………..

    ……………………………………………………………………………..

18. Heeft u vakanties gepland in het komende half jaar? ❑ ja ❑ nee

    Zo ja, wanneer is de vakantie gepland?

    Van: ……/……../……. tot ……../………/……..

    Van: ……/……../……..tot ……../………/……..

19. Wat zijn uw normale werktijden?

Van ……..:………uur tot ……….:………..uur

Van ……..:………uur tot ……….:………..uur

Van ……..:………uur tot ……….:………..uur

Indien u nog verdere opmerkingen of bijzonderheden heeft, kunt u deze hier vermelden:

……………………………………………………………………………………………….

……………………………………………………………………………………………….

……………………………………………………………………………………………….

……………………………………………………………………………………………….

……………………………………………………………………………………………….

Bedankt voor het invullen!

Indien u voldoet aan de eisen van het onderzoek, zal met u contact worden opgenomen voor de screening (het vooronderzoek).

Food questionnaire

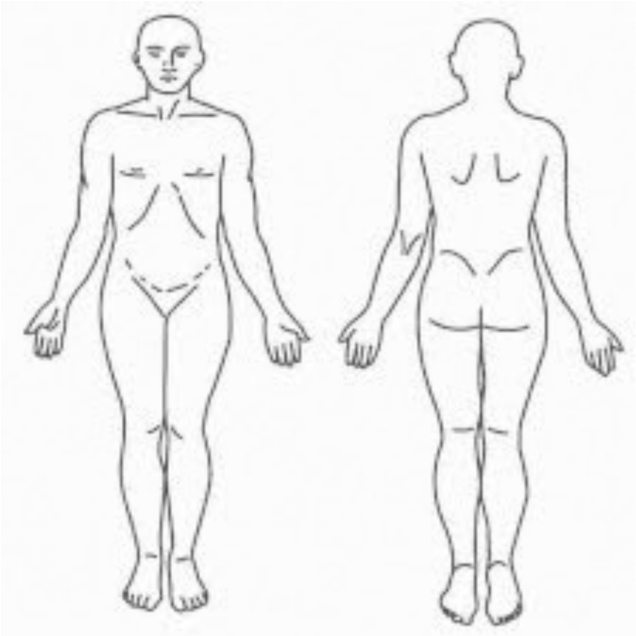
U mag op de lijntjes noteren wat u de afgelopen 4 uur gegeten heeft.
Probeer zo gedetailleerd mogelijk te zijn.

Testmoment 1 (datum + tijdstip: ……….)

……
……
……
……
……
……
……
……
……
……………………………………………………………………………………………………

Body map + numeric rating scale

Heeft u ergens discomfort ervaren tijdens het wandelen? Zo ja, dan mag u de locatie daarvan aanduiden op het lichaam met een kruisje. De intensiteit van het discomfort mag op de NRS worden ingevuld. Een score 0 is gelijk aan geen ervaren discomfort en 10 is het meest denkbare discomfort.



0	Geen discomfort
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	Maximaal discomfort

Borg RPE-scale

Hoe zwaar vond je de inspanning? De ervaren zwaarte hangt voornamelijk af van de mate van inspanning, vermoeidheid in de spieren en het gevoel van ‘buiten adem zijn’. Geef een score van 6 tot 20. Hierbij betekent 6 geen enkele belasting en 20 een maximale inspanning. Probeer jouw gevoelens zo eerlijk mogelijk te beschrijven zonder te overwegen hoe zwaar de belasting werkelijk is.

Belasting	Borg RPE-score
	6
Zeer zeer licht	7
	8
Zeer licht	9
	10
Tamelijk zwaar	11
	12
Redelijk zwaar	13
	14
Zwaar	15
	16
Zeer zwaar	17
	18
Zeer zeer zwaar	19
	20

In te vullen door de promotor(en) en eventuele copromotor aan het einde van MP2:

Naam Student(e): Lore Huijers, Helena Vermeersch **Datum:** 24/05/2019

Titel Masterproef: Clinical impact of a weight vest during walking

1) Geef aan in hoeverre de student(e) onderstaande competenties zelfstandig uitvoerde:
   - NVT: De student(e) leverde hierin geen bijdrage, aangezien hij/zij in een reeds lopende studie meewerkte.
   - 1: De student(e) was niet zelfstandig en sterk afhankelijk van medestudent(e) of promotor en teamleden bij de uitwerking en uitvoering.
   - 2: De student(e) had veel hulp en ondersteuning nodig bij de uitwerking en uitvoering.
   - 3: De student(e) was redelijk zelfstandig bij de uitwerking en uitvoering
   - 4: De student(e) had weinig tot geringe hulp nodig bij de uitwerking en uitvoering.
   - 5: De student(e) werkte zeer zelfstandig en had slechts zeer sporadisch hulp en bijsturing nodig van de promotor of zijn team bij de uitwerking en uitvoering.

Competenties	NVT	1	2	3	4	5
Opstelling onderzoeksvraag	O	O	O	O	X	O
Methodologische uitwerking	O	O	O	O	O	X
Data acquisitie	O	O	O	O	O	X
Data management	O	O	O	O	X	O
Dataverwerking/Statistiek	O	O	O	O X	O	O
Rapportage	O	O	O	O	X	O

2) Niet-bindend advies: Student(e) krijgt toelating/geen toelating (schrappen wat niet past) om bovenvermelde Wetenschappelijke stage/masterproef deel 2 te verdedigen in bovenvermelde periode. Deze eventuele toelating houdt geen garantie in dat de student geslaagd is voor dit opleidingsonderdeel.

3) Deze wetenschappelijke stage/masterproef deel 2 mag wel/niet (schrappen wat niet past) openbaar verdedigd worden.

4) Deze wetenschappelijke stage/masterproef deel 2 mag wel/niet (schrappen wat niet past) opgenomen worden in de bibliotheek en docserver van de UHasselt.

Datum en handtekening Student(e)	Datum en handtekening promotor(en)	Datum en handtekening Co-promotor(en)
24/05/2019	24/05/2019	
[signature] Lore Huijers	[signature]	
[signature] Helena Vermeersch		

www.uhasselt.be
Campus Hasselt | Martelarenlaan 42 | BE-3500 Hasselt
Campus Diepenbeek | Agoralaan gebouw D | BE-3590 Diepenbeek
T + 32(0)11 26 81 11 | E-mail: info@uhasselt.be

UHASSELT
KNOWLEDGE IN ACTION

INVENTARISATIEFORMULIER WETENSCHAPPELIJKE STAGE DEEL 2

DATUM	INHOUD OVERLEG	HANDTEKENINGEN
30/10/2018	Protocol	Promotor: Copromotor/Begeleider: Student(e): Student(e):
19/02/2019	Zoeken van extra deelnemers Data in excell overlopen Statistiek bespreken	Promotor: Copromotor/Begeleider: Student(e): Student(e):
05/03/2019	Statistiek in Jmp bespreken	Promotor: Copromotor/Begeleider: Student(e): Student(e):
19/04/2019	Overlopen artikel en statistiek	Promotor: Copromotor/Begeleider: Student(e): Student(e):
13/05/2019	Overlopen nieuwe methode statistiek	Promotor: Copromotor/Begeleider: Student(e): Student(e):
23/05/2019	Controle definitieve versie	Promotor: Copromotor/Begeleider: Student(e): Student(e):
		Promotor: Copromotor/Begeleider: Student(e): Student(e):
		Promotor: Copromotor/Begeleider: Student(e): Student(e):
		Promotor: Copromotor/Begeleider: Student(e): Student(e):
		Promotor: Copromotor/Begeleider: Student(e): Student(e):