CENTER FOR EXERCISE & NUTRITION SCIENCE

PHYSICAL ACTIVITY AND FUNCTIONAL CAPACITY AMONG NORMAL-WEIGHT, OVERWEIGHT AND OBESE GREEK YOUNG ADULTS

"Dissertation submitted in accordance with the requirements of University of Chester for the degree of Master of Science"

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ABSTRACT

Physical activity and functional capacity among normal-weight, overweight and obese Greek young adults

Athinais-Georgia Psichogiou

Objective: The aims of this study were to present information regarding the physical activity (PA) profile, functional capacity (FC) status and body composition of normal-weight, overweight and obese young Greeks, to investigate the impact of overweight and obesity on the subjects' PA and FC and to explore possible interrelations between their anthropometric characteristics, PA and FC.

Method: Sixty-two healthy, Greek young adults (27 males), with a mean age of 23.9 ± 3.9 years, attended a single testing session during which they were subjected to anthropometric and physiological measurements, they completed the Greek version of the Short International Physical Activity Questionnaire (IPAQ-S_{GR}) and they performed two six-minute walk tests (6MWT) using a standardised protocol. Analysis of variance and post hoc analysis was used to investigate possible differences between the three groups, while bivariate correlational techniques were used to assess possible interrelations between the subjects' anthropometric characteristics, their PA and FC.

Results: During the 6MWT, overweight subjects walked significantly further (624.0 ± 88.8 m) than obese subjects (544.9 ± 108.4 m) (p<0.01). No significant differences were observed between the three groups regarding IPAQ scores. Significant associations were mainly detected between the subjects' anthropometric characteristics and 6MWT-related variables.

Conclusions: The FC of normal and overweight subjects appeared to be similar and better than that of obese subjects, while, all subjects, regardless of BMI categorisation, were found to have similar PA profiles. This study further supports the association between obesity indices and functional capacity.

Key words: IPAQ, 6-minute walk test, overweight, obesity, young Greeks

℘ DECLARATION ☙

This work is original and has not been previously submitted in support of a Degree, qualification or other course.

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"If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health".

Hippocrates, 460-370 B.C.

To my family

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℘ LIST OF ABBREVIATIONS ☙

ACSM: American College of Sports Medicine
ADL: activities of daily living
ADP: air-displacement plethysmography
AHA: American Heart Association
ASD: abdominal sagittal diameter
ATS: American Thoracic Society
BH: body height
Borg CR-10 Scale: Ten-point category-ratio Borg scale
BIA: bioelectrical impedance analysis
BMI: body mass index
BP: arterial blood pressure
BW: body weight
CAD: coronary artery disease
CDC: Centers for Disease Control and Prevention
CMA: Canadian Medical Association
CT: computed axial tomography
CVD: cardiovascular disease
DBP: diastolic blood pressure
DXA: dual-energy x-ray absorptiometry
EASO: European Association for the Study of Obesity
EU: European Union
EE: energy expenditure
FC: functional capacity
FFM: fat free mass
FM: fat mass
HC: hip circumference
HD: hydrodensitometry
HR_{max}: maximum heart rate
HR_{peak}: peak heart rate
%HRmax: percentage of age-predicted maximum heart rate
HRR: heart rate reserve
HLBI: Heart, Lung & Blood Institute
IASO: International Association for the Study of Obesity
IPAQ: International Physical Activity Questionnaire
IPAQ-L: Long version of the International Physical Activity Questionnaire
IPAQ-S: Short version of the International Physical Activity Questionnaire
IPAQ-S_{EN}: English version of the short IPAQ
IPAQ-S_{GR}: Greek version of the short IPAQ
METs: resting metabolic equivalents (1 MET = 3.5 ml O2/kg/min, representing the average rate of energy expenditure at rest)
MRI: magnetic resonance imaging
NHLBI: National Heart, Lung & Blood Institute
NICE: National Institute for Health and Clinical Excellence
NIR: near-infrared interactance
PA: physical activity
RPE: ratings of perceived exertion
SKFA: skinfold analysis
SBP: systolic blood pressure
SIGN: The Scottish Intercollegiate Guidelines Network
6MDWP: six-minute distance weight product
6MWD: six-minute walk distance
6MWT: six-minute walk test
TBW: total body water
USDHHS: United States Department of Health and Human Services
$\dot{V}O_{2max}$: maximal oxygen uptake
WC: waist circumference
WHO: World Health Organization
WHR: waist-to-hip ratio
%BF: percent body fat

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Introduction

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INTRODUCTION

1.1 GENERAL INTRODUCTION

1.1.1 STATEMENT OF THE PROBLEM

According to the World Health Organisation (WHO), cardiovascular diseases (CVDs) – particularly ischemic heart disease and cerebrovascular disease – are the number one cause of death globally (WHO, 2009). In 2004, an estimated 17.1 million people died from CVDs, representing 29% of all global deaths (WHO, 2009). Things will only get worse as, by 2030, it is predicted that almost 23.6 million people will die from CVDs, which will remain the single leading cause of death worldwide (WHO, 2009). Similarly, CVDs comprise the main cause of death in the European Union (EU), accounting for 42% of all deaths in the total population (Eurostat, 2009).

Along with the rest of the world, CVDs constitute the bigger killer among Greek people, accounting for 49% of total deaths in Greece (NSSG, 2007). Moreover, the burden of CVDs in Greece is increasing at alarming rates as indicated by the escalating prevalence rates of CVD risk factors (Vardavas, Linardakis, Hatzis, Saris & Kafatos, 2010; Tambalis *et al.*, 2010; Panagiotakos, Pitsavos, Chrysohoou, Skoumas & Stefanadis, 2009; Vardavas, Linardakis, Hatzis, Saris & Kafatos, 2009; Yannakoulia *et al.*, 2008; Panagiotakos *et al.*, 2008; Tzotzas *et al.*, 2008; Papadimitriou *et al.*, 2008; Tzormpatzakis & Sleap, 2007; Athyros *et al.*, 2005; Magkos, Manios, Christakis & Kafatos, 2005; Bertsias, Mammas, Linardakis & Kafatos, 2003; Panagiotakos *et al.*,

2003; Pitsavos *et al.*, 2003; Pitsavos & Toutouzas, 2002) and the mounting incidence of CVD morbidity and mortality (Andrikopoulos *et al.*, 2007; Papathanasiou *et al.*, 2005; Pitsavos *et al.*, 2005; Chimonas, 2001; Voukiklaris, Kafatos & Dontas, 1996). This fact is highly disturbing considering that in the early 1960s Greece had very low mortality rates from CVDs, as indicated by the findings of the Seven Countries Study (Keys, 1970; cited in Manios, Panagiotakos, Pitsavos, Polychronopoulos & Stefanadis, 2005). This was primarily attributed to the devotion to the traditional Greek diet and its protective influence from CVDs and the high levels of physical activity (PA), both leading to a low CVD risk profile. However, from the mid-1900s until the end of the 20th century the health profile of Greek people has dramatically changed leading to high rates of both adult and childhood obesity – which is currently reaching epidemic proportions in Greece – (Roditis, Parlapani, Tzotzas, Hassapidou & Krassas, 2009; Kapantais *et al.*, 2006; Panagiotakos *et al.*, 2004), as well as one of the most rapidly rising morbidity and mortality rate from CVDs (Vardavas *et al.*, 2010). These trends are in line with socio-economic changes taking place in the Greek society and the behavioural patterns of the Greek communities, as a consequence of increased urbanisation and industrialisation, leading to a more Westernised lifestyle, characterised by adverse dietary practices and sedentary lifestyle (Vardavas *et al.*, 2010).

1.1.2 AIM OF THE STUDY

The primary aims of this study are three-fold; a) to present information about Greece regarding the PA profile and functional capacity (FC) status of normal-weight, overweight and obese young adults, b) to investigate the impact of

overweight and obesity on PA and FC of Greek young adults and c) to assess underlying relationships among the subjects' characteristics and their PA and FC.

1.1.3 SPECIFIC OBJECTIVES OF THE STUDY

The specific goals of this study are: a) to give information regarding the PA profile, FC status and body composition of Greek young adults aged 18-30 years old, b) explore the differences between normal-weight, overweight, and obese participants in relation to their PA level – based on their scoring in the International Physical Activity Questionnaire (IPAQ) – and FC status – based on their performance in the six-minute walk test (6MWT) –, in order to determine the impact of overweight and obesity in the aforementioned factors, c) to investigate the influence of several anthropometric (height - BH, weight - BW, body mass index - BMI, waist circumference - WC and waist-to-hip ratio - WHR), physiological (heart rate - HR, blood pressure - BP and perceived exertion - RPE), socio-demographic (age and gender) and lifestyle (smoking) characteristics of the participants' PA level and FC status, and d) to determine the relationship between the participants' PA level and FC status.

1.1.4 STUDY NULL AND ALTERNATIVE HYPOTHESES

The study's null hypothesis (H_0) could be stated as three separate hypotheses which are expressed as follows:

H_0^1: *There are no significant differences in PA level (IPAQ) and FC status (6MWT) between normal-weight, overweight and obese participants.*

H_0^2: *There is no significant relationship among the participants' anthropometric, socio-demographic and lifestyle characteristics and their PA level (IPAQ) and FC status (6MWT).*

H_0^3: *There is no significant relationship between the participants' PA level (IPAQ) and FC status (6MWT).*

The corresponding alternative hypotheses could be stated as follows:

H_a^1: *There are significant differences in PA level (IPAQ) and FC status (6MWT) between normal-weight, overweight and obese participants.*

H_a^2: *There is a significant relationship among the participants' characteristics and their PA level (IPAQ) and FC status (6MWT).*

H_a^3: *There is a significant relationship between the participants' PA level (IPAQ) and FC status (6MWT).*

1.1.5 SIGNIFICANCE OF THE STUDY

There is indisputable evidence supporting the effectiveness of regular PA in the primary and secondary prevention of obesity, several chronic diseases and premature death (Janssen & LeBlanc, 2010; Bouchard, Blair & Haskell, 2007; Warburton, Whitney & Bredin, 2006; Shephard & Balady, 1999; USDHHS, 1996). However, PA is not part of the average lifestyle of most people in Greece, currently (Tzormpatzakis & Sleap, 2007). The fact that young adulthood is identified as the age of greatest decrease in PA levels (Zimmermann-Sloutskis, Wanner, Zimmermann & Martin, 2010; Allison, Adlaf, Dwyer, Lysy & Hyacinth, 2007; Leslie, Fotheringham, Owen & Bauman, 2001; Caspersen *et al.*, 2000; Telama & Yang, 2000; Van Mechelen, Twisk, Post, Snel & Kemper, 2000; Sallis, 2000; WHO, 2000), underscores the necessity to study PA behaviours and obesity status within the general Greek young adult population, because that way patterns may emerge that could be beneficial in designing and implementing effective prevention and health promotion

programmes targeting at the same age group. In view of the scarcity of relevant epidemiological data regarding young Greeks' PA profile, FC and body composition, the information provided by this study will be a valuable addition to the existing, limited literature, with a particular emphasis placed on studying differences between normal-weight, overweight and obese individuals.

1.2 BACKGROUND TO THE RESEARCH – LITERATURE REVIEW

1.2.1 PHYSICAL ACTIVITY

1.2.1.1 OPERATIONAL DEFINITIONS AND CONCEPTUAL FRAMEWORK

Physical activity is a complex exposure variable. The construct representing this exposure may best be defined as "movement" with two dimensions: PA, as a behaviour, which is typically quantified in terms of its frequency (e.g. number of PA bouts per week) and its duration (e.g. minutes per PA bout) and energy expenditure (EE), the energy cost of the behaviour, which reflects the intensity associated with a given PA (Lamonte & Ainsworth, 2001). Physical activity can be operationally defined as "any bodily movement, produced by the contraction of skeletal muscles, resulting in a substantial increase over resting energy expenditure" (Caspersen, Powell & Christenson, 1985). It is a global term which encompasses a wide range of activities including purposive exercise, sports, dance, leisure-time activity, occupation-, transportation-, household- and family-related activity. Exercise, on the other hand, is a subset of PA that could be defined as "planned, structured and repetitive bodily movement done to improve or maintain one or more components of physical fitness" (Caspersen *et al.,* 1985). Sport is a form of PA that involves competition (Bouchard *et al.,* 2007). Health-enhancing PA is activity that, when

added to baseline activity produces health benefits and promotes FC (CDC, 2009). Leisure is a concept that includes the elements of free choice, freedom from constraints, intrinsic motivation, enjoyment, relaxation, personal involvement, and opportunity for self-expression (Henderson, Bialeschki, Shaw & Freysinger, 1996; in Thomas, Nelson & Silverman, 2005). Leisure-time PA is an activity undertaken in the individual's discretionary time that increases the total daily energy expenditure (Bouchard *et al.*, 2007). Physical fitness is "a multidimensional concept associated with a set of attributes that people have or achieve that relates to the ability to perform PA", and includes a number of components such as cardiorespiratory endurance, skeletal muscle endurance, strength and power, flexibility, balance, speed of movement, reaction time and body composition (Caspersen *et al.*, 1985).

1.2.1.2 ASSESSMENT OF PHYSICAL ACTIVITY

Several methods of assessing PA and EE exist along a continuum of accuracy and feasibility (Westerterp, 2009; Ainsworth, 2009; Lagerros & Lagiou, 2007; ACSM, 2006b; Vanhees *et al.*, 2005; Welk, 2002; Lamonte & Ainsworth, 2001; Schutz, Weinsier & Hunter, 2001; Smith & Morris, 1992; Schoeller & Racette, 1990; Laporte, Montoye & Caspersen, 1985), yet, no true "gold standard" measure of PA exists (Tudor-Locke & Myers, 2001; cited in Fitzgerald & Morrow, 2006). Each method has strengths and limitations for its use in epidemiological research and as a health-related outcome measure either among free-living individuals or under controlled conditions.

Physical activity can be directly or indirectly assessed either as the behaviour, or as the energy cost of that behaviour. Direct methods assessing the behavioural aspect of PA, can either describe or measure PA as it occurs. Direct

methods describing PA behaviour include direct observation, where a trained observer records PA behaviour for a predetermined period (Pate, O'Neill & Mitchell, 2010; McIver, Brown, Pfeiffer, Wowda & Pate, 2009; McKenzie, 2002), PA diaries, providing a detailed accounting of virtually all PAs performed, and PA logs, an ongoing record of a subject's participation in certain types of PA (Haskell & Kiernan, 2000). Direct methods measuring movement as it occurs, include mechanical or electronic devices such as pedometers counting steps taken (De Cocker, De Bourdeaudhuij & Cardon, 2009; Schneider, Crouter & Bassett, 2004; Welk *et al.*, 2000), or accelerometers measuring movement based on acceleration and deceleration of the body (Bonomi, Goris, Yin & Westerterp, 2009; Godfrey, Conway, Meagher & ÓLaighin, 2008; Plasqui & Westerterp, 2007; Ward, Evenson, Vaughn, Rodgers & Troiano, 2005; Trost, McIver & Pate, 2005; Chen & Bassett, 2005), or global positioning units using signal information between satellites and receivers, worn by individuals, ascertaining the velocity and duration of displacement (Maddison & Mhurchu, 2009; Duncan, Badland & Mummery, 2009; Townshend, Worringham & Stewart, 2008; Rodríguez, Brown & Troped, 2005; Schutz & Herren, 2000).

On the other hand, direct methods measuring the energy cost of PA include techniques such as the doubly labeled water technique, determining carbon dioxide utilisation by measuring the elimination kinetics of deuterium and oxygen-18 isotopes (Starling, 2002; Speakman, 1998; Coward, 1991; Schoeller, 1988; Schoeller, 1983) or direct and indirect calorimetry, measuring body heat production and oxygen consumption, respectively (Levine, 2005; Starling, 2002; De Jonge *et al.*, 2001; Schoeller & Racette, 1990).

Indirect methods provide indicators of PA and EE, such as the use of questionnaires for patients to recall characteristics of recent activity (Matthews, 2002; Sallis & Saelens, 2000; Pereira *et al.*, 1997; Kriska & Caspersen, 1997) or monitoring of HR, a physiological correlate of EE (Strath *et al.*, 2000; Freedson & Miller, 2000). Since, no single assessment device or method adequately measures PA, the combination of different methods of PA assessment, as, for example, HR monitoring used simultaneously with a motion sensor, may be employed in order to obtain a more accurate PA profile (Janz, 2006; Brage, Brage, Franks, Ekelund & Wareham, 2005; Strath, Bassett, Thompson & Swartz, 2002; Treuth, 2002; Strath, Bassett, Swartz & Thompson, 2001). Furthermore, several other types of technologically advanced objective measures of PA, such as small, wearable computers which can be made sensible of their surroundings through video cameras and microphones and sensible of the physiology of the wearer through HR, respiration, skin conductance, and muscle activity sensors, may be helpful for improving PA assessment in the future (Healey, 2000).

1.2.1.2.1 International Physical Activity Questionnaire (IPAQ)

Physical activity questionnaires represent the most widely used method to assess PA in large numbers of subjects, as they are non-invasive, thus, well accepted by participants and easy to administer at a low cost. The IPAQ was designed by a multinational working group, supported by the WHO, as a common instrument for epidemiological studies, to estimate health-related PA levels across different countries and socio-cultural environments, targeting young and middle aged adults, 18-69 years old (Craig *et al.*, 2003). The IPAQ measures multiple domains of PA, integrating PA during leisure-time, at work, around the house, in the garden, and

for transportation. Long (IPAQ-L) and short (IPAQ-S) versions of the IPAQ are available, which could be administered either by telephone interview or by self-administration (IPAQ, 2005).

The validity and reliability of the IPAQ has been assessed by several investigators in different populations and settings (Hagströmer, Ainsworth, Oja & Sjöström, 2010; Van der Ploeg *et al.,* 2010; Deng *et al.,* 2008; Kurtze, Rangul & Hustvedt, 2008; Wolin, Heil, Askew, Matthews & Bennett, 2008; Oyeyemi, Adegoke, Oyeyemi & Fatudimu, 2008; Graff-Iversen, Anderssen, Holme, Jenum & Raastad, 2007; Maddison *et al.,* 2007; Macfarlane, Lee, Ho, Chan & Chan, 2007; Hagstromer, Oja & Sjostrom, 2006; Fogelholm *et al.,* 2006; Ekelund *et al.,* 2006; Macfarlane, Lee, Ho, Chan & Chan, 2006; Mäder, Martin, Schutz & Marti, 2006; Johnson-Kozlow, Sallis, Gilpin, Rock & Pierce, 2006; Guedes, Lopes & Guedes, 2005; Brown, Trost, Bauman, Mummery & Owen, 2004), as well as in healthy, Greek, young adults (Papathanasiou et al., 2010; Papathanasiou et al., 2009). A 12-country reliability and validity study assessing the measurement properties of IPAQ, showed that 75% of test-retest (after 3-7 days) correlations in the 12 countries were above 0.65 and that the overall estimation of PA by the questionnaire was correlated, though, moderately (r=0.30), to a 7-day measurement by accelerometers (Craig *et al.,* 2003).

The IPAQ has been used increasingly in various populations and settings (Bauman *et al.,* 2009; Knuth, Bacchieri, Victora, Hallal, 2009; De Cocker, De Bourdeaudhuij, Cardon, 2009; Jurakić, Pedišić, Andrijašević, 2009; Boon, Hamlin, Steel, Ross, 2008; Bond *et al.,* 2008; Arabaci & Korkmaz, 2008; Rosenberg, Bull, Marshall, Sallis, Bauman, 2008; Ishikawa-Takata *et al.,* 2008; McGrady *et al.,* 2007; Al-Hazzaa, 2007; De Cocker, Cardon, De Bourdeaudhuij, 2007; Ainsworth *et al.,* 2006;

Bassett, Schneider, Huntington, 2004; Rütten & Abu-Omar, 2004a; Rütten & Abu-Omar, 2004b; Brown, Bauman, Chey, Trost, Mummery, 2004; De Bourdeaudhuij, Sallis, Saelens, 2003; Hallal, Victora, Wells, Lima, 2003; Rutten *et al.,* 2003a; Rutten *et al.,* 2003b), as well as among healthy, Greek adults (Kavouras *et al.,* 2007), healthy Greek young adults (Papathanasiou *et al.,* 2010; Papathanasiou *et al.,* 2009; Papathanasiou *et al.,* 2007) and healthy Greek adolescents (Tsioufis *et al.,* 2010).

1.2.1.3 PHYSICAL ACTIVITY RECOMMENDATIONS AND GUIDELINES

Over the last decades, in recognition of the health-related benefits of regular PA, several scientific societies, health- and fitness-related associations and organisations have published PA guidelines for the promotion of overall cardiorespiratory fitness and general health and the prevention of chronic diseases. Among several nationally and internationally recognised PA guidelines, some of the most frequently referenced ones include those produced by the American College of Sports Medicine (ACSM), the American Heart Association (AHA), the United States (US) Department of Health and Human Services (USDHHS), the US Centers for Disease Control and Prevention (CDC) and the WHO.

Apart from PA recommendations specifically focusing on the development and maintenance of cardiorespiratory and muscular fitness, healthy body composition and joint flexibility in healthy adults (Ratamess *et al.,* 2009; Kraemer *et al.,* 2002; Pollock *et al.,* 2000; Pollock *et al.,* 1998; ACSM, 1990; ACSM, 1978; cited in USDHHS, 1996) and healthy older adults (Chodzko-Zajko *et al.,* 2009; Nelson *et al.,* 2007; Mazzeo *et al.,* 1998), the ACSM, in collaboration with the CDC, have published recommendations for health promotion and disease prevention for healthy adults (Pate *et al.,* 1995), based on which a public health message was provided; "all adults

should perform 30 or more minutes of moderate-intensity PA on most, and preferably all, days of the week", either in a single session or accumulated in multiple bouts, each lasting at least 8-10 minutes. This public health message is endorsed by the USDHHS and the CDC (USDHHS, 1996), the British Department of Health (UKDH, 2004) and the WHO (WHO, 2004b; WHO, 2007). It is, also, in accordance with earlier recommendations provided by the AHA (Fletcher *et al.*, 1992), suggesting moderate-intensity (50% of maximum heart rate - HR_{max}) dynamic exercise of the large muscles for 30-60 minutes per session, three to four times weekly, as well as with more recent AHA recommendations focusing on the promotion of health and CVD prevention in women (Mosca *et al.*, 2007).

In the most recent update of ACSM recommendations (Haskell *et al.*, 2007), apart from advice regarding the maintenance and improvement of muscular strength and endurance, healthy adults are advised to engage in moderate-intensity aerobic PA for a minimum of 30 minutes per day, on five days each week or vigorous-intensity aerobic PA for a minimum of 20 minutes per day, on three days each week in order to promote and maintain health. Moreover, combinations of moderate- and vigorous-intensity activity can be performed to meet this recommendation. This recommended amount of aerobic activity should be added to routine activities of daily living (ADLs) that tend to be of light intensity or last less than 10 minutes in duration. In these updated ACSM recommendations the dose-response relation between PA and health is highlighted, urging people who wish to gain additional health benefits to exceed the minimum recommended amounts of PA. These guidelines, although fundamentally unchanged from the 1995 recommendations (Pate *et al.*, 1995), differ from the latter on that they clarify the

type of PA being recommended by using the term "aerobic" or "endurance", they clarify the recommended frequency for moderate-intensity PA (from "most, preferably all days per week" to "five days per week"), it explicitly suggest vigorous-intensity PA as an integral part of the recommendation underlining that moderate- and vigorous-intensity activities are complementary in the production of health benefits and that a variety of activities can be combined to meet the recommendation, it highlights the meaningfulness of routine, light-intensity ADLs, it emphasizes the fact that PA above the recommended minimum amount provides even greater health benefits and, finally, it clarifies the minimum length of accumulating short bouts of PA toward the 30-minute goal as being 10 minutes.

1.2.1.4 PHYSICAL ACTIVITY IN GREECE

Several national and European epidemiological studies, focusing on the assessment of PA prevalence, patterns and trends, have been conducted in Greece since the early 1990s. The majority of these studies were large-scale, regional studies with a cross-sectional design, conducted around the '20s, localised in Attica or the greater Athens area, involving representative samples of the adult Greek population, assessing exercise, sport and leisure-time PA, through the employment of translated, self-reported questionnaires usually not validated for the Greek language and culture, or questionnaires designed especially for the particular study, thus, not able to provide comparable data, with cut-off points for the classification of subjects in different PA levels (high, moderate and low) which did not correspond to contemporary internationally established PA recommendations. Trying to get an overall picture regarding the PA profile of Greek adults based on these studies, would be problematic due to methodological differences, such as

heterogeneity of design and samples, as well as differences in the operational definition of PA, the method and instrument used for the assessment of PA, and the criteria for the classification in high, moderate and low PA categories. Nevertheless, the fact that comes across all these studies is that the prevalence of PA and exercise in Greece is low, both in absolute terms and in comparison to the rest of the EU countries (Tzormpatzakis & Sleap, 2007).

In particular, based on the results of a prospective cohort study of 28,030 Greek adults from several parts of Greece, conducted between 1994 and 1999, which will follow-up the participants for the rest of their lives, though, with no longitudinal data having been published yet, a significant proportion of Greeks (25%) reported that they do not exercise in any way apart from ADLs, such as walking and housekeeping, while only 28.8% and 32.3% of men and women, respectively, reported that they perform vigorous PA (Valanou, Bamia, Chloptsios, Koliva & Trichopoulou, 2006). In a more recent study of a national representative sample of 4,153 Greek adults from several urban, semi-urban and rural areas of Greece, carried out in 2003, it was revealed that a striking 81% of the general population was classified as sedentary (Athyros *et al.*, 2005). Similarly, according to the findings of a nationwide study conducted a year later, including 5,003 Greek adults, 67.8% of men and 82.3% of women were classified as inactive (Milias *et al.*, 2006). As revealed by the aforementioned studies, physical inactivity is dangerously high among Greeks, and it is getting higher, as indicated by the findings of a five-year follow-up of the ATTICA study, carried out in 2006, involving 3,042 Greek adults from the greater area of Athens (Panagiotakos *et al.*, 2008). According to their results 69% and 73% of men and women, respectively, were classified as physically

inactive, indicating an increase in physical inactivity rates of 13% and 7% in men and women, respectively, compared to those observed at baseline, between 2001 and 2002 (Panagiotakos *et al.*, 2008).

On the other hand, information regarding the PA profile of Greek young adults is provided from Greek and European studies involving university and college students, as well as recruits of the Greek army. In particular, PA prevalence in Greek university students range from 25% to 70.1% in men and from 23% to 51% in women (Tirodimos, Georgouvia, Savvala, Karanika & Noukari, 2009; Haase, Steptoe, Phil, Sallis & Wardle, 2004; Steptoe *et al.*, 2002). In Greek recruits, the prevalence of PA is relatively higher, reaching 76.1% (Pitsavos *et al.*, 1998) or a mean ± standard deviation (SD) of 3.85 (±2.35) hours per day (Mantzoros & Georgiadis, 1995). In Greek college students the prevalence of PA ranges from as low as 17% (Nikolakopoulos & Nikolakopoulou, 2009) to as high as 73.2% and 68.3% for men and women, respectively (Steptoe *et al.*, 1997).

1.2.2 OVERWEIGHT AND OBESITY

1.2.2.1 OPERATIONAL DEFINITIONS AND RELATED CONCEPTS

Obesity could be defined as a state of abnormal or excessive fat accumulation (mainly in the form of triglycerides) in subcutaneous and/or visceral adipose tissue, usually resulting from a sustained positive energy balance (energy intake > energy expenditure) – due to biological, behavioural, socioeconomic, psychological and environmental factors – to the extent that health and quality of life may be impaired (WHO, 2000). On the other hand, overweight could be defined as excess weight relative to height (WHO, 2000).

The degree of fat storage associated with elevated health risks should be used to operationally define obesity. However, fat mass (FM) in the human body is difficult to measure under field conditions, and since there are no clearly established cut-off points for FM or fat percentage (%BF) that constitutes obesity (Prentice & Jebb, 2001; WHO, 1995), its operational definition is based on BMI, which relates height to weight (by the formula $kg \cdot m^{-2}$). Using BMI, an overweight condition is defined as a BMI of 25.0 to 29.9 $kg \cdot m^{-2}$, and obesity is defined as a BMI of 30 $kg \cdot m^{-2}$ or more (NHLBI, 1998; WHO, 2000; WHO, 2004a). The National Heart, Lung and Blood Institute developed these standard definitions of overweight and obesity based on an extensive evidence-based review of morbidity and mortality related to weight (NHLBI, 1998). For the NHLBI-specified overweight, the World Health Organisation (WHO) adopted the term preobese, with the rationale that some health risks can exist at these BMIs and to increase awareness for strategies to prevent further weight gain beyond this level of adiposity (WHO, 2000). Further subcategories of obesity include obesity class I, which is defined as a BMI of 30.0 to 34.9 $kg \cdot m^{-2}$, obesity class II, which is defined as a BMI of 35.0 to 39.9 $kg \cdot m^{-2}$, and obesity class III, which is defined as a BMI of 40 $kg \cdot m^{-2}$ or greater (WHO, 2004a).

Body fat distribution refers to the relative amounts of fat in the primary compartments where adipose tissue and fat are stored in the body (Sardinha & Teixeira, 2005). Regarding patterns of body fat distribution, two types of fat distribution are recognised; android fat distribution, which is characterised by upper body fat accumulation (mainly abdominal fat), providing an increased risk of hypertension, type II diabetes, dyslipidaemia, coronary artery disease, and premature death and gynoid fat distribution, which is characterised by lower body

fat accumulation (mainly in the hips and thighs) (Folsom *et al.,* 1993; cited in ACSM, 2006a). Abdominal fatness or abdominal obesity or central obesity refers to fat deposition, primarily visceral, reflected in a large waist circumference, especially relative to hip or lower body circumferences (WHO, 1995). Visceral or intra-abdominal adipose tissue refers to adipose tissue located within the abdominal cavity, below abdominal muscles, and is composed of omental and mesenteric adipose tissue as well as retroperitoneal and perinephric adipose tissue (Goodpaster & Kelley, 2005). Abdominal adiposity refers to both visceral and subcutaneous adiposity in the abdominal area.

1.2.2.2 ASSESSMENT OF OVERWEIGHT AND OBESITY

Obesity, attributable to increased adiposity, is considered a disorder of body composition (Goodpaster & Kelley, 2005); hence, methods of measuring body composition are employed for a detailed assessment and characterisation of the obese state. Body composition can be assessed on five distinct and separate, though, integrated levels, beginning with the atomic level and moving to molecular, cellular, tissue-organ, and whole-body levels (Wang, Heshka, Pierson & Heymsfield, 1995; Wang, Ma, Pierson & Heymsfield, 1993; Wang, Pierson & Heymsfield, 1992), measuring up to 40 different components of human body composition, such as fat mass (FM) and fat free mass (FFM) in the molecular level or adipose tissue and skeletal muscle in the tissue-organ level (Heymsfield, Lohman, Wang & Going, 2005). In health and fitness environments the principle interests for the assessment of the obese status are the quantification of the relative amount of FM in proportion to FFM and the determination of the anatomical distribution of fat in the body (Heymsfield *et al.,* 2005). Total body fat/adiposity and fat/adiposity distribution can

be directly measured in vitro, using human cadaver anatomical dissection or biochemical analysis (Ellis, 2000), or estimated indirectly in vivo, using both laboratory and field techniques, which vary in terms of availability, feasibility, amount of technician training and skill, subject cooperation and comfort, time required for assessment, complexity, equipment cost, maintenance and operation cost and accuracy (Lee & Gallagher, 2008; Tzotzas, Krassas & Doumas, 2008a; Heymsfield *et al.*, 2005; Norgan, 2005; Ellis, 2001; Ellis, 2000; Wagner & Heyward, 1999).

Laboratory techniques for the assessment of total body adiposity and adiposity distribution – at the tissue-organ level of body composition – include computed axial tomography (CT) and magnetic resonance imaging (MRI), whereas, field techniques include skinfold analysis (SKFA) and anthropometry. In particular, CT and MRI can produce scans that can non-invasively quantify the volume of subcutaneous, visceral, intermuscular and even epicardial adipose tissue, while total body adiposity can be assessed by a total body composition analysis with sequential slicing through the body and assumptions for tissue densities (Tzotzas *et al.*, 2008b; Ross & Janssen, 2005). Moreover, through MRI the abdominal sagittal diameter (ADS) – the shortest distance between the anterior and posterior trunk at the level of the iliac crest – which is highly related with the visceral fat volume (Sardinha & Teixeira, 2005) and shows strong correlations to CVD risk (Ohrvall, Berglund & Vessby, 2000). SKFA involves the measurement of the thickness of two layers of skin and the underlying subcutaneous adipose tissue with a manual skinfold calliper at several body sites (Wagner & Heyward, 1999) and the prediction of %BF, using specific regression equations (Kaminsky & Dwyer, 2006; Wagner & Heyward, 1999).

On the other hand, laboratory techniques for the assessment of total body fat – at the molecular level of body composition – include hydrodensitometry (HD), air displacement plethysmography (ADP) and dual-energy x-ray absorptiometry (DXA), whereas, field techniques include bioelectrical impedance analysis (BIA) and near-infrared interactance (NIR). Hydrodensitometry – also known as underwater or hydrostatic weighing – involves the complete submersion of the subject under water after exhaling the air in his/her lungs to correct for residual lung volume (Fields, Goran & McCrory, 2002; Ellis, 2001; Wagner & Heyward, 1999). It is based on Archimedes's principle and can determine the body's density, from body mass and volume, which is then, converted to %BF using specific equations (Fields *et al*., 2002; Going, 2005). Body volume can, also, be measured by ADP, an alternative technique to HD, which records changes in air pressure within a closed two-compartment chamber (Going, 2005; Ellis, 2001; Wagner & Heyward, 1999). After body density has been determined, %BF can be calculated using equations similar to those used in HD (Heyward & Wagner, 2004; cited in Kaminsky & Dwyer, 2006). Dual-energy x-ray absorptiometry, based on a three-component model of total body mineral stores, mineral-free lean mass, and fat mass, is capable of quantifying total body FM and FFM by applying the use of a specialised x-ray device to take whole body or segmental measurements (Tzotzas *et al.,* 2008b; Lee & Gallagher, 2008; Lohman & Chen, 2005). In BIA a small electrical current is passed into the body, the impedance to that current is measured and an estimate of total body water (TBW) is acquired from which total body FFM is calculated using the assumption that 73% of the body's FFM is water (Lee & Gallagher, 2008; Chumlea & Sun, 2005; Ellis, 2001; Wagner & Heyward, 1999). TBW can also be measured by isotope dilution techniques, allowing for the evaluation of FM and FFM in which it is assumed that

the hydration of FFM is stable (Lee & Gallagher, 2008; Wagner & Heyward, 1999). Finally, in NIR the absorption of light is measured using near-infrared spectroscopy to provide information about the body's chemical composition (Kaminsky & Dwyer, 2006; Wagner & Heyward, 1999).

1.2.2.2.1 Body mass index, waist circumference and waist-to-hip ratio

The ratio of the weight in kilogrammes divided by the square of the height in metres, or the Quetelet Index, originally described in 1832 by Belgian mathematician/statistician Adolphe Quetelet (Billewicz, Kemsley, Thomson, 1962; Khosla & Lowe, 1967), or the Body Mass Index (BMI), as it was termed later on by Ancel Keys in 1972 (Eknoyan, 2008), provides the easiest, most useful, inexpensive, albeit crude, population-level measure of overweight and obesity (WHO, 2000; Keys, Fidanza, Karvonen, Kimura & Taylor, 1972; cited in Gallagher *et al.*, 1996). The BMI, a surrogate of total body adiposity, demonstrates good (r=0.63, p<0.0001, Romero-Corral *et al.,* 2008) to high (r=0.79, p<0.05 and r=0.84, p<0.05 in young men and women, respectively, Flegal *et al.,* 2009) and very high (r=0.92, p<0.0001 in women and r=0.78, p=0.0001 in men, Janssen, Heymsfield, Allison, Kotler & Ross, 2002a) correlation with the %BF; however, it does not account for differences in sex, age, race, or ethnicity, nor does it take into account variance in bone density, muscle mass or body fat distribution, and may not correspond to the same degree of fatness or associated health risk in different individuals (Jackson, Ellis, McFarlin, Sailors & Bray, 2009; Carroll *et al.,* 2008; Lear, Humphries, Kohli & Birmingham, 2007; Sardinha & Teixeira, 2005; Prentice & Jebb, 2001; Ellis, 2000; Deurenberg, Deurenberg-Yap, Wang & Schmidt, 1999; Gallagher *et al.,* 1996; Norgan, 1994). Thus, a high BMI, for example, may indicate either obesity or an athletic, muscular build

with low body fat. Nevertheless, due to the absence of any epidemiological data relating health risk to %BF, BMI is commonly used to screen for overweight and obese individuals, providing a meaningful clinical assessment of health risk (PSC, 2009; Janssen, Katzmarzyk & Ross, 2004; Janssen, Katzmarzyk & Ross, 2002b; NHLBI, 1998).

Waist circumference (WC) and waist-to-hip ratio (WHR) are widely used for the assessment of fat distribution, particularly of abdominal adiposity. Waist circumference correlates well (r=0.68, p<0.001 and r=0.87, p<0.001 in men and women, respectively, Janssen *et al.,* 2002a) in adults and highly in young adults (r=0.85, p<0.05 and r=0.84, p<0.05 in young men and women, respectively, Flegal *et al.,* 2009) with the %BF and highly with abdominal fat mass (r=0.68, p<0.001 and r=0.73, p<0.001 in men and women, respectively, Janssen *et al.,* 2002a). Moreover, WC greater than 102 cm in men and 88 cm in women presents a close association with CVD risk factors (HNLBI, 1998) and, thus, its measurement is recommended by the WHO (2000) and the NHLBI (1998) for obesity-related risk assessment. The WHR, the circumference of the waist divided by the circumference of the hips, is highly correlated with the %BF in young men (r=0.87, p<0.05) and women (r=0.82, p<0.05) (Flegal *et al.,* 2009). Health risk increases with WHR, and a WHR greater than 0.95 and 0.86 in young men and women, respectively, indicates a very high health risk (Heyward & Stolarczyk, 1996; cited in ACSM, 2006a).

1.2.2.3 PHYSICAL ACTIVITY RECOMMENDATIONS FOR OVERWEIGHT AND OBESITY PREVENTION AND MANAGEMENT

In the last decade, several national and international scientific societies, associations and organisations, such as the Scottish Intercollegiate Guidelines

Network (SIGN), the UK National Institute for Health and Clinical Excellence (NICE), the European and the International Association for the study of Obesity (EASO and IASO, respectively), the ACSM, the AHA, the US National Heart, Lung and Blood Institute (NHLBI), the Canadian Medical Association and the WHO, have published clinical practice guidelines including PA recommendations specifically focusing on the facilitation of weight loss or the prevention of unhealthy weight gain or regain following a loss.

According to an evidenced-based report on the identification, evaluation and treatment of overweight and obesity in adults, published by the NHLBI, PA, in combination with low caloric diet and behavioural therapy, should be an integral part of weight loss and weight maintenance therapy (NIH, 2000; NHLBI, 1998). Initially, moderate levels of PA for 30 to 45 minutes, 3 to 5 days a week, should be encouraged with a long-term goal to accumulate at least 30 minutes or more of moderate-intensity PA on most, and preferably all, days of the week, a recommendation which is in consistence with the WHO (2000), the EASO (Tsigos *et al.,* 2008) and the CMA (Lau *et al.,* 2007) guidelines.

On the other hand, after an evidence-based review of the role of PA in the prevention and treatment of obesity (Grundy *et al.,* 1999), the ACSM published a position statement (Jakicic *et al.,* 2001) including detailed information relative to exercise interventions most appropriate for weight loss and prevention of weight regain for overweight and obese adults. According to that statement, which is in accordance with the NHLBI recommendation (NHLBI, 1998), as far as the initial PA goal of at least 150 minutes of moderate intensity PA per week is concerned, higher levels of exercise are recommended to enhance long-term weight loss and to

facilitate weight loss maintenance. In particular, exercise should be progressively increased to approximately 200-300 minutes per week (40-60 minutes, five days per week) to optimise the impact of exercise on body weight regulation (Jakicic *et al.*, 2001). In the 2009 update of the ACSM position statement (Donnelly *et al.*, 2009) the recommended level of PA required to enhance weight loss and prevent weight gain and regain in overweight and obese adults has been slightly increased. In particular, moderate intensity PA between 150 and 250 minutes per week is recommended for the prevention of weight gain, whereas, more than 250 minutes per week of moderate intensity PA is recommended for weight loss and weight maintenance after weight loss (Donnelly *et al.*, 2009).

The AHA, apart from an extensive scientific statement on population-based prevention of obesity through various strategies focusing on the improvement of social and environmental contexts to enable and encourage PA (Kumanyika *et al.*, 2008), has, also, published dietary guidelines (Lichtenstein *et al.*, 2006; Krauss *et al.*, 2000) in which PA recommendations are included, focusing on the desire to balance caloric intake and PA in order to achieve and maintain a healthy body weight, with an ultimate goal to reduce cardiovascular disease risk. According to the recommendations, initially, for sedentary individuals, it is suggested to engage in a moderate level of PA, such as intermittent walking for 30 to 45 minutes, while reducing sedentary time (Krauss *et al.*, 2000). Subsequent increases in PA to 30 to 60 minutes on most if not all days of the week need to be individualised and are generally targeted to expend a total of 100 to 200 kcal (Krauss *et al.*, 2000). In the 2006 revision of the dietary guidelines, the AHA recommends that adults who are attempting to lose weight or maintain weight loss should engage in at least 60

minutes of PA most days of the week, which can be accumulated throughout the day (Lichtenstein *et al*., 2006).

Dietary guidelines, with built-in PA recommendations for overweight and obesity prevention were, also, provided by the USDHHS in collaboration with the US Department of Agriculture (USDA & USDHHS, 2005). These guidelines, in contrast with those issued by the AHA, differentiate between the amount of PA required to prevent unhealthy body weight gain and the amount of PA required to maintain weight loss. In particular, to prevent gradual, unhealthy body weight gain in adulthood, it is recommended to engage in approximately 60 minutes of moderate- to vigorous intensity PA on most days of the week, whereas, to sustain weight loss in adults who have lost substantial body weight, it is recommended to participate in at least 60 to 90 minutes of moderate-intensity PA daily (USDA & USDHHS, 2005).

The USDHHS PA recommendations (USDA & USDHHS, 2005) are similar to those published by the IASO in 2003 (Saris *et al.*, 2003). According to the IASO guidelines, for the prevention of weight regain in formerly obese individuals, 60-90 minutes of moderate intensity activity or lesser amounts of vigorous intensity activity may be required, whereas, moderate intensity PA of approximately 45 to 60 minutes per day is required to prevent the transition to overweight or obesity. A good approach for many individuals to obtain the recommended level of PA is to reduce sedentary behaviour by incorporating more incidental and leisure-time activity into the daily routine. The IASO guidelines are in accordance with those issued by the NICE (NICE, 2006) and the SIGN (SIGN, 2010). According to the latter, which is an update of the 2003 version of the guidelines, sedentary

individuals should build up to their PA targets over several weeks, starting with 10-20 minutes of PA every other day during the first week or two of the programme, while individuals choosing to incorporate vigorous intensity activity into their programme should do this gradually and after an initial 4-12 week period of moderate intensity activity (SIGN, 2010).

1.2.2.4 OVERWEIGHT AND OBESITY IN GREECE

To date, different subgroups of the Greek population have been studied with regard to prevalence and trends of overweight, obesity and central obesity. The majority of the relevant studies have involved regional, cross-sectional studies targeting mainly at children and adolescents, with fewer studies involving adults, and studies focusing on young adults being rather scarce. Most of these studies were based only on self-reports and may have, thus, provided biased estimates of the prevalence of obesity in the general population. Nevertheless, the existing literature appears to point at a high prevalence of overweight and obesity in Greece (Roditis *et al.,* 2009). Moreover, obesity continues to escalate rapidly, contemporarily reaching pandemic proportions with major economic as well as health consequences that are increasing the burden of chronic non-communicable diseases throughout the country (Vardavas *et al.,* 2009; Roditis *et al.,* 2009; Yannakoulia *et al.,* 2008; Kapantais *et al.,* 2006).

Greece suffers from paucity regarding national data on the prevalence and trends of overweight, obesity and central obesity. According to the only, so far, relevant national epidemiological study of 17,341 adult Greeks from different geographical areas of Greece, carried out in 2003, the overall prevalence of obesity, as estimated by self-reports, was 22.5% (26% and 18.2% in men and women,

respectively), while that of overweight was 35.2% (41.1% and 29.9% in men and women, accordingly) (Kapantais *et al.,* 2006). In the total population the mean BMI was 26.5 kg · m^{-2} (27.3 kg · m^{-2} in men and 25.7 kg · m^{-2} in women), while abdominal obesity appeared to be particularly prevalent in both genders especially after the age of 50, reaching 26.6% and 35.8% in men and women, correspondingly. The mean WC ± SD in the total population was 90.1 ± 16.1 cm (95.4 ± 16.1 cm in men and 85.5 ± 14.6 cm in women), while increased WHR was evident in 32.5% and 42.5% of men and women, respectively.

On the other hand, regional variations have been observed regarding the prevalence of overweight and obesity in Greek adults. In particular, according to the ATTICA study, which was carried out from 2001 to 2002 in the greater Athens area, including a representative sample of 3,042 Greek adults, the prevalence of overweight and obesity, based on direct anthropometric measurements, was 53% and 20% in men and 31% and 15% in women, respectively (Tzima *et al.,* 2007; Panagiotakos, Chrysohoou, Pitsavos & Stefanadis, 2006; Panagiotakos, Pitsavos, Yannakoulia, Chrysohoou & Stefanadis, 2005; Manios, Panagiotakos, Pitsavos, Polychronopoulos & Stefanadis, 2005; Panagiotakos *et al.,* 2004 / Tzima *et al.,* 2007). The age-adjusted peak prevalence of obesity was observed in men older than 40 years old and women between 50 and 59 years old. Central obesity prevailed in 36% of men and 43% of women. In Central Greece, the prevalence of obesity is 27.8% and 25.6% in men and women, respectively, while the prevalence of overweight is 50.8% and 29.3% in men and women, accordingly, as revealed by a study of 852 adult Greeks from Thessaly, carried out between 2001 and 2003, with obesity indices being directly measured (Koukoulis *et al.,* 2010). On the basis of the same study, the

prevalence of central obesity was higher in men (40.4%) than women (35.3%). In Northern Greece, overall prevalence of overweight and obesity reaches 35.4% and 19.9%, respectively, as indicated by the findings of a study, based on self-reported information on height and weight, involving 4,032 Greek adults from central Macedonia (Krassas *et al.,* 2003). The corresponding figures for Southern Greece are 52% and 35.7% in men and 33.7% and 50.7% for women, respectively, as observed by Vardavas *et al.* (2009) in their study of 502 Greek adults from Crete, carried out in 2005. Based on the same study, the prevalence of central obesity was 40.3% and 85.8% for men and women, respectively.

As far as young Greek adults are concerned, data on the prevalence of overweight and obesity is very limited, and comes mainly from studies involving university students and army recruits. In particular, the prevalence of overweight and obesity in young Greek men varies from 26.6% and 4.8%, respectively, as reported in a study of 274 men serving on a Greek warship, conducted in 1998 (Mazokopakis *et al.,* 2004), to 41% and 8%, respectively, as demonstrated in the study of Panagiotakos *et al.* (2004) regarding the subgroup of young Greeks aged 20 to 29 years old from the general population. In young male medical students the prevalence of overweight and obesity were 34.4% and 5.1%, respectively (Bertsias *et al.,* 2003), while the corresponding values for Greek army conscripts were 28.5% and 10.4%, accordingly (Papadimitriou *et al.,* 2008). Regarding young Greek women, the prevalence of overweight and obesity ranges from 13.3% and 2.7% to 19.9% and 3.4%, respectively, as reported by studies involving university students (Farajian, Renti & Manios, 2008; Bertsias *et al.,* 2003), while the corresponding figures regarding young females from the general population are 11% and 3%, accordingly

(Panagiotakos *et al.,* 2004). Thus, as in the case of Greek adults (Kapantais *et al.,* 2006), young Greek men appear to be heavier than young Greek women.

1.2.3 FUNCTIONAL CAPACITY

1.2.3.1 OPERATIONAL DEFINITION AND RELATED CONCEPTS

The term functional capacity reflects the ability to perform ADLs that require sustained aerobic metabolism (Arena *et al.,* 2007). The integrated efforts and health of the pulmonary, cardiovascular, and skeletal muscle systems dictate an individual's FC (Arena *et al.,* 2007). According to Leidy (Leidy, 1994; cited in Wang, 2004) FC may be considered as one of the four dimensions of the functional status concept, with the other three being functional performance, functional reserve and functional capacity utilisation. Functional status is operationally defined by Wang (2004) as "activities performed by an individual to realise needs of daily living in many aspects of life including physical, psychological, social, spiritual, intellectual, and roles". Functional capacity is operationally defined by Leidy (1994) as "an individual's maximum potential to perform those activities people do in the normal course of their lives to meet basic needs, fulfil usual roles, and maintain their health and well-being". In contrast to functional capacity, functional performance is defined as "the physical, psychological, social, occupational, and spiritual activities that people actually do in the normal course of their lives to meet basic needs" (Leidy, 1994; cited in Wang, 2004), a definition which is in accordance with the WHO's international classification of functioning, disability and health, in which performance is defined as "what an individual does in his or her current environment", whereas, capacity is "what an individual can do in a standardised environment" (WHO, 2002). On the other hand, functional reserve is defined as "the

difference between functional capacity and functional performance and refers to latent or dormant abilities that can be called upon in times of perceived need" (Leidy, 1994; cited in Wang, 2004), whereas, functional capacity utilisation is "the extent to which capacity is called upon in the selected level of performance" (Leidy, 1994; cited in Wang, 2004). The term functional status is often used interchangeably with the term functional ability in the literature, however, these terms differ in that functional status is the actual performance of an activity and the level or degree of performance, whereas, functional ability is "the capacity to perform a given function or activity" (Knight, 2000; cited in Wang, 2004). An alternative definition of functional ability is provided by the U.S. Physical Activity Guidelines Advisory Committee (USDHHS, 2008b), according to which functional ability is "the capacity of a person to perform a task, activity, or behaviour in a controlled environment that neither enhances nor impairs behavioural abilities".

1.2.3.2 ASSESSMENT OF FUNCTIONAL CAPACITY

Functional capacity is ideally assessed directly by measuring maximum oxygen uptake ($\dot{V}O_{2max}$) via maximal cardiopulmonary exercise testing, performed either on a motorised treadmill or a stationary cycle ergometer (Arena *et al.*, 2007; Fleg *et al.*, 2000). Maximum oxygen uptake may, also, be indirectly estimated through sub-maximal exercise testing, which is not as precise as maximal exercise testing, nevertheless, it provides a reasonably accurate reflexion of an individual's fitness at a lower cost and reduced risk, and requires less time and effort on the part of the subject (ACSM, 2006a). Field tests and particularly walk tests are typically administered as a means of evaluating sub-maximal functional capacity. A variety of walk tests exist, including time-based tests (e.g. six-minute walk test), fixed-

distance tests (e.g. 100m walk test), velocity-determined walk tests (e.g. self-paced walk tests and controlled-pacing incremental tests) (ACSM, 2006a).

1.2.3.2.1 The six-minute walk test (6-MWT)

The indoor, self-paced, 6-minute walk test (6MWT), the successor of the "*12-minute walk test*" (McGavin, Gupta & McHardy, 1976), was originally introduced by Butland, Pang, Gross, Woodcock & Geddes (1982) as a measure of exercise tolerance in patients with chronic airflow obstruction. Since then, the 6MWT has been increasingly used as a functional exercise capacity status indicator, as a predictor of morbidity and mortality, as well as an outcome measure across various disease populations (Solway, Brooks, Lacasse & Thomas, 2001), and among healthy adults (Alameri, Al-Majed & Al-Howaikan, 2009; Jenkins *et al.*, 2009; Bohannon, 2007; Camarri, Eastwood, Cecins, Thompson, Jenkins, 2006; Poh, Eastwood, Cecins, Ho, Jenkins, 2006; Troosters, Gosselink & Decramer, 1999; Enright & Sherrill, 1998) and healthy young adult individuals (Chetta *et al.*, 2006; Grindrod, Paton, Knez, O'Brien, 2006; Gibbons, Fruchter, Sloan, Levy, 2001). Moreover, the measurement properties of 6MWT (validity, reliability, responsiveness and interpretability) have been the most extensively researched and established across various populations (Solway *et al.*, 2001).

The 6MWT is a practical, simple test that requires a 100 feet hallway, without any sophisticated exercise equipment or advanced training for technicians (Enright, 2003; Sadaria & Bohannon, 2001). It measures the distance that a person can quickly walk on a flat, hard surface in a period of six minutes (the six-minute walk distance - 6MWD). It evaluates the global and integrated responses of all the systems involved during exercise, including the pulmonary and cardiovascular systems,

systemic and peripheral circulation, blood, neuromuscular units, and muscle metabolism. However, it does not provide specific information on the function of each of the different organs and systems involved in exercise or the mechanism of exercise limitation, as is possible with maximal cardiopulmonary exercise testing. In light of the fact that most ADLs are performed at sub-maximal levels of exertion, the 6MWD, assessing the sub-maximal level of FC, may be a better index of a person's ability to perform such activities compared to other indexes (e.g. $\dot{V}O_{2max}$ via cardiopulmonary exercise testing) (Solway *et al.,* 2001).

1.3 RATIONALE OF THE RESEARCH

1.3.1 MEASUREMENT OUTCOMES

Bearing in mind that the burden of CVDs in Greece is increasing at alarming rates and that physical inactivity (Fogelholm, 2010; Löllgen, Böckenhoff & Knapp, 2009; Nocon *et al.,* 2008; Mora, Cook, Buring, Ridker & Lee, 2007; WHO, 2007b; Warburton, Nicol & Bredin, 2006; McGee, 2005; Lee, Folsom & Blair, 2003; Rodriguez *et al.,* 1994), low cardiorespiratory fitness (Fogelholm, 2010; Sassen *et al.,* 2009; Barlow *et al.,* 2006; Carnethon *et al.,* 2003; Williams, 2001) and obesity (Strazzullo *et al.,* 2010; Lenz, Richter & Mühlhauser, 2009; Guh *et al.,* 2009; Bogers *et al.,* 2007; Li *et al.,* 2006; Klein *et al.,* 2004; Poirier & Després, 2003; Solomon & Manson, 1997) are considered among the major CVD morbidity and mortality risk factors, PA and FC in relation to BMI were selected as the study's main measurement outcomes.

1.3.2 STUDY POPULATION

As indicated by recent studies, physical inactivity, low physical fitness (Telama, 2009; Herman, Craig, Gauvin & Katzmarzyk, 2009; Kjønniksen *et al*., 2008; Matton *et al*., 2006; Gordon-Larsen, Nelson & Popkin, 2004; Boreham, 2004; Malina, 2001; Janz *et al*., 2000) and obesity (Herman *et al*., 2009; Singh, Mulder, Twisk, Van Mechelen & Chinapaw, 2008; Stovitz, 2008: Viner & Cole, 2005; Field, 2005; Martin *et al*., 2005; Boreham, 2004; Wright, Parker, Lamont & Craft, 2001; Godfrey & Barker, 2000; Whitaker, Wright, Pepe, Seidel & Dietz, 1997) during childhood, in most cases, track into adulthood, suggesting that health-related behaviour in early life influences later risks for lifestyle-related disorders; thus, it is important to investigate health-related behaviours among young people. Moreover, given that PA participation decreases with age (Knuth & Hallal, 2009; Norman, Bellocco, Vaida & Wolk, 2003; Caspersen *et al*., 2000) and that late adolescence and early adulthood is identified by several longitudinal epidemiological studies as the critical period of transition towards a more inactive lifestyle, (Zimmermann-Sloutskis *et al*., 2010; Allison *et al*., 2007; Leslie *et al*., 2001; Caspersen *et al*., 2000; Telama & Yang, 2000; Van Mechelen *et al*., 2000; Sallis, 2000; WHO, 2000) 18- to 30-year old adults were selected as the study's target age group. Moreover, the fact that undergraduate students are an easily identifiable, accessible and homogeneous – in terms of educational and socioeconomic status – group, which represents a significant segment of young Greek adults, advocated for choosing this group for the study's sampling frame. Another reason for focusing on undergraduates in the present study is the fact that they, as a well-educated group, are more reliable in reporting their PA, plus, their daily activities are rather regular in their pattern (i.e. due to

compliance to a standard daily academic schedule), and, therefore, more easy to recall (Haase *et al.,* 2004). Finally, Greek young adults were the population of choice for this study because they consist of a relatively underrepresented group in the Greek literature regarding CVD risk factors.

1.3.3 MEASUREMENT INSTRUMENTS

The main criteria used for the selection of a suitable method for assessing PA and FC were that the method should have acceptable validity and reliability properties, should be standardised in order to ensure the comparability of its results in a national and international level, be relatively quick to undertake, applicable to large groups, involve a low subject burden and minimal subject discomfort, require no sophisticated equipment and be cost effective. Both the IPAQ (Craig *et al.,* 2003) and the 6MWT (Enright, 2003; Sadaria & Bohannon, 2001; Solway *et al.,* 2001) meet the above criteria. Moreover, in light of the fact that overweight, obese and perhaps extremely obese individuals would be subjected to FC assessment, a sub-maximal (6MWT) instead of a maximal field test was preferred for that purpose, in order to minimise exercise-related risk.

∞ Chapter 2 ∞

Method

∞ CHAPTER 2 ∞

METHOD

2.1 PARTICIPANTS

2.1.1 STUDY POPULATION

The *target population* was the general Greek population. The *study population* was healthy Greek young adults aged 18 to 30 years. The *sampling frame* was constituted of physiotherapy undergraduates, from all semesters, studying at a Technological Educational Institute (TEI) in central Greece during the academic year 2008-2009 and healthy young people of the same age group who were invited to participate in the study by the physiotherapy students.

2.1.2 SAMPLING STRATEGY

A non-probability, two-stage, purposive sample (Huck, 2004) was extracted from the population of young physiotherapy undergraduates studying at the TEI. Students were approached at the entrance of the student dining hall, outside the library and in the gymnasium on the TEI campus. Recruitment occurred on different days of the week, excluding weekends, and at different times of day in order to minimise selection bias. Interested students were asked to complete a "pre-participation health screening questionnaire" (see sections C.2 and C.3 in Appendix C), which was designed by the author for the purposes of the study, based on the work of Koester (1995) and Lombardo & Badolato (2001), in order to evaluate their

health status and, thus, confirm their eligibility for inclusion in the study. All students who agreed to participate, and met the inclusion criteria were placed into the study as they were identified, until the desired number of subjects was reached for each of the three groups of normal, overweight and obese young adults. At the same time, students who were included in the study identified other potential subjects from among their friends, acquaintances etc., gave them information about the study and encouraged them to contact the researcher if they were interested in participating in the study. The investigator and the research assistant were the ones who recruited the subjects.

2.1.3 ASSIGNMENT TO GROUPS

Assignment to groups was consecutive as every individual with a BMI between 18.5 and 24.9 $kg \cdot m^{-2}$ was allocated into Group 1 (= normal weight), every individual with a BMI between 25.0 $kg \cdot m^{-2}$ and 29.9 $kg \cdot m^{-2}$, was allocated into Group 2 (= overweight), and finally, every individual with a BMI above 30.0 $kg \cdot m^{-2}$, were allocated into Group 3 (= obese). Categorisation of the participants to the three groups in relation to their BMI was based on the BMI classification cut-off points presented by the World Health Organization (WHO, 2000; WHO, 2004a). Assignment to groups continued until three approximately equal groups of normal, overweight and obese young Greeks were created.

2.1.4 INCLUSION CRITERIA

Both male and female healthy young adults were eligible for inclusion in the study as long as they met the following criteria:

- Caucasian race

- Greek citizenship and nationality
- Age of 18 – 30 years
- Preferably lifetime non-smokers in order to minimise the confounding effect of smoking on physical fitness, since chronic smoking affects cardiovascular fitness, impairing exercise performance in healthy Greek young adults (Papathanasiou *et al.*, 2007)

2.1.5 EXCLUSION CRITERIA

Potential participants were excluded from the study if they met the following criteria:

- Documented history of any medical disorder, with particular attention to a history of cardiopulmonary or cardiovascular diseases
- Medications affecting exercise capacity
- Recent illness in the last 4 weeks
- Factors that may limit ability to participate in the 6MWT, such as musculoskeletal injuries or disorders, neurological disease, or impaired cognitive function
- Pregnancy

2.1.6 SAMPLE SIZE DETERMINATION

Taking into consideration that larger samples tend to be more representative of their parent populations than smaller ones, leading to more precise estimates of population parameters and more powerful statistical tests (Armitage & Berry, 1994; cited in Sim & Wright, 2000), the goal was to include at least 20 subjects in each of the three groups. This goal was achieved in all three groups.

2.1.7 ETHICAL ISSUES

All procedures followed during the study were in accordance with Greek national standards of physiotherapeutic ethics (PPTA, 2007), as well as the ethical principles for medical research involving human subjects as presented by the World Medical Association in the Helsinki Declaration (WMA, 2008). The study possessed no risk for participants and the topic of the survey (PA and FC) was not sensitive. Anonymity of the participants, as well as confidentiality of their personal information were ensured. The protection of the participants' identity was insured by assigning a "study identification number" and a "study group" to each participant entering the study. A list specifying each participant's name, phone number, study identification number and group membership was only available to the researcher, and only during the conduction of the study. At the end of the study all data on personal identifiers were destroyed. Furthermore, all participants' responses were coded and the results of the study were displayed in an aggregate form. All participants were given adequate information (verbally and in writing) about the aims, methods and the voluntary nature of the study, as well as about the testing and measurements that they themselves would be subjected to, in order to make an educated decision about participating or not in the study (see C.6 and C.7 in Appendix C). Everyone who agreed to participate in the study signed an informed consent form prior to testing (see sections C.8 and C.9 in Appendix C). Approval for the study was granted by the Research Ethics Committee of the Technological Educational Institute of Lamia (see section C.1 in Appendix C).

2.2 STUDY DESIGN

The present study was designed as a cross-sectional comparative study, where three groups of young adults (normal weight, overweight, and obese) were compared in relation to their PA profile, FC status and various anthropometric, physiological, socio-demographic and lifestyle characteristics. This study design was chosen due to the objectives desired to achieve, as well as efficiency in time and expenses.

2.3 APPARATUS

2.3.1 THE GREEK VERSION OF THE IPAQ SHORT LAST-7-DAYS SELF-ADMINISTERED FORMAT (IPAQ-S_{GR})

The English standard version of the short, last-7-days, self-administered format of the IPAQ (IPAQ-S_{EN}) (see section A.2 in Appendix A), designed for use among young and middle aged adults, 18-69 years old and last updated in August 2002 (IPAQ, 2002), was used in the Eurobarometer Survey – conducted by the European Commission – in which a Greek version was included (EC, 2003). Recently, that version of IPAQ-short modified and adapted for the Greek culture (IPAQ-S_{GR}) (see section A.3 in Appendix A), according to the IPAQ committee guidelines, was tested for criterion-related validity against exercise capacity in young Greek adults with satisfactory results (Papathanasiou *et al.*, 2010); total and vigorous PA were significantly associated with exercise capacity, with correlation coefficients reaching moderate to good levels, respectively (Spearman's r=0.36 and r=0.43, p<0.001), while sitting showed a fair, negative and significant association with exercise capacity (r=-0.25, p<0.001). However, the IPAQ-S_{GR} showed poor to

near-zero correlations among exercise capacity and moderate and walking PA. The IPAQ-S_{GR} was, also, found to present acceptable reliability properties in young Greek adults (Papathanasiou *et al.,* 2009). In particular, intra-class correlation coefficients for IPAQ-S_{GR} total and vigorous PA were high in all groups examined, ranging from 0.84 to 0.93. On the other hand, walking, moderate-intensity activity and sitting correlations were good and significant but lower, ranging from 0.74 to 0.81 for walking, 0.72 to 0.78 for moderate PA and from 0.69 to 0.75 for sitting, between the first day and the ninth day of follow-up. Intra-class correlation coefficients were lower between the first day and the thirtieth day of follow-up (0.68-0.70, 0.74-0.77 and 0.64-0.68 for moderate PA, walking PA and sitting hours, respectively).

In the present study the IPAQ-S_{GR} was applied for the assessment of the subjects' PA status. It is a seven-item instrument consisting of six questions inquiring PA during the last week or during a recent week, if last week was atypical and a seventh question, inquiring hours of sitting time during an average weekday, as a measure of inactivity. All domains of PA – leisure-time, occupational, domestic-related, and transportation-related – are addressed by the IPAQ-S_{GR}, however, questions, in contrast with the IPAQ's long form, are not specific to each domain. Instead, the IPAQ-S_{GR} collects information about three specific types of PA undertaken in the four domains introduced above; walking, moderate- and vigorous-intensity activities. Only activities practiced for at least ten consecutive minutes should be recalled. The items in the IPAQ-S_{GR} are structured to provide separate scores on walking, moderate-intensity and vigorous-intensity activity, expressed in metabolic equivalent of the task (average MET value) multiplied by the

duration (in minutes) of the task, per week (MET · min · week^{-1}). A total PA score is generated by adding the duration (in minutes per day) and frequency (in days per week) of walking, moderate-intensity and vigorous-intensity activities. The average MET value for vigorous, moderate and walking PAs is 8.0, 4.0 and 3.3 METs, respectively (IPAQ, 2005). In addition, questionnaire responses could be re-coded in a categorical score, based on which respondents are classified into three PA categories; "low", "moderate" and "high" PA categories as defined by the IPAQ working group (IPAQ, 2005). The three PA categories were developed according to current public health guidelines for PA (Haskell *et al.*, 2007).

2.3.2 TEN-POINT CATEGORY-RATIO BORG SCALE

The Borg 15-point rating of perceived exertion (RPE) scale (Borg, 1982; cited in Chiu & Wang, 2007; Borg, 1973; cited in O'Sullivan, 1984) has been widely applied to evaluate the relationship between psychophysical responses and physiological criteria (Robertson *et al.*, 2000). On the other hand, the ten-point category-ratio Borg scale (Borg CR-10 scale), which is illustrated in sections A.11 and A.12 of Appendix A, has been in use, in its original format, mainly as a pain and dyspnoea scale, for more than two decades. However, lately, there has been an increase in its use in the area of perceived exertion (Borg & Kaijser, 2006). The Borg CR-10 scale is more complicated than the Borg RPE scale in its construction. It is a graded scale with numbers ranging from 0 to 10, while descriptive words are included with every other number and range from "*nothing at all*" to "*maximal*", giving responses that may be said to belong to a ratio scale. The Borg CR-10 scale, thus, combines the advantages of a simple rating method for direct level estimates with the advantages of a ratio scaling method for determinations of ratio

relationships between perceptual responses (Borg, 1998). Its construction makes it possible to determine growth functions for different modes, to compare them with physiological growth functions, and to make direct level estimates for inter-individual comparisons (Borg, 1998). The non-linear, positively accelerating growth function of the CR-10 responses is the most fundamental difference among RPE and CR-10 scales when scaling perceived exertion (Borg, 1998). The Borg CR-10 scale has demonstrated its validity and reliability in evaluating different physical tasks (Borg, 1982), while for walking, in particular, significant correlations have been reported between the scale and various physiological criteria like oxygen uptake and HR, among young healthy individuals (Chen, Fan, Moe, 2002 / Chiu & Wang, 2007).

The Borg CR-10 scale was applied in this study to rate the overall perceived exertion before and at the end of the 6MWT. This scale, in particular, was chosen because it explicitly recognises the non-linear response of many physiological variables (e.g., blood lactate), thus, providing a better indicator of overall effort (Borg, 1998). Besides, the CR-10 scale was the one suggested by the American Thoracic Society (ATS, 2002) in order to rate perceived exertion during the 6MWT.

2.3.3 ELECTRONIC AND OTHER EQUIPMENT

Equipment for the conduction of the 6MWT included:

- A digital stopwatch (CIELO PULSE WC-061)
- A personal HR monitor with a wireless chest-strap electrode radio-transmitter and wristwatch receiver (Polar F11, Polar Electro Oy, Finland)

- A mercurial precision sphygmomanometer (RIESTER Diplomat Presameter 1002, desk model, Germany)
- A stethoscope
- A 30 meters long, manually retractable, fibreglass measuring tape (Profi Qualitat 700550, Australia)
- A left-side tablet-arm chair that could be easily moved along the walking course
- Administrator's sheet for the 6MWT designed by the author (see Sections A.5 and A.6 in Appendix A) on a clipboard

Other equipment used:

- A digital scale (Beurer BG19 Diagnostic Scale, Germany)
- A wall mounted stadiometer (Seca 206 Bodymeter, Hamburg, Germany)
- A 1.5 meter long, high-resolution, non-retractable, fibreglass, measuring tape with metal-capped ends (Germany)
- Researcher's general report sheet designed by the author(see Sections C.10 and C.11 in Appendix C)

2.4 PROCEDURES

2.4.1 OVERVIEW OF PROCEDURES

A schematic outline of the study process is available in section A.1 of Appendix A. Procedures took place during morning hours, in order to avoid intra-day variability, from October 2008 until June 2009. Participants were given explicit written instructions in advance of the testing session, in order to prepare adequately

(sections C.4 and C.5 in Appendix C). In order to control factors affecting HR and BP, participants were asked to avoid tobacco, caffeine, alcohol, salt, and consumption of a heavy meal for at least 3 hours prior to testing and strenuous PA or exercise in the previous 24 hours. On the other hand, adequate fluid intake before the 6MWT was encouraged in order to prevent dehydration during the test and ensure optimal exercise performance (ACSM, ADA & DC, 2009). All tests and measurements were conducted under constant conditions of temperature (around 20°C) and humidity (<40%), in a well ventilated site, at an altitude of approximately 20 metres above sea level. All testing procedures were explained adequately to the subjects, while the test environment remained quiet and private, in order to minimise subjects' anxiety. Each subject attended a single, pre-arranged, testing session. All measurements were conducted by the author in order to avoid inter-examiner variability, following the same order for every participant. At first, each subject was asked to sign the "informed consent form". Next, anthropometric measurements were performed (BH, BW, WC, HC). Afterwards, the 6-minute walk test (6-MWT) would take place. Subjects performed two 6-MWTs separated by a resting period of 30 minutes. During that period of time subjects completed the IPAQ-S_{GR}, after being given standardised guidelines on how to administer the questionnaire. Immediately before initiating the 6MWT, participants were given standardised instructions (see Sections A.7 and A.8 in Appendix A) on how to perform the test. Before the administration of the 6MWT, participants were, also, familiarised with CR-10 Borg scale and were, also, provided with standardised instructions (see Sections A.13 and A.14 in Appendix A) on how to employ the scale. Heart rate, BP and RPE were recorded before and at the end of each 6MWT. Only

after the subjects had completed the second 6MWT, were they given feedback on their performance in the test, in order to avoid any influential effect.

2.4.2 MEASUREMENTS

2.4.2.1 DEMOGRAPHIC AND LIFESTYLE CHARACTERISTICS

2.4.2.1.1 Age and gender

Age and gender were the demographic characteristics that were recorded for each subject. Age was defined as whole years.

2.4.2.1.2 Smoking status

Information concerning smoking habits was collected using standardised questions, which were a part of the "pre-participation health screening questionnaire" (see section C.2 and C.3 in Appendix C). Questions were designed by the author for the purposes of the study and evaluated the years of smoking, the daily number of cigarettes, as well as the exposure to second hand/environmental cigarette smoke at workplace, home or other public places. Current smokers were defined as those who smoked at least one cigarette per day. Never smokers were defined as participants who had never tried a cigarette in their life. Former smokers were defined as those who had stopped smoking for at least one year and occasional smokers were defined as those who smoked less than 7 cigarettes per week.

2.4.2.2 ANTHROPOMETRIC CHARACTERISTICS

2.4.2.2.1 Body weight

A digital scale was used to measure BW with an accuracy of ± 0.1 kg. Subjects were weighed without shoes, barefoot or in thin socks, in light clothing (usually shorts and a T-shirt), after voiding the bladder, during morning hours. The

subjects would stand still in the centre of the scale's platform, with the body weight evenly distributed between both feet.

2.4.2.2.2 Body height

Standing body height (BH) was measured to the nearest 0.1 cm with the use of a wall mounted stadiometer with a wide horizontal movable headboard, during morning hours. Subjects were positioned with the heels, buttocks, scapulae, and posterior aspect of the cranium in contact with the wall underneath the stadiometer, with the shoulders in relaxed position and arms hanging freely by the sides, eyes looking straight ahead (ensuring a horizontal visual axis) with the head's Frankfort plane (the plane passing through the inferior margin of the left bony orbit and the upper margin of each external auditory meatus) parallel with the floor. Subjects were barefoot or in thin socks and they were wearing little clothing so that the positioning of the body could be seen. Moreover, they were standing with their heels together (feet forming a 60° angle) on a flat, uncarpeted floor, with weight distributed evenly on both feet. They were measured while holding their breath after a deep inspiration. The headboard was positioned so that it would compress the hair and touch the most superior point on the head. Duplicate measures were taken and were averaged. If they differed by more than 0.5 cm, one additional measurement was performed and then averaged.

2.4.2.2.3 Body mass index calculation

Body mass index (BMI) was calculated as BW in kilogrammes (kg) divided by the squared BH in meters (m^2).

2.4.2.2.4 Waist circumference

Waist circumference (WC) was measured with the subjects standing comfortably with their weight evenly distributed on both feet, and the feet about 25-30 cm apart, with arms at the sides, and abdomen relaxed, at the end of a normal expiration. Waist circumference was recorded with the use of a flexible yet inelastic (non-stretchable), graduated tape measure which was placed horizontally at the narrowest part of the torso above the umbilicus and below the xiphoid process, directly on the naked skin surface without compressing the subcutaneous adipose tissue. The WC measurement was based on the standardized description of circumference sites and procedures suggested by ACSM (2006a). However, in obese subjects who had no natural waist, WC was measured in the middle between the lower rib margin and the iliac crest at the level of umbilicus, as suggested by WHO (1995). Waist circumference was recorded to the nearest 0.1 cm. Duplicate measures were taken and were averaged. If they differed by more than 0.5 cm, one additional measurement was performed and then averaged.

2.4.2.2.5 Hips circumference

Hip circumference (HC) measurement was, also, based on the guidelines presented by the ACSM (2006a) and WHO (1995) regarding anthropometry. Hips circumference was measured with subjects wearing light clothing with no restrictive underwear, while standing erect with arms at the sides and feet together. Hips circumference was recorded with the use of a flexible yet inelastic tape measure which was placed horizontally at the level of the widest circumference over the greater trochanters (or the fullest point around the buttocks). The research assistant would help position the tape on the opposite side of the subject's body. The tape

was snug against the skin without compressing the subcutaneous adipose tissue. Similar to waist circumference, hip circumference was also rounded up to the nearest 0.1 cm. Duplicate measures were taken and were averaged. If they differed by more than 0.5 cm, one additional measurement was performed and then averaged.

2.4.2.2.6 Waist-to-hip ratio calculation

Waist circumference (cm) was divided by HC (cm) in order to calculate the waist-to-hip ratio (WHR). The WC and WHR measurements were used to determine the extent of abdominal adiposity. For WC, cut-off points of ≥ 102 cm in men and ≥ 88 cm in women were considered to represent central obesity in young adults, while the corresponding cut-off points for WHR were ≥ 0.95 in men and ≥ 0.86 in women (ACSM, 2006a).

2.4.2.3 PHYSIOLOGICAL MEASUREMENTS

2.4.2.3.1 Heart rate

Heart rate was (HR) measured with a personal HR monitor with a wireless chest-strap electrode radio-transmitter and wristwatch receiver. Resting HR (HR_{bef}) was measured before the 6MWT with the subject sat comfortably in a left-side tablet-arm chair, relaxed, for a period of at least ten minutes. Peak heart rate (HR_{aft}) was recorded for each subject approximately five seconds before the termination of the 6MWT. Measured HR_{aft} was, also, expressed as a percentage of age-predicted HR maximum (%predHR_{max}), with predHR_{max} calculated as 220-age.

2.4.2.3.2 Arterial blood pressure

Arterial blood pressure (BP) was determined by brachial artery auscultation. Blood pressure was measured with subjects sitting comfortably on a left-side tablet-arm chair, with their back supported and their left arm bared, relaxed and well supported by the tablet-arm, with the inside of the lower arm facing upwards. The arm was placed at heart level (with an angle of approximately 45° from the trunk). Any differences in height between the heart level and the upper arm were adjusted by placing a cushion under the elbow.

Resting BP measurement was performed at least after 10 minutes of rest before the initiation of the 6MWT. During the measurement subjects were advised to breathe normally and avoid taking deep breaths. Moreover, subjects were instructed not to move or talk, during the measurement. Before the BP measurement, the arm circumference of each subject was measured with a measure tape in order to ensure that the appropriate BP cuff size was used, guaranteeing a valid measurement (two different sizes of cuffs were used, one suitable for arm circumference of 24-32 cm and another one for arm circumference of 32-42 cm).

Measurements were taken using a stethoscope and a mercurial precision sphygmomanometer. The cuff was applied on the upper left arm, with the distal margin of the cuff placed approximately 3 cm above the cubital fossa. The diaphragm of the stethoscope was placed firmly on the skin above the brachial artery's course through the groove formed by the bifurcation of the triceps and biceps brachii muscles on the medial aspect of the arm, right on the inside of the bicipital aponeurosis.

In the beginning of the measurement procedure, the cuff was inflated to a pressure of 30 mmHg above the point when the blood flow was completely occluded and, therefore, there was no sound audible. Afterwards, by slowly releasing the valve of the sphygmomanometer, the pressure would drop gradually. Auscultation of the first audible, rhythmic sound of tapping quality (first Korotkoff sound) designated the systolic BP (SBP). As the pressure in the cuff was allowed to fall further, the diastolic BP (DBP) was determined at a level approximately 2 mmHg above the point when the repetitive sounds became fully muffled (fifth Korotkoff sound).

The cuff remained on the arm of the subjects during the 6MWT in order to minimise the time between the termination of the test and the time of BP measurement.

2.4.2.3.3 Perceived exertion

The Borg CR-10 scale was applied to rate the overall perceived exertion before and at the end of the 6MWT. The scale was printed on heavy, laminated, A3 size paper, in 20-point type size, as suggested by the American Thoracic Society (ATS, 2002) and was constantly visible to participants during the 6MWT.

Subjects were familiarised with the scale immediately before initiating the 6MWT test. They were provided with standardised instructions (see Sections A.13 and A.14 in Appendix A) on how to employ the scale and were encouraged to focus on their overall perception of exertion in their responses. Instructions for the employment of the scale were based on Borg (1998) the American College of Sports Medicine handbook (ACSM, 2006a) and the instructions provided by the Centers for Disease Control and Prevention (CDC) – available online at

http://www.cdc.gov/physicalactivity/everyone/measuring/exertion.html –.At the end of the 6MWT, subjects were reminded of the number that they had chosen before the test and then they were asked to grade their level of exertion again.

2.4.3 SIX-MINUTE WALK TEST APPLICATION PROTOCOL

The 6-MWT was performed twice by each subject with a 30-minute interval rest. The test was conducted according to a standard protocol based on published guidelines by the American Thoracic Society (ATS, 2002). It was performed indoors, with controlled temperature (around 20°C) and humidity (<40%), along an approximately 40 meters long, flat, straight, undisturbed corridor with a hard, uncarpeted surface. The walking course was 30 meters in length. The length of the course was marked on the floor with a 30-m long, yellow tape. On that tape, every three meters were marked with orange tape. Each turnaround point was marked with an orange cone. A starting line, which marked the beginning and end of each 60-m lap, was, also, marked on the floor using yellow tape.

No warm-up period before the test was allowed and the subject sat at rest in a left-side tablet-arm chair, located near the starting position, for at least 10 minutes prior to the initiation of the test. Subjects were asked to walk at their own maximal pace along the marked walking course covering as much ground as they could during the allotted time without running. In addition, they were told they could rest if they were too exhausted to continue the test and that they would have to resume walking as soon as they were able to do so. Elapsed time was recorded by the research assistant using a stopwatch, while the number of laps covered was recorded by the author using a worksheet especially designed for the 6MWT by the author (see Sections A.5 and A.6 in Appendix A). Each minute during the test,

subjects were given feedback on time progression as well as standardised verbal encouragement (see Sections A.9 and A.10 in Appendix A) to keep on walking by the research assistant (ATS, 2002). In both occasions an even tone of voice was used avoiding any body language which would encourage the participant to speed up (Guyatt *et al.*, 1984). During the last ten seconds, the research assistant was counting down orally until the end of the test in order to let the subjects know exactly when to stop and remain absolutely still. During those last seconds the subjects were advised to look at their Polar watch and inform the author as to what was the maximum HR indication at that time. After the subject having stopped, the author would immediately approach him/her and mark the spot where he/she stopped, by placing a piece of red tape on the floor, exactly in the mid distance between the participant's two feet. Simultaneously, the research assistant would bring the chair for the subject to sit on swiftly, immediately after marking the subject's position, in order for the BP measurement to take place. All BP measurements were performed by the author.

In order to calculate the total distance walked, the investigator would add the number of meters in the final partial lap, after rounding to the nearest centimetre, to the number of laps covered multiplied by 60 meters, which is the length of each lap. The maximum 6MWD achieved (better of two tests) was used in the analyses.

Participants were instructed, in advance, to wear comfortable clothes (preferably shorts and t-shirt) and shoes appropriate for walking (firm, supportive, lightweight footwear) (see Sections C.4 and C.5 in Appendix C). Immediately before initiating the 6MWT, participants were given standardised instructions on how to

perform the test (see Sections A.7 and A.8 in Appendix A), which were based on those issued by the American Thoracic Society (ATS, 2002). The standard phrases of encouragement (see Sections A.9 and A.10 in Appendix A) used during the 6-MWT were, also, based on those suggested by the American Thoracic Society (ATS, 2002).

2.4.4 IPAQ-S_{GR} ADMINISTRATION PROTOCOL

During the 30-minutes resting interval between the two 6MWTs, subjects were asked to complete the IPAQ-S_{GR}. Prior to IPAQ-S_{GR} administration, the answering procedure was explained to the participants. Emphasis was given to the condition that only PAs practiced for at least 10 consecutive minutes should be recorded. Moreover, given the subjects' difficulty in distinguishing between vigorous and moderate PAs, as reported by Craig *et al.* (2003) and Shephard (2003), the IPAQ criteria by which PAs are classified as of vigorous or moderate intensity were underlined. Subjects were given an approximately 20-minutes period to complete the questionnaire.

2.5 STATISTICAL ANALYSIS

IPAQ-SF_{GR} continuous PA scores, expressed in METs · min · week^{-1}, were generated for each participant according to the IPAQ scoring guidelines (see section A.4 in Appendix A) (IPAQ, 2005). Moreover, categorical analysis (see section A.4 in Appendix A) grouped the subjects in three PA levels; low, moderate and high. As far as the 6MWT is concerned, the maximum 6MWD achieved and related data were used in the analyses. The product of six-minute walking distance and body weight (6MDWP), which is considered to mimic the work of walking (Chuang, Lin,

Wasserman, 2001), was calculated as the product of 6MWD (in metres) x BW (in kilogrammes).

Raw data was initially entered into a Microsoft Office Excel 2007 spreadsheet in order for the appropriate calculations to take place (e.g. calculation of the BMI, WHR, %predHR$_{max,}$ 6MDWP). All data was then copied and transferred into a SPSS spreadsheet (data editor), after having defined (named and coded) all variables. The Statistical Package for Social Sciences (SPSS) version 14.0 software package for Windows (SPSS Inc., Chicago, IL) was used for all data analyses. The level of statistical significance (alpha level) was set at $a < 0.05$, while all p values are two-tailed. Continuous variables are presented as mean ± standard deviation (SD), and categorical variables are presented as absolute (number of subjects) and relative frequencies (percentages). On the other hand, IPAQ-SF$_{GR}$ PA scores are presented as median (minimum – maximum values).

The data's normality of distribution and homogeneity of variance were assessed using the Shapiro-Wilk test and the Levene's statistic, respectively (see Tables B.7, B.8, B.9 and B.10 in Section B). Simple one-way analysis of variance (ANOVA) and post hoc analysis (Tukey test) was used for the examination of possible differences between normal-weight, overweight and obese subjects regarding the variables which were normally distributed and homogeneous (6MDWP, HR$_{bef}$, HR$_{aft}$, %predHR$_{max}$, SBP$_{aft}$, DBP$_{bef}$ and SitHours). For the investigation of possible differences between the three groups, regarding the variables which were not normally distributed and/or not homogeneous (6MWD, SBP$_{bef}$, DBP$_{aft}$, and RPE$_{aft,}$ VigPA$_{score}$, ModPA$_{score}$, WalkPA$_{score}$, TotalPA$_{score}$), the Kruskal-Wallis ANOVA and post hoc analysis (multiple Mann Whitney U tests)

was used. When multiple tests were used in the same sample, a Bonferroni adjustment was employed in order to reduce the possibility of a type I error to occur.

Bivariate correlational techniques were used for the assessment of the relationship among the subjects' anthropometric characteristics and data related to the 6MWT and the IPAQ-SF_{GR}, as well as for the assessment of the association between the 6MWT and the IPAQ-SF_{GR}. In particular, the Pearson's product-moment correlation (r) was used for the investigation of the relationship among variables which were normally distributed, while the Spearman's rank-order correlation (Spearman's rho - r_s) was used for the exploration of possible associations among the variables which did not present a normal distribution. The coefficient of determination (r^2) was calculated for correlation coefficients greater than 0.70, in order to determine what proportion of variability in one variable is associated with variability in another variable.

∞ Chapter 3 ∞

Results

∞ CHAPTER 3 ∞

RESULTS

3.1 RESPONSE RATE

In total, 74 young Greeks expressed interest in participating in the study. Of those, two males and six females failed to appear for testing due to personal or unknown reasons, forming a response rate of approximately 89%. After the health screening process, of the remaining 66 volunteers, four were excluded from the study, forming the current sample size of 62 young Greeks, of which 21 were of normal weight, 21 were overweight and 20 were obese.

3.2 DESCRIPTIVE STATISTICS

3.2.1 CHARACTERISTICS OF STUDY SUBJECTS

Participants had no medical conditions that would interfere with physiological testing or the ability to complete written questionnaires and were under no prescribed medication. Socio-demographic, lifestyle and anthropometric characteristics of the subjects are summarised in Tables 3.1 and 3.2 with regard to gender and BMI category, respectively. Twenty-seven (44%) male and 35 (56%) female Greek young adults were recruited for the study. Overall, the mean ± standard deviation (SD) age, weight, BMI, WC and WHR was 23.9 (±3.9) years, 87.3 (±22.8) kilogrammes, 28.6 (±6.8) $kg \cdot m^{-2}$, 95.5 (±19.5) centimetres and 0.86 (±0.09), respectively. Nine percent, 24% and 90% of normal-weight, overweight and obese

subjects, accordingly, had an abnormally high WC (greater than 102 cm and 88 cm for men and women, respectively, NHLBI, 1998) (Figure 3.1), while the corresponding values for abnormally high WHR (greater than 0.95 and 0.86 for men and women, respectively, Heyward & Stolarczyk, 1996; cited in ACSM, 2006a) are five percent, five percent and 60% (Figure 3.2).

Among the participants there were 28 (45%) smokers, none of which had extensive smoking history.

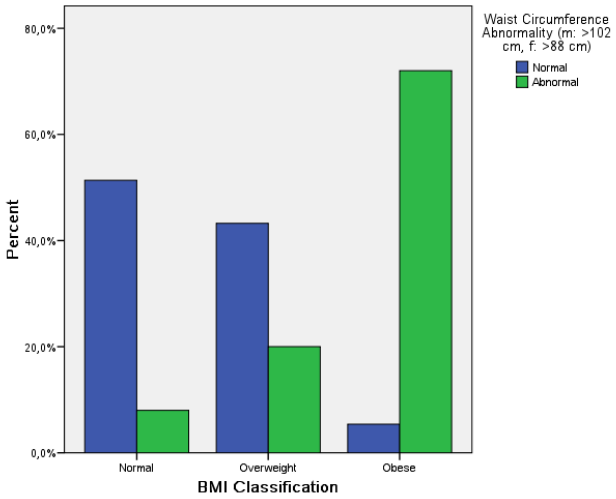

Figure 3.1 *Percentage of waist circumference abnormality across BMI categories*

Of them, eight (38%) were of normal-weight, 11 (52%) were overweight and 9 (45%) were obese. Three (5%) and two (3%) of the participants were classified as "former" and "occasional" smokers, respectively; however, due to their small number, they were recorded and combined with "never" and "current" smokers, accordingly, for further analysis.

Table 3.1 *Characteristics of study subjects (N=62) in relation to gender*

	ALL SUBJECTS *(N=62)* 100%		MALES *(n=27)* 44%		FEMALES *(n=35)* 56%	
	Mean (±SD) or N (%)	**(Min-Max)**	**Mean (±SD) or N (%)**	**(Min-Max)**	**Mean (±SD) or N (%)**	**(Min-Max)**
SOCIO-DEMOGRAPHIC & LIFESTYLE CHARACTERISTICS						
Age (years) †	23.9 (±3.9)	(18-30)	23.7 (±4.2)	(18-30)	24.0 (±3.8)	(19-30)
Smoking status						
Never smokers ‡	29 (47%)	–	13 (48%)	–	16 (46%)	–
Former smokers ‡	3 (5%)	–	2 (7%)	–	1 (3%)	–
Occasional smokers ‡	2 (3%)	–	1 (4%)	–	1 (3%)	–
Current smokers ‡	28 (45%)	–	11 (41%)	–	17 (48%)	–
ANTHROPOMETRIC CHARACTERISTICS						
BH (cm) †	174.3 (±7.9)	(158.0-198.0)	181.0 (±5.8)	(172.0-198.0)	169.27 (±4.7)	(158.0-179.0)
BW (kg) †	87.3 (±22.8)	(47.8-130.0)	97.0 (±16.6)	(70.0-130.0)	79.9 (±24.3)	(47.8-124.4)
BMI ($kg \cdot m^{-2}$) †	28.6 (±6.8)	(18.5-44.1)	29.5 (±4.7)	(22.5-41.0)	27.8 (±8.1)	(18.5-44.1)
WC (cm) †	95.5 (±19.5)	(60.0-151.0)	100.2 (±18.5)	(60.0-151.0)	91.9 (±19.6)	(62.0-126.0)
HC (cm) †	110.2 (±14.2)	(87.0-137.0)	110.2 (±11.8)	(91.0-135.3)	110.2 (±16.0)	(87.0-137.0)
WHR †	0.9 (±0.1)	(0.6-1.1)	0.9 (±0.1)	(0.68-1.1)	0.8 (±0.1)	(0.7-1.1)
Abnormal WC ‡ (♂>102, ♀>88 cm)	25 (40%)	–	9 (33%)	–	16 (46%)	–
Abnormal WHR ‡ (♂>0.95, ♀>0.86)	14 (23%)	–	4 (15%)	–	10 (29%)	–
BMI CLASS						
Normal ‡	21 (34%)	–	5 (18%)	–	16 (46%)	–
Overweight ‡	21 (34%)	–	13 (48%)	–	8 (23%)	–
Obese ‡	14 (22%)	–	8 (30%)	–	6 (17%)	–
Morbidly obese ‡	6 (10%)	–	1 (4%)	–	5 (14%)	–

∗ ***Definition of abbreviations and symbols:*** **N** = number of subjects in total, **n** = number of subjects in subgroups, **SD =** standard deviation, **Min =** minimum, **Max =** maximum, **cm =** centimetres, **kg =** kilogrammes, **m =** metres, **BH** = body height, **BW** = body weight, **BMI** = body mass index, **WC** = waist circumference, **HC** = hip circumference, **WHR** = waist-to-hip ratio.

† Age and anthropometric characteristics are presented as means ± standard deviation.

‡ Smoking status, BMI class, WC abnormality (NHLBI, 1998) and WHR abnormality (Heyward & Stolarczyk, 1996; cited in ACSM, 2006a) are presented as N(%); number of subjects in each group (percentage of the total number of subjects).

Similarly, due to their small number, six (10%) of the participants who were morbidly obese with a body mass index (BMI) greater than 40 $kg \cdot m^{-2}$, were recorded and combined with obese ones for further analysis.

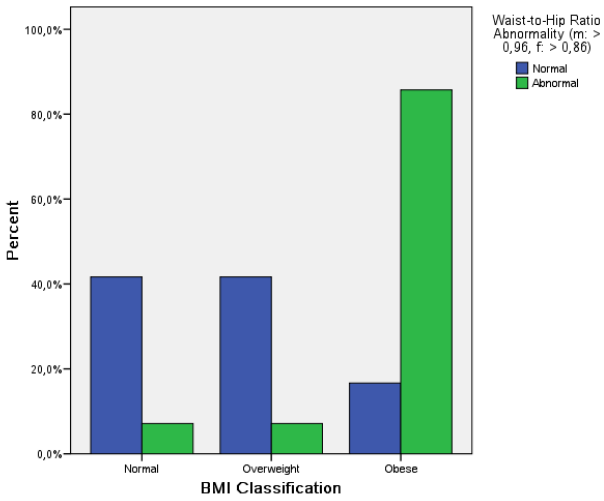

Figure 3.2 *Percentage of waist-to-hip ratio abnormality across BMI categories*

Table 3.2 *Characteristics of study subjects (N=62) in relation to BMI category*

	NORMAL (18.5 – 24.9 kg · m-2) (*n*=21) 34%		OVERWEIGHT (25.0 – 29.9 kg · m-2) (*n*=21) 34%		OBESE (≥ 30.0 kg · m-2) (*n*=20) 32%	
	Mean (±SD) or N (%)	**(Min-Max)**	**Mean (±SD) or N (%)**	**(Min-Max)**	**Mean (±SD) or N (%)**	**(Min-Max)**
SOCIO-DEMOGRAPHIC & LIFESTYLE CHARACTERISTICS						
Age (years) †	24.7 (±4.1)	(19-30)	22.9 (±3.3)	(18-30)	24.0 (±4.4)	(18-30)
Gender						
Male ‡	5 (24%)	–	13 (62%)	–	9 (45%)	–
Female ‡	16 (76%)	–	8 (38%)	–	11 (55%)	–
Smoking status						
Never smokers ‡	10 (48%)	–	10 (48%)	–	9 (45%)	–
Former smokers ‡	2 (9%)	–	0 (0%)	–	1 (5%)	–
Occasional smokers ‡	1 (5%)	–	0 (0%)	–	1 (5%)	–
Current smokers ‡	8 (38%)	–	11 (52%)	–	9 (45%)	–
ANTHROPOMETRIC CHARACTERISTICS						
BH (cm) †	169.8 (±6.0)	(158.0-181.0)	177.9 (±8.2)	(166.0-198.0)	175.3 (±7.3)	(164.0-190.0)
BW (kg) †	62.6 (±8.2)	(47.8-78.0)	87.57 (±11.0)	(71.0-110.9)	113.0 (±9.9)	(94.9-130.0)
BMI (kg · m-2) †	21.6 (±2.0)	(18.5-24.9)	27.6 (±1.9)	(25.1-32.4)	36.9 (±3.8)	(30.9-44.1)
WC (cm) †	78.4 (±9.1)	(62.0-92.5)	92.0 (±10.7)	(60.0-107.0)	117.2 (±13.3)	(99.0-151.0)
HC (cm) †	96.1 (±6.6)	(87.0-110.0)	109.4 (±6.3)	(91.0-119.0)	125.8 (±9.2)	(111.1-137.0)
WHR †	0.8 (±0.1)	(0.7-0.9)	0.8 (±0.1)	(0.6-0.9)	0.9 (±0.09)	(0.8-1.1)
Abnormal WC ‡ (♂>102, ♀ >88 cm)	2 (9%)	–	5 (24%)	–	18 (90%)	–
Abnormal WHR ‡ (♂>0.95, ♀ >0.86)	1 (5%)	–	1 (5%)	–	12 (60%)	–

⁎***Definition of abbreviations and symbols:*** **N** = number of subjects in total, **n** = number of subjects in subgroups, **SD =** standard deviation, **Min =** minimum, **Max =** maximum, **cm =** centimetres, **kg =** kilogrammes, **m =** metres, **BH** = body height, **BW** = body weight, **BMI** = body mass index, **WC** = waist circumference, **HC** = hip circumference, **WHR** = waist-to-hip ratio.

† Age and anthropometric characteristics are presented as means ± standard deviation.

‡ Gender, smoking status, WC abnormality (NHLBI, 1998) and WHR abnormality (Heyward & Stolarczyk, 1996; cited in ACSM, 2006a) are presented as N(%); number of subjects in each group (percentage of the total number of subjects).

3.2.2 PHYSICAL ACTIVITY

Descriptive statistical analysis was performed for all variables and the results are presented in Table 3.3 with regard to BMI class (and in Table B.6 in Appendix B, with regard to gender). On the basis of IPAQ-S_{GR} classification criteria (see section A.4 in Appendix A), fifteen (24%) of the subjects were classified as highly active, 24 (39%) were classified as moderately active and 23 (37%) were classified as having low PA or being sedentary. Forty-eight percent, 38% and 25% of normal-weight, overweight and obese subjects were classified as having low PA or being sedentary (Figure 3.3). About 11% of the participants had a $TotPA_{score}$ less than 200 METs · min · $week^{-1}$ (data not shown). A striking 71% of the subjects reported no participation in vigorous-intensity PAs, while, 42% and 18% reported no participation in moderate-intensity or walking PA, respectively (data not shown). Surprisingly enough, the highest $TotPA_{score}$ (median of 927.00 METs · min · $week^{-1}$) was observed among obese subjects, while the lowest (median of 688.50 METs · min · $week^{-1}$) was observed among subjects of normal weight. The median of $WalkPA_{score}$ was 264.0, 330.0 and 313.50 METs · min · $week^{-1}$ for normal-weight, overweight and obese subjects, respectively, while the corresponding values for $ModPA_{score}$ was 240.0, 360.0 and 40.0 METs · min · $week^{-1}$. The median for $VigPA_{score}$ was 0.0 METs · min · $week^{-1}$ for subjects in all three groups.

3.2.3 FUNCTIONAL CAPACITY

Although participants were informed that they could rest if they were too exhausted to continue the test, no test was interrupted nor terminated prematurely.

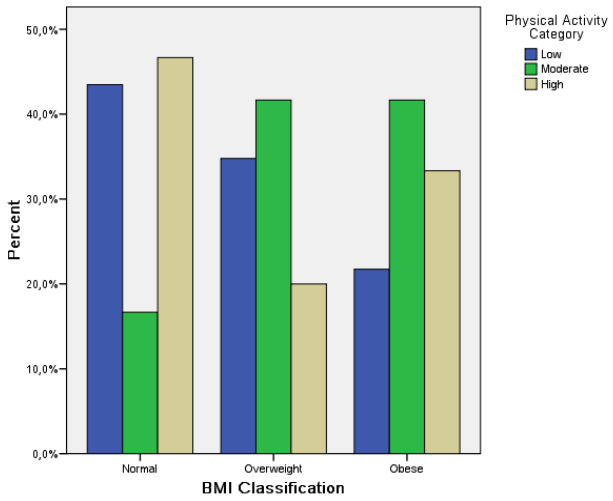

Figure 3.3 *Percentage of the level of physical activity across BMI categories*

All participants completed both 6MWTs, however, the best of the two (longer 6MWD) was used for further analysis. Ten (16%) subjects had the best 6MWD at first trial and the rest of them (84%) had the best 6MWD at the second trial. Descriptive statistics regarding the performance of the subjects in the first and second 6MWT are summarised in tables B.1, B.2, B.3, B.4 in Appendix B, while for the better 6MWT descriptive data are presented in Table 3.4 with regard to BMI category (and in Table B.5 in Appendix B with regard to gender). The mean (±SD) best 6MWD for all subjects was 587.5 (±101.956) metres, ranging from 290 to 750.5 metres and the mean (±SD) best 6MDWP was 51,035.7 (±15,253) kg · m, ranging from 24,163 to 86,025 kg · m. The mean (±SD) best 6MWD was 591.5 (±97.0), 624.0 (±88.8) and 544.9 (±108.4) metres for normal-weight, overweight and obese subjects, respectively, while the corresponding values for 6MDWP were 36,913.8 (±7,504.7), 55,165.4 (±12,475.9) and 61,527.5 (±12,987.4) kg · m.

Table 3.3 *IPAQ results of the subjects (N=62) in relation to BMI category*

	NORMAL (18.5 – 24.9 kg · m^{-2}) ***(n=21)* 34%**		**OVERWEIGHT** (25.0 – 29.9 kg · m^{-2}) ***(n=21)* 34%**		**OBESE** (≥ 30.0 kg · m^{-2}) ***(n=20)* 32%**	
	Median or N (%) or Mean (±SD)	**(Min-Max)**	**Median or N (%) or Mean (±SD)**	**(Min-Max)**	**Median or N (%) or Mean (±SD)**	**(Min-Max)**
IPAQ CATEGORICAL SCORE						
Highly active †	7 (33%)	–	3 (14%)	–	5 (25%)	–
Moderately active †	4 (19%)	–	10 (48%)	–	10 (50%)	–
Sedentary †	10 (48%)	–	8 (38%)	–	5 (25%)	–
IPAQ CONTINUOUS SCORES						
PA scores (METs · min · week^{-1})						
TotPA$_{score}$ ‡	688.5	(0.0 – 8620.0)	720.0	(0.0 – 6730.0)	927.0	(0.0 – 10788.0)
VigPA$_{score}$ ‡	0.00	(0.0 – 5760.0)	0.0	(0.0 – 1600.0)	0.0	(0.0 – 9600.0)
ModPA$_{score}$ ‡	240.0	(0.0 – 3600.0)	360.0	(0.0 – 4800.0)	40.0	(0.0 – 3600.0)
WalkPA$_{score}$ ‡	264.0	(0.0 – 4620.0)	330.0	(0.0 – 2772.0)	313.5	(0.0 – 1188.0)
SITHOURS ⊥	6.4 (±3.1)	(2.0 – 13.0)	6.9 (±3.1)	(3.00 – 13.0)	6.10 (±3.00)	(2.0 – 12.0)

∗ ***Definition of abbreviations and symbols:*** **N** = number of subjects in total, **n** = number of subjects in subgroups, **SD** = standard deviation, **Min** = minimum, **Max** = maximum, **PA** = physical activity, **TotPA$_{score}$** = total physical activity score, **VigPA$_{score}$** = vigorous physical activity score, **ModPA$_{score}$** = moderate physical activity score, **WalkPA$_{score}$** = walking physical activity score, **SitHours** = sitting hours, **METs** = resting metabolic equivalents (1 MET = 3.5 ml O_2 · kg^{-1} · min^{-1}), **min** = minutes.

† Categorical scores are presented as N(%); the number of subjects and (percentage of the total number of subjects).

‡ TotPA$_{score}$, VigPA$_{score}$, ModPA$_{score}$ and WalkPA$_{score}$ data are expressed in METs · min · week^{-1} and presented as the median and (minimum – maximum) values.

⊥ SitHours are presented as the mean ± standard deviation.

Table 3.4 *Best 6-MWT results of the subjects (N=62) in relation to BMI category*

	NORMAL (18.5 – 24.9 kg · m-2) (*N*=21) 34%		OVERWEIGHT (25.0 – 29.9 kg · m-2) (*n*=21) 34%		OBESE (≥ 30.0 kg · m-2) (*n*=20) 32%	
	Mean (±SD)	**Min-Max**	**Mean (±SD)**	**Min-Max**	**Mean (±SD)**	**Min-Max**
BEST SIX-MINUTE WALK TEST						
6MWD (m)	591.5 (±97.0)	372.0-722.2	624.0 (±88.8)	331.0-750.5	544.9 (±108.4)	290.0-750.0
6MDWP (m · kg)	36,913.8 (±7,504.7)	25,296.0-53,898.0	55,165.4 (±12,475.9)	24,163.0-77,846.2	61,527.5 (±12,987.4)	32,770.0-86,025.0
PHYSIOLOGICAL MEASUREMENTS						
Heart Rate (b · min-1)						
HR_{bef}	77.0 (±9.4)	61-97	75.9 (±11.6)	58-103	92 (±12.7)	69-120
HR_{aft}	126.6 (±20.8)	97-171	119.3 (±22.5)	81-163	138.4 (±23.3)	88-182
$\%^{pred}HR_{max}$	64.9 (±11.5)	49-90	60.43 (±11.5)	42-82	70.5 (±11.8)	45-91
Systolic Blood Pressure (mmHg)						
SBP_{bef}	105.9 (±13.9)	83-152	115.3 (±11.4)	100-139	130.2 (±10.3)	115-150
SBP_{aft}	129.3 (±18.9)	100-163	135.3 (±17.2)	100-167	150.6 (±16.9)	125-179
Diastolic Blood Pressure (mmHg)						
DBP_{bef}	68.7 (±7.9)	53-92	77.4 (±8.3)	62-95	86.7 (±8.6)	71-104
DBP_{aft}	78.8 (±10.0)	64-108	81.6 (±9.3)	65-100	92.0 (±9.0)	75-110
Ratings of Perceived Exertion						
RPE_{bef}	0 (±0)	0-0	0 (±0)	0-0	0 (±0)	0-0
RPE_{aft}	2.5 (±1.4)	1.0-6.0	1.7 (±1.2)	0.5-4.0	3.1 (±1.1)	0.5-5.0

∗***Definition of abbreviations and symbols:*** **N** = number of subjects in total, **n** = number of subjects in subgroups, **SD** = standard deviation, **Min** = minimum, **Max** = maximum, **6MWD** = six-minute walk distance, **m** = metres, **6MDWP** = distance-weight product, **bef** = before the 6MWT, **aft** = after the 6MWT, **HR** = heart rate, **b · min-1** = beats per minute, **SBP** = systolic blood pressure, **DBP** = diastolic blood pressure, **mmHg** =milimetres mercury, **RPE** = ratings of perceived exertion.
⊦ 6MWD is expressed in metres and presented as the mean ± standard deviation.
⊧ 6MDWP is expressed in metres · kilogrammes and presented as the mean ± standard deviation.
† HR is expressed in beats per minute and presented as the mean ± standard deviation.
‡ SBP and DBP is expressed in milimetres mercury and presented as the mean ± standard deviation.
‖ RPE is presented as the mean ± standard deviation.

3.3 INFERENTIAL STATISTICS

3.3.1 DIFFERENCES BETWEEN GROUPS RELATED TO 6MWT

Significant differences between normal-weight, overweight and obese subjects, regarding the 6MWT, as revealed from the results of the simple one-way ANOVA (Table 3.5) and post hoc analysis (Tukey test) (Table 3.6) and the results of the Kruskal-Wallis ANOVA (Table 3.7) and post hoc analysis (three Mann Whitney U tests, with a new level of significance p=0.05/3=0.017 provided by a Bonferroni adjustment) (Tables 3.8, 3.9, 3.10) are presented in Table 3.11. According to Table 3.11, significant differences were observed mainly between normal-weight and obese and between overweight and obese subjects.

Table 3.5 *Results of the simple one-way ANOVA test for the 6-MWT-related variables*

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Best 6-Minute Walk Distance-Weight Product (m · kg)	Between Groups	6,7E+009	2	3373835586	26,740	,000
	Within Groups	7,4E+009	59	126172599,4		
	Total	1,4E+010	61			
Heart Rate (bpm) Before Best 6-MWT	Between Groups	3298,783	2	1649,392	12,912	,000
	Within Groups	7536,571	59	127,738		
	Total	10835,355	61			
Heart Rate (bpm) After Best 6-MWT	Between Groups	3797,704	2	1898,852	3,854	,027
	Within Groups	29072,038	59	492,746		
	Total	32869,742	61			
Percent of age-predicted HRmax	Between Groups	1042,334	2	521,167	3,879	,026
	Within Groups	7926,714	59	134,351		
	Total	8969,048	61			
Systolic Blood Pressure (mmHg) After Best 6-MWT	Between Groups	4898,705	2	2449,353	7,822	,001
	Within Groups	18476,133	59	313,155		
	Total	23374,839	61			
Diastolic Blood Pressure (mmHg) Before Best 6-MWT	Between Groups	3332,447	2	1666,224	24,267	,000
	Within Groups	4050,988	59	68,661		
	Total	7383,435	61			

Table 3.6 *Post hoc analysis (Tukey test) for the 6-MWT-related variables*

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) BMI Classification	(J) BMI Classification	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Best 6-Minute Walk Distance-Weight Product (m · kg)	Normal	Overweight	-18251,564*	3466,473	,000	-26585,8212	-9917,3065
		Obese	-24613,671*	3509,537	,000	-33051,4638	-16175,8789
	Overweight	Normal	18251,564*	3466,473	,000	9917,3065	26585,8212
		Obese	-6362,1076	3509,537	,174	-14799,9000	2075,6849
	Obese	Normal	24613,671*	3509,537	,000	16175,8789	33051,4638
		Overweight	6362,10757	3509,537	,174	-2075,6849	14799,9000
Heart Rate (bpm) Before Best 6-MWT	Normal	Overweight	1,143	3,488	,943	-7,24	9,53
		Obese	-15,000*	3,531	,000	-23,49	-6,51
	Overweight	Normal	-1,143	3,488	,943	-9,53	7,24
		Obese	-16,143*	3,531	,000	-24,63	-7,65
	Obese	Normal	15,000*	3,531	,000	6,51	23,49
		Overweight	16,143*	3,531	,000	7,65	24,63
Heart Rate (bpm) After Best 6-MWT	Normal	Overweight	7,333	6,850	,536	-9,14	23,80
		Obese	-11,781	6,936	,214	-28,46	4,89
	Overweight	Normal	-7,333	6,850	,536	-23,80	9,14
		Obese	-19,114*	6,936	,021	-35,79	-2,44
	Obese	Normal	11,781	6,936	,214	-4,89	28,46
		Overweight	19,114*	6,936	,021	2,44	35,79
Percent of age-predicted HRmax	Normal	Overweight	4,429	3,577	,436	-4,17	13,03
		Obese	-5,643	3,621	,272	-14,35	3,06
	Overweight	Normal	-4,429	3,577	,436	-13,03	4,17
		Obese	-10,071*	3,621	,020	-18,78	-1,36
	Obese	Normal	5,643	3,621	,272	-3,06	14,35
		Overweight	10,071*	3,621	,020	1,36	18,78
Systolic Blood Pressure (mmHg) After Best 6-MWT	Normal	Overweight	-6,000	5,461	,519	-19,13	7,13
		Obese	-21,267*	5,529	,001	-34,56	-7,97
	Overweight	Normal	6,000	5,461	,519	-7,13	19,13
		Obese	-15,267*	5,529	,021	-28,56	-1,97
	Obese	Normal	21,267*	5,529	,001	7,97	34,56
		Overweight	15,267*	5,529	,021	1,97	28,56
Diastolic Blood Pressure (mmHg) Before Best 6-MWT	Normal	Overweight	-8,667*	2,557	,004	-14,81	-2,52
		Obese	-18,036*	2,589	,000	-24,26	-11,81
	Overweight	Normal	8,667*	2,557	,004	2,52	14,81
		Obese	-9,369*	2,589	,002	-15,59	-3,14
	Obese	Normal	18,036*	2,589	,000	11,81	24,26
		Overweight	9,369*	2,589	,002	3,14	15,59

*. The mean difference is significant at the .05 level.

Table 3.7 *Results of the Kruskal-Wallis ANOVA test for the 6-MWT-related variables*

Test Statistics[a,b]

	Best 6-Minute Walk Distance (m)	Systolic Blood Pressure (mmHg) Before Best 6-MWT	Diastolic Blood Pressure (mmHg) After Best 6-MWT	Ratings of Perceived Exertion Before Best 6-MWT	Ratings of Perceived Exertion After Best 6-MWT
Chi-Square	9,204	28,331	18,366	,000	12,559
df	2	2	2	2	2
Asymp. Sig.	,010	,000	,000	1,000	,002

a. Kruskal Wallis Test

b. Grouping Variable: BMI Classification

Table 3.8 *Results of the Mann Whitney U test for 6-MWT-related variables (Normal – Overweight)*

Test Statistics[a]

	Best 6-Minute Walk Distance (m)	Systolic Blood Pressure (mmHg) Before Best 6-MWT	Diastolic Blood Pressure (mmHg) After Best 6-MWT	Ratings of Perceived Exertion After Best 6-MWT
Mann-Whitney U	172,000	101,500	164,500	138,500
Wilcoxon W	403,000	332,500	395,500	369,500
Z	-1,220	-3,001	-1,413	-2,119
Asymp. Sig. (2-tailed)	,222	,003	,158	,034

a. Grouping Variable: BMI Classification

Table 3.9 *Results of the Mann Whitney U test for 6-MWT-related variables (Normal – Obese)*

Test Statistics[a]

	Best 6-Minute Walk Distance (m)	Systolic Blood Pressure (mmHg) Before Best 6-MWT	Diastolic Blood Pressure (mmHg) After Best 6-MWT	Ratings of Perceived Exertion After Best 6-MWT
Mann-Whitney U	134,000	32,000	60,500	133,000
Wilcoxon W	344,000	263,000	291,500	364,000
Z	-1,982	-4,650	-3,907	-2,085
Asymp. Sig. (2-tailed)	,047	,000	,000	,037

a. Grouping Variable: BMI Classification

Table 3.10 *Results of the Mann Whitney U test for 6-MWT-related variables (Overweight – Obese)*

Test Statistics[a]

	Best 6-Minute Walk Distance (m)	Systolic Blood Pressure (mmHg) Before Best 6-MWT	Diastolic Blood Pressure (mmHg) After Best 6-MWT	Ratings of Perceived Exertion After Best 6-MWT
Mann-Whitney U	99,000	72,500	86,500	90,000
Wilcoxon W	309,000	303,500	317,500	321,000
Z	-2,895	-3,597	-3,231	-3,219
Asymp. Sig. (2-tailed)	,004	,000	,001	,001

a. Grouping Variable: BMI Classification

3.3.2 DIFFERENCES BETWEEN GROUPS RELATED TO IPAQ-S_{GR}

According to the results of the simple one-way ANOVA (Table 3.12) and Kruskal-Wallis ANOVA (Table 3.13) no significant differences are observed among normal-weight, overweight and obese subjects in relation to their PA status.

Table 3.11 *Significant 6MWT-related differences between the three groups*

	Mean (± SD)			*p* value		
	G1: NORMAL	**G2: OVERWEIGHT**	**G3: OBESE**	**G1 vs G2**	**G1 vs G2**	**G2 vs G3**
6MWD (m)	591.5 (±97.0)	624.0 (±88.8)	544.9 (±108.4)	NS	NS	<0.01
6MDWP (m·kg)	36,913.8 (±7,504.7)	55,165.4 (±12,475.9)	61,527.5 (±12,987.4)	<0.0001	<0.0001	NS
HR_{bef} ($b \cdot min^{-1}$)	77.0 (±9.4)	75.9 (±11.6)	92.0 (±12.7)	NS	<0.0001	<0.0001
HR_{aft} ($b \cdot min^{-1}$)	126.6 (±20.8)	119.3 (±22.5)	138.4 (±23.3)	NS	NS	<0.05
$\%_0^{pred}HR_{max}$	64.9 (±11.5)	60.4 (±11.5)	70.5 (±11.8)	NS	NS	<0.05
SBP_{bef} (mmHg)	105.9 (±13.9)	115.3 (±11.4)	130.2 (±10.3)	<0.01	<0.0001	<0.0001
SBP_{aft} (mmHg)	129.3 (±18.9)	135.3 (±17.2)	150.6 (±16.9)	NS	<0.01	<0.05
DBP_{bef} (mmHg)	68.7 (±7.9)	77.4 (±8.3)	86.7 (±8.6)	<0.01	<0.0001	<0.01
DBP_{aft} (mmHg)	78.8 (±10.0)	81.6 (±9.3)	92.0 (±9.0)	NS	<0.0001	<0.01
RPE_{bef} (mmHg)	0 (±0)	0 (±0)	0 (±0)	NS	NS	NS
RPE_{aft} (mmHg)	2.5 (±1.3)	1.7 (±1.2)	3.1 (±1.1)	NS	NS	<0.01

∗***Definition of abbreviations and symbols:*** **SD** = standard deviation, **6MWD** = six-minute walk distance, **6MDWP** = six-minute distance-weight product, **HR** = heart rate, **SBP** = systolic blood pressure, **DBP** = diastolic blood pressure, **RPE** = ratings of perceived exertion, **bef** = before the 6MWT, **aft** = after the 6MWT, **NS** = non-significant.

Table 3.12 *Simple one-way ANOVA for sitting hours*

ANOVA

Sitting hours

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6,731	2	3,366	,355	,702
Within Groups	558,752	59	9,470		
Total	565,484	61			

Table 3.13 *Kruskal-Wallis ANOVA for IPAQ scores*

Test Statistics[a,b]

	Vigorous Physical Activity	Moderate Physical Activity	Walking Physical Activity	Total Physical Activity Score (METs·min/week)
Chi-Square	1,849	1,509	,167	,167
df	2	2	2	2
Asymp. Sig.	,397	,470	,920	,920

a. Kruskal Wallis Test

b. Grouping Variable: BMI Classification

3.3.3 RELATIONSHIP BETWEEN THE SUBJECTS' CHARACTERISTICS, 6MWT AND IPAQ-S_{GR}

No significant association was observed between the IPAQ scores and the subjects' age and anthropometric characteristics (Table 3.15), nor between the IPAQ scores and the 6MWT-related variables (Table 3.16), with the exception of a significant but low, negative correlation between $VigPA_{score}$ and RPE_{aft} (r_s=-0.31, p<0.05) and $TotPA_{score}$ and RPE_{aft} (r_s=-0.25, p<0.05), indicating that the more one participated in PA and especially in vigorous-intensity PA, the less fatigue and exertion he/she experienced at the end of the 6MWT. On the other hand, significant associations were noticed in several occasions among the 6MWT-related variables and the subjects' anthropometric characteristics (Table 3.14). The highest significant

correlations were detected between BW and 6MDWP (r_s=0.79, r^2=0.62, p<0.001), BW and SBP_{bef} (r_s=0.74, r^2=0.55, p<0.001), BW and DBP_{bef} (r_s=0.74, r^2=0.55, p<0.001), BH and 6MDWP (r=0.73, r^2=0.53, p<0.001) and, finally, between BMI and DBP_{bef} (r_s=0.71, r^2=0.50, p<0.001), indicating that BW accounted for 62%, 55% and 55% of variance in 6MDWP, SBP_{bef} and DBP_{bef}, respectively, while, BH accounted for 53% of variance in 6MDWP, and, finally, BMI and DBP_{bef} have 50% shared variance.

Table 3.14 *Correlations between subject characteristics and 6MWT-related variables*

		6MWT RELATED VARIABLES									
		6MWD	**6MDWP**	**HR_{bef}**	**HR_{aft}**	**$\%_0^{pred}HR_{max}$**	**SBP_{bef}**	**SBP_{aft}**	**DBP_{bef}**	**DBP_{aft}**	**RPE_{aft}**
SUBJECT CHARACTERISTICS	**Age**	-0.04‡	-0.10‡	-0.21‡	0.14‡	0.25‡	0.05‡	**0.26***‡	0.007‡	0.20‡	0.24‡
	BW	-0.14‡	**0.79****‡	**0.36***‡	0.14‡	0.14‡	**0.74****‡	**0.44****‡	***0.74***‡	***0.52***‡	0.23‡
	BH	**0.45****‡	**0.73****†	-0.075†	-0.09†	-0.09†	**0.41****†	0.18†	**0.44****†	0.14†	-0.08‡
	BMI	**-0.28***‡	**0.67****‡	**0.40****‡	0.15‡	0.14‡	**0.69****‡	**0.43****‡	**0.71****‡	**0.55****‡	**0.25***‡
	WC	**-0.32***‡	**0.55****†	**0.50****†	0.24†	0.23†	**0.66****†	**0.52****†	**0.65****†	**0.57****†	0.24‡
	WHR	-0.13‡	**0.41****†	**0.35***†	0.19†	0.20†	**0.57****†	**0.51****†	**0.54****†	**0.56****†	**0.30***‡

† Pearson's product-moment correlation coefficient (r).
‡ Spearman's rank-order correlation coefficient or Spearman's rho (r_s).
* p<0.05
** p<0.001

Table 3.15 *Correlations between subject characteristics and IPAQ-related variables*

		IPAQ Related Variables				
		$VigPA_{score}$	**$ModPA_{score}$**	**$WalkPA_{score}$**	**$TotPA_{score}$**	**SitHours**
Subject Characteristics	**Age**	0.005	-0.07	0.08	0.05	-0.23
	BW	-0.02	-0.06	-0.07	-0.08	0.08
	BH	-0.11	0.01	-0.05	-0.14	0.13
	BMI	-0.02	-0.07	-0.07	-0.05	0.05
	WC	0.004	-0.11	-0.07	-0.04	0.08
	WHR	0.07	-0.11	-0.08	-0.05	-0.06

Spearman's rank-order correlation coefficient or Spearman's rho (r_s).

Table 3.16 *Correlations between 6MWT- and IPAQ-related variables*

		6MWT Related Variables									
		6MWD	**6MDWP**	**HR_{bef}**	**HR_{aft}**	**$\%_{pred}HR_{max}$**	**SBP_{bef}**	**SBP_{aft}**	**DBP_{bef}**	**DBP_{aft}**	**RPE_{aft}**
IPAQ Scores	**$VigPA_{score}$**	0.02	-0.06	-0.006	0.04	0.05	0.06	0.01	0.01	-0.02	**-0.31***
	$ModPA_{score}$	0.19	0.11	-0.09	0.23	0.22	0.05	0.06	-0.04	-0.20	-0.12
	$WalkPA_{score}$	0.001	-0.09	0.13	0.04	0.04	-0.06	0.15	0.03	0.10	-0.15
	$TotPA_{score}$	0.01	-0.07	-0.03	0.25	0.25	0.000	0.08	0.008	-0.07	**-0.25***
	SitHours	0.12	0.11	0.14	-0.06	-0.09	-0.07	-0.20	-0.03	-0.20	-0.10

Spearman's rank-order correlation coefficient or Spearman's rho (r_s).
* $p<0.05$

∞ Chapter 4 ∞

Discussion

∞ CHAPTER 4 ∞

DISCUSSION

4.1 MAIN FINDINGS – SUMMARY OF KEY RESULTS

Apart from presenting information regarding the PA profile, FC status and body composition of young Greeks, the main purpose of this study was to investigate the impact of overweight and obesity on the subjects' PA and FC, while exploring possible interrelations between their anthropometric characteristics, PA and FC.

Based on the study findings, normal and overweight subjects appeared to have similar FC and better than that of obese subjects, indicating an adverse effect of obesity in FC. No significant differences were detected in IPAQ-S_{GR} scores between the three groups, indicating that all subjects, regardless of BMI categorisation, had similar PA profiles.

Contrary to the author's expectation and the bulk of the literature, no significant association was observed between the subjects' anthropometric characteristics and their IPAQ-S_{GR} scores, neither between their 6MWT-related variables and IPAQ-S_{GR} scores, except in the case of $TotPA_{score}$ and $VigPA_{score}$. Significant associations were mainly detected between the subjects' anthropometric characteristics and 6MWT-related variables, further supporting the association between anthropometrics and functional capacity. The highest significant

associations were identified between BW and 6MDWP, BW and resting BP, BH and 6MDWP and BMI and DBP_{bef}.

4.2 METHODOLOGICAL ISSUES – LIMITATIONS AND STRENGTHS

Prior to the interpretation of the study's findings, several limitations must be acknowledged. To begin with, this study, due to its cross-sectional nature, has the inherent limitation of not being able to establish causal relations between the variables under investigation, hence, the associations revealed are not cause-and-effect ones.

Moreover, in light of the relatively small sample size, its non-probability nature and its constitution of mainly young undergraduates, who represent a significant sector of young Greeks, nevertheless, are not representative of the whole population of Greek young adults, caution in generalisation of the results is necessary.

In addition, for practical reasons, PA was assessed by a questionnaire, which is a subjective measure of PA. Consequently, the results concerning PA are self-reported estimates of PA; therefore, considering that self-reports of PA are subjects to recall bias and misreporting (Slootmaker, Schuit, Chinapaw, Seidell & Van Mechelen, 2009; Prince *et al.,* 2008), the employment of a questionnaire for the assessment of PA may have led to misclassification of the true PA levels. Some participants may have not reported accurately, while some others may have experienced more pressure to answer questions in a socially desirable manner (Adams *et al.,* 2005; Motl, McAuley & DiStefano, 2005). It has, indeed, been shown that IPAQ-short may over-report (Ekelund *et al.,* 2006; Mcfarlane *et al.,* 2006;

Fogelholm *et al.,* 2006; Rzewnicki *et al.,* 2003) or underestimate (Kurtze *et al.,* 2008; Hallal, Victora, Wells, Lima & Valle, 2004) PA, when compared with other objective PA measures, or with IPAQ-long.

Overweight and obesity were assessed indirectly by measuring BW, BMI, WC and WHR, obesity indices which are not able to capture variations in fat and fat-free body mass (Frankenfield, Rowe, Cooney, Smith & Becker, 2001).

Furthermore, the study outcomes may have been influenced by seasonality in PA patterns, since data were collected during a period of nine months (from October 2008 to June 2009), hence, self-reported PA may have differed from subject to subject due to the fact it was assessed during different seasons of the year (Buchowski *et al.,* 2009; Tucker & Gilliland, 2007; Hull, Hester & Fields, 2006; Pivarnik, Reeves & Rafferty, 2003).

On the other hand, there are important strengths of this study that should be recognised. The homogeneous and well-characterised study sample and the control for the most important confounding factors (ambient temperature and humidity, medical condition and medication, emotional state, tobacco, caffeine, alcohol, salt, heavy meal and vigorous exercise or strenuous PA induced fatigue) affecting HR, BP and exercise performance, should be included among the study's strengths.

Moreover, bearing in mind that self-reports of anthropometric data are subjects to misreporting, with female, overweight and obese subjects usually underestimating weight and overestimating height, thus, seriously underestimating BMI (Stommel & Schoenborn, 2009; Lim, Seubsman & Sleigh, 2009; Shields, Gorber & Tremblay, 2008; Gorber, Tremblay, Moher & Gorber, 2007; Taylor *et al.,* 2006; Visscher, Viet, Kroesbergen & Seidell, 2006), the fact that anthropometric data in this

study was obtained through direct measurement should, also, be acknowledged as an important strength of this study.

Finally, given that many studies assessing PA in Greece have used either PA questionnaires designed especially for their study, thus, not possessing the ability to produce comparable data, or translated, internationally recognised questionnaires without having validated them in the Greek language or assessed their measurement properties, the fact that IPAQ-S_{GR} has been validated in the Greek language and has, also, been assessed for its reliability in young Greek adults, in combination with the fact that it provided internationally comparable data, should, also, be considered among the study's strengths.

4.3 INTERPRETATION OF STUDY RESULTS

Physical activity levels, as presented in this study, are generally, higher than those reported in several studies involving Greek, young university or college students, especially regarding women (Tirodimos *et al.,* 2009; Haase *et al.,* 2004; Steptoe *et al.,* 2002), but lower, compared to the PA levels reported for young Greek army recruits (Pitsavos *et al.,* 1998).

Due to the scarcity of relevant epidemiological data among young adults in Greece, direct comparisons are not feasible, nor can conclusive remarks be reached regarding either IPAQ-S_{GR} or 6MWT current results, leaving space mostly for speculations to be made. Still, in the study by Papathanasiou *et al.* (2009), where the reliability of IPAQ-S_{GR} was examined in 218 healthy, young Greek medical students, overweight subjects were included; however, results regarding the IPAQ-S_{GR} were presented in relation to gender, precluding direct comparison with current IPAQ-S_{GR}

results. Nevertheless, what can be observed is that, overall, compared to the current population, subjects who participated in the aforementioned study, were predominantly male, younger, less heavy and with a lower BMI, yet, all their IPAQ-S_{GR} PA scores were lower, whereas, their SitHours score was higher. The same observation is made when comparing current IPAQ-S_{GR} PA scores with the ones reported in the IPAQ-S_{GR} validation study by Papathanasiou *et al.,* (2010), involving young health science students. Considering that male gender, younger age and lower BMI are associated with higher PA levels, as consistently reported in studies assessing PA through self-reports (Panagiotakos *et al.,* 2008; Gordon-Larsen, Adair & Popkin, 2002; Norman, Bellocco, Vaida & Wolk, 2002; Caspersen *et al.,* 2000; Telama & Yang, 2000; Sallis & Saelens, 2000), and confirmed by studies using objective measures to assess PA (Tudor-Locke, Brashear, Johnson & Katzmarzyk, 2010; Slootmaker *et al.,* 2009; Troiano *et al.,* 2008), these observations, may be either reflecting real differences between the populations, or, may be attributable to the method used to assess PA, indicating that participants in the present study may have overestimated their self-reported levels of PA. Such a speculation is not unlikely, considering that self-reported PA is based on the individual's perception of his/her own quantity of PA and, thus, is prone to misinterpretation, recall bias and/or social desirability (Slootmaker *et al.,* 2009; Prince *et al.,* 2008; Adams *et al.,* 2005; Motl *et al.,* 2005; Duncan, Sydeman, Perri, Limacher & Martin, 2001); however, it conflicts existing literature indicating that overestimation appears to be greater among healthier, younger and less heavy subjects (Watkinson *et al.,* 2010; Van Sluijs, Griffin & Van Poppel, 2007).

On the other hand, no significant differences were detected in IPAQ-S_{GR} scores between the three groups, either indicating that all subjects, regardless of BMI categorisation, had similar PA profiles, or suggesting that it was not possible to detect significant differences between them, perhaps due to the small sample size. Nevertheless, this observation contrasts existing literature based on objective measures of PA assessment, indicating that obese subjects are less physically active than overweight and normal-weight subjects (Tudor-Locke *et al.,* 2010; Davis, Hodges & Gillham, 2006). However, similar PA levels, assessed by accelerometry, between normal-weight and overweight individuals have, also, been reported in the study by Cooper, Page, Fox & Misson (2000). Furthermore, in light of existing literature supporting the link between PA and anthropometrics in Greek adults (Panagiotakos *et al.,* 2008; Kavouras *et al.,* 2007; Pitsavos, Panagiotakos, Lentzas & Stefanadis, 2005), the failure to demonstrate a relation between PA and obesity indices probably stems from the method used to assess PA or the relatively small sample size, suggesting that a significant finding may have been obscured by low statistical power. Finally, the lack of association between IPAQ-Sgr scores and 6MWT variables is inconsistent with existing literature (Talbot, Metter & Fleg, 2000) linking PA and FC.

The 6MWT has been studied in several healthy, young adult populations (Chetta *et al.*, 2006; Grindrod *et al.,* 2006; Gibbons *et al.,* 2001), however, to the author's knowledge, this is the first study to present data regarding the 6MWT in the general Greek adult population. According to current results, the mean (±SD) 6MWD was 587.5 (±101.9) metres, with males covering longer distances (639.3 ± 59.8 metres) than females (547.60 ± 110.2 metres). This finding is in congruence with

those obtained from relevant studies (Alameri *et al.,* 2009; Chetta *et al.,* 2006; Grindrod *et al.,* 2006; Gibbons *et al.,* 2001). The current mean (±SD) 6MWD is lower than the corresponding values reported in the studies by Chetta *et al.,* 2006, Grindrod *et al.,* 2006 and for the 20-49 years age subgroup in Gibbons *et al.,* 2001. Compared to the current population, all the aforementioned studies included shorter and older subjects. Considering that age is inversely associated and height directly associated with 6MWD (Alameri *et al.,* 2009; Poh *et al.,* 2006; Chetta *et al.,* 2006; Gibbons *et al.,* 2001; Troosters *et al.,* 1999; Enright & Sherrill, 1998), this observation is highly unexpected; however, a possible explanation might stem from the fact that the current population were much heavier, with higher BMIs, which are both related with shorter 6MWD (Camarri *et al.,* 2006). The currently observed association between the subjects' anthropometric characteristics and the 6MWT-related variables is consistent with findings from other studies, supporting the association between anthropometrics and FC assessed by the 6MWT (Alameri *et al.,* 2009; Grindrod *et al.,* 2006; Camarri *et al.,* 2006; Chetta *et al.,* 2006; Gibbons *et al.,* 2001; Enright & Sherrill, 1998).

4.4 CONCLUSION

Overweight and obesity appeared to have an adverse effect on FC of young Greeks, but not on PA, as all subjects, regardless of BMI categorisation, were found to have similar PA profiles. However, given the extent of misreporting in many PA surveys, it remains unclear whether the apparent lack of difference observed in PA levels is real. Nonetheless, current findings contribute to the growing body of evidence that indicates that physical inactivity has become a major public health problem in Greece. These findings are highly disturbing considering that

participants in this study were young, healthy, mainly health science students, who are, therefore, likely to hold influential positions in health promotion and public health policy making in the future. This study further supports the positive association between anthropometrics and functional capacity.

4.5 RECOMMENDATIONS – IMPLICATIONS FOR FURTHER RESEARCH

In view of the dearth of epidemiological data regarding the PA profile of the general Greek young adult population, there is urgent need for further investigating the prevalence, patterns and trends of PA, in large, nationwide, representative samples of young Greeks, using combinations of different objective, valid and reliable measures of PA, to highlight particular mediators of PA participation, that could be targeted by public health policy makers in Greece, in order to design and implement effective prevention and health promotion strategies to combat increasing sedentarism and enhance physical fitness in young Greeks. Policy makers should take biological, psychological, behavioural, socioeconomic and environmental factors, affecting PA participation, into consideration and should implement strategies focusing not only on sedentary, though, ostensibly healthy young Greeks, but especially on those young Greeks who have already developed clinical manifestations of CVD risk factors.

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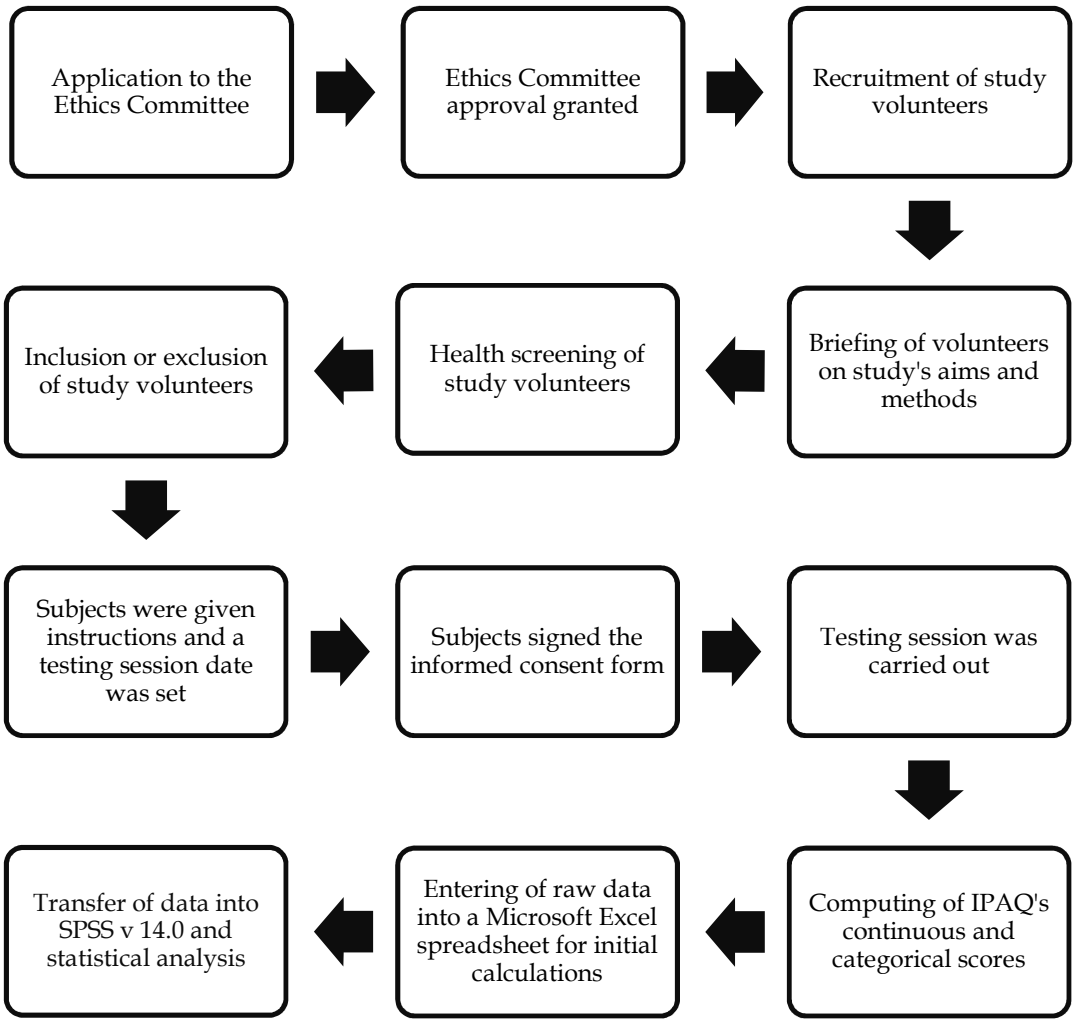
APPENDICES

℘ APPENDIX A ☙

ADDITIONAL METHODOLOGY

A.1

SCHEMATIC OUTLINE OF THE STUDY PROCESS



A.2

ENGLISH VERSION OF THE SHORT, LAST-7-DAYS, SELF-ADMINISTERED FORMAT OF THE IPAQ (IPAQ-SEN)

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

A.3

GREEK VERSION OF THE SHORT, LAST-7-DAYS, SELF-ADMINISTERED FORMAT OF THE IPAQ (IPAQ-S_{GR})

International Physical Activity Questionnaire

Short – self answered – last 7 days recall

Greek Version

Οι παρακάτω ερωτήσεις αφορούν στο χρόνο που έχετε αφιερώσει για κάποια σωματική δραστηριότητα τις **τελευταίες 7 ημέρες**. Περιλαμβάνουν ερωτήσεις σχετικά με δραστηριότητες που κάνατε κατά την εργασία σας, στις μετακινήσεις σας, στις δουλειές του σπιτιού, του κήπου και στον ελεύθερο χρόνο σας για ψυχαγωγία, άσκηση ή άθληση. Σας παρακαλώ να απαντήσετε όλες τις ερωτήσεις, ακόμα και εάν πιστεύετε ότι δεν είστε ένα σωματικά δραστήριο άτομο.

Πριν απαντήσετε τις ερωτήσεις 1 και 2, σκεφτείτε όλες τις **έντονες** σωματικές δραστηριότητες που κάνατε κατά τις **τελευταίες 7 ημέρες**. Μια έντονη σωματική δραστηριότητα αναφέρεται σε δραστηριότητες που απαιτούν έντονη σωματική προσπάθεια και σας κάνουν να αναπνέετε σημαντικά δυσκολότερα από ότι συνήθως. Σκεφθείτε μόνο τις **έντονες** σωματικές δραστηριότητες που κάνατε και είχαν διάρκεια **μεγαλύτερη από 10 λεπτά** κάθε φορά.

1. **Κατά τις τελευταίες 7 ημέρες, πόσες ημέρες κάνατε κάποια έντονη σωματική δραστηριότητα, όπως σκάψιμο, έντονη άσκηση με βάρη, τρέξιμο σε διάδρομο με κλίση, γρήγορο τρέξιμο, aerobics, γρήγορη ποδηλασία, γρήγορη κολύμβηση, τένις μονό, αγώνα σε γήπεδο (ποδόσφαιρο, basketball, volleyball, handball);**

   _____ ημέρες ανά εβδομάδα

   ☐ εάν δεν κάνατε έντονες σωματικές δραστηριότητες: → προχωρήστε στην ερώτηση 3

2. **Τις ημέρες που κάνατε κάποια έντονη σωματική δραστηριότητα, πόση ώρα αφιερώνατε συνήθως;**

   _____ λεπτά ανά ημέρα δεν γνωρίζω / δεν είμαι βέβαιος ☐

Πριν απαντήσετε τις ερωτήσεις 3 και 4, σκεφτείτε όλες τις **μέτριας έντασης** σωματικές δραστηριότητες που κάνατε κατά τις **τελευταίες 7 ημέρες**. Μια μέτριας έντασης σωματική δραστηριότητα αναφέρεται σε δραστηριότητες που απαιτούν μέτρια σωματική προσπάθεια και σας κάνουν να αναπνέετε κάπως δυσκολότερα από ότι συνήθως. Σκεφθείτε μόνο τις **μέτριας έντασης** σωματικές δραστηριότητές που κάνατε και είχαν διάρκεια **μεγαλύτερη από 10 λεπτά** κάθε φορά.

- 1 -

3. **Κατά τις τελευταίες 7 ημέρες, πόσες ημέρες κάνατε κάποια μέτρια σωματική δραστηριότητα, όπως το να σηκώσετε και να μεταφέρετε ελαφρά βάρη (μικρότερα από 10 κιλά), συνολική καθαριότητα του σπιτιού, ήπιες ρυθμικές ασκήσεις σώματος, ποδηλασία αναψυχής με χαμηλή ταχύτητα, χαλαρή κολύμβηση; <u>Σας παρακαλώ να μη συμπεριλάβετε το περπάτημα.</u>**

_____ ημέρες ανά εβδομάδα

☐ εάν δεν κάνατε μέτριας έντασης σωματικές δραστηριότητες: → προχωρήστε στην ερώτηση 5

4. **Τις ημέρες που κάνατε κάποια μέτρια σωματική δραστηριότητα, πόση ώρα αφιερώνατε συνήθως;**

_____ λεπτά ανά ημέρα δεν γνωρίζω / δεν είμαι βέβαιος ☐

Πριν απαντήσετε στις ερωτήσεις 5 και 6, σκεφτείτε το χρόνο που περπατήσατε κατά τις <u>τελευταίες 7 ημέρες</u>. Να συμπεριλάβετε το περπάτημα στο χώρο της εργασίας σας, στις μετακινήσεις σας και στον ελεύθερο χρόνο σας για ψυχαγωγία, άσκηση ή άθληση.

5. **Τις τελευταίες 7 ημέρες, πόσες ημέρες περπατήσατε για περισσότερο από 10 συνεχόμενα λεπτά;**

_____ ημέρες ανά εβδομάδα

☐ εάν δεν περπατήσατε καμία φορά περισσότερο από 10 συνεχόμενα λεπτά: → προχωρήστε στην ερώτηση 7

6. **Τις ημέρες που περπατήσατε, για περισσότερο από 10 συνεχόμενα λεπτά, πόση ώρα περάσατε περπατώντας;**

_____ λεπτά ανά ημέρα δεν γνωρίζω / δεν είμαι βέβαιος ☐

7. **Πόσο χρόνο περάσατε καθισμένοι σε μια συνηθισμένη μέρα κατά τη διάρκεια των τελευταίων 7 ημερών; Ο χρόνος αυτός μπορεί να περιλαμβάνει το χρόνο που περνάτε καθισμένοι στο σπίτι, στο γραφείο, όταν επισκέπτεστε φίλους, όταν διαβάζετε, μελετάτε ή βλέπετε τηλεόραση, αλλά δεν περιλαμβάνει τον ύπνο.**

_____ ώρες ανά ημέρα δεν γνωρίζω/ δεν είμαι βέβαιος ☐

Τέλος του ερωτηματολογίου. Σας ευχαριστούμε για τη συμμετοχή σας.

A.4

IPAQ-SF$_{GR}$ SCORING PROTOCOL AND GUIDELINES FOR COMPUTING CONTINUOUS AND CATEGORICAL SCORES

SCORING PROTOCOL AND FORMULAS FOR COMPUTATION OF CONTINUOUS SCORES

PA_{score}† = MET level x (daily minutes of activity) x (days / week)

$VigPA_{score}$† = 8.0 x (daily minutes of walking activity) x (days / week)

$ModPA_{score}$† = 4.0 x (daily minutes of moderate-intensity activity) x (days / week)

$WalkPA_{score}$† = 3.3 x (daily minutes of vigorous-intensity activity) x (days / week)

$TotalPA_{score}$† = $VigPA_{score}$ + $ModPA_{score}$ + $WalkPA_{score}$

- Participants are instructed to record only those PA that last at least 10 minutes
- Any responses to duration provided in *hours-minutes* format is converted into *minutes*
- Any responses to duration reported as *weekly* are converted into an average *daily* time by dividing by 7
- The recorded PAs with duration less than ten min · day^{-1} are recoded to zero min · day^{-1}
- The recorded PAs with duration more than 180 min · day^{-1} are recoded to 180 min · day^{-1}
- Questionnaires with missing data for time or days or *"don't know"/"not sure"* checked items are excluded from analysis
- Questionnaires with Total PA duration > 960 minutes are excluded from analysis
- Questionnaires with PA frequency > 9 days are excluded from analysis

SCORING PROTOCOL FOR CATEGORICAL SCORES (PA CLASSIFICATION CRITERIA)

Low level of PA:

- No activity reported *or*
- $TotalPA_{score}$ < 600 METs · min · week^{-1}

Moderate level of PA:

- ≥ 3 days of VigPA ≥ 20 min/day ⇨ $VigPA_{score}$ ≥ 480 METs · min · week^{-1} *or*
- ≥ 5 days of ModPA ≥ 30 min/day ⇨ $ModPA_{score}$ ≥ 600 METs · min · week^{-1} *or*
- ≥ 5 days of WalkPA ≥ 30 min/day ⇨ $WalkPA_{score}$ ≥ 495 METs · min · week^{-1} *or*
- ≥ 5 days of Total PA ⇨ Total PA_{score} ≥ 600 METs · min · week^{-1}

High level of PA:

- ≥ 3 days of VigPA ⇨ $VigPA_{score}$ ≥ 1500 METs · min · week^{-1} *or*
- ≥ 7 days of Total PA ⇨ Total PA_{score} ≥ 3000 METs · min · week^{-1}

✳***Definition of abbreviations and symbols:*** **min** = minutes, **PA** = physical activity, **VigPA** = vigorous physical activity, **ModPA** = moderate physical activity, **WalkPA** = walking physical activity, **METs** = metabolic equivalents (1 MET = 3.5 ml O_2/kg/min, representing the average rate of energy expenditure at rest).
† All PA_{scores} are expressed as METs · min · week^{-1}

A.5

ADMINISTRATOR'S SHEET FOR THE 6MWT IN ENGLISH

SIX-MINUTE WALK TEST (6MWT)

FULL NAME: _____ DATE: ___ / ___ / _____

■ **During the 1st 6MWT:**

LAPS	1	2	3	4	5	6	7	8	9	10	11
	12	13	14	15	16	17	18	19	20	21	22
	23	24	25	26	27	28	29	30	31	32	33
INTERRUPTIONS	1	2	3	4	5	6	7	8	9	10	11
Additional distance (metres):											
Total number of laps:					6MWD (metres):						
Total number of interruptions:					6MDWP (kg · m):						

■ **Completed the test** With ☐ Without ☐ **interruption**
If with interruption, explain:
_____

■ **Symptoms after the completion of the test**
Leg pain ☐ Shortness of breath ☐ Dizziness ☐ Other ☐ explain:_____

■ **During the 2nd 6MWT:**

LAPS	1	2	3	4	5	6	7	8	9	10	11
	12	13	14	15	16	17	18	19	20	21	22
	23	24	25	26	27	28	29	30	31	32	33
INTERRUPTIONS	1	2	3	4	5	6	7	8	9	10	11
Additional distance (metres):											
Total number of laps:					6MWD (metres):						
Total number of interruptions:					6MDWP (kg · m):						

■ **Completed the test** With ☐ Without ☐ **interruption**
If with interruption, explain:
_____

■ **Symptoms after the completion of the test**
Leg pain ☐ Shortness of breath ☐ Dizziness ☐ Other ☐ explain:_____

A.6

ADMINISTRATOR'S SHEET FOR THE 6MWT IN GREEK

Δοκιμασια 6 Λεπτων Βαδισης (6MWT)

Ονοματεπωνυμο: _____ **Ημερομηνια:** ___/___/_____

■ Κατά τη διάρκεια της 1ης 6MWT:

ΓΥΡΟΙ	1	2	3	4	5	6	7	8	9	10	11
	12	13	14	15	16	17	18	19	20	21	22
	23	24	25	26	27	28	29	30	31	32	33
ΣΤΑΣΕΙΣ	1	2	3	4	5	6	7	8	9	10	11

Επιπλέον απόσταση (μέτρα):	
Συνολικός αριθμός γύρων:	6MWD (μέτρα):
Συνολικός αριθμός στάσεων:	6MDWP (m · kg):

■ Τερμάτισε τη δοκιμασία Με ☐ Χωρίς ☐ στάση
Αν με διακοπή, αιτιολογείστε:

_____

■ Συμπτώματα μετά το τέλος της δοκιμασίας
Πόνος στα κάτω άκρα ☐ Δύσπνοια ☐ Ζάλη ☐ Άλλο ☐ εξηγείστε:_____

■ Κατά τη διάρκεια της 2ης 6MWT:

ΓΥΡΟΙ	1	2	3	4	5	6	7	8	9	10	11
	12	13	14	15	16	17	18	19	20	21	22
	23	24	25	26	27	28	29	30	31	32	33
ΣΤΑΣΕΙΣ	1	2	3	4	5	6	7	8	9	10	11

Επιπλέον απόσταση (μέτρα):	
Συνολικός αριθμός γύρων:	6MWD (μέτρα):
Συνολικός αριθμός στάσεων:	6MDWP (m · kg):

■ Τερμάτισε τη δοκιμασία Με ☐ Χωρίς ☐ στάση
Αν με διακοπή, αιτιολογείστε:

_____

■ Συμπτώματα μετά το τέλος της δοκιμασίας
Πόνος στα κάτω άκρα ☐ Δύσπνοια ☐ Ζάλη ☐ Άλλο ☐ εξηγείστε:_____

_____

A.7

VERBAL INSTRUCTIONS FOR THE 6MWT IN ENGLISH

"The object of this test is to walk as far as possible for six minutes. You will walk back and forth in this hallway. Six minutes is a long time to walk, so you will be exerting yourself. You will probably get out of breath or become exhausted. You are permitted to slow down, to stop, and to rest as necessary. You may lean against the wall while resting, but resume walking as soon as you are able".

"You will be walking back and forth around the cones. You should pivot briskly around the cones and continue back the other way without hesitation. Now I' m going to show you. Please watch me the way I turn without hesitation".

The investigator demonstrates…

"Are you ready to do that? I am going to keep track of the number of laps you complete. Every one minute I will be reminding you of the remaining time until you complete the six minutes. During the last ten seconds, I will be counting down until the end of the test. That is when you have to stop walking and remain absolutely still in order to accurately mark your position".

"Remember that the object is to walk as far as possible for 6 minutes, but don't run or jog".

"Start now or whenever you are ready".

A.8

VERBAL INSTRUCTIONS FOR THE 6MWT IN GREEK

«Το ζητούμενο σε αυτή τη δοκιμασία είναι να διανύσεις όσο το δυνατόν μεγαλύτερη απόσταση μέσα σε έξι λεπτά. Θα βαδίσεις πέρα δώθε κατά μήκος αυτού του διαδρόμου. Έξι λεπτά είναι αρκετός χρόνος βάδισης, οπότε θα αισθανθείς κόπωση. Ίσως νιώσεις δύσπνοια ή εξάντληση. Επιτρέπεται να επιβραδύνεις, να σταματήσεις, και να ξεκουραστείς όσο χρειαστείς. Μπορείς να ακουμπήσεις στον τοίχο ενώ ξεκουράζεσαι, ωστόσο συνέχισε τη βάδιση όσο το δυνατόν πιο σύντομα».

«Θα βαδίζεις πέρα δώθε γύρω από τους κώνους. Θα πρέπει να στρίβεις γρήγορα γύρω από τους κώνους και να συνεχίζεις προς την αντίθετη μεριά χωρίς δισταγμό. Τώρα θα σου δείξω τον τρόπο. Σε παρακαλώ να παρακολουθήσεις πώς στρίβω χωρίς δισταγμό».

Η ερευνήτρια επιδεικνύει…

«Είσαι έτοιμος/η να ξεκινήσεις; Θα καταγράψω τον αριθμό των γύρων που θα ολοκληρώσεις. Κάθε λεπτό θα σου υπενθυμίζω τον υπολειπόμενο χρόνο μέχρι να συμπληρωθούν τα έξι λεπτά. Κατά τη διάρκεια των τελευταίων δέκα δευτερολέπτων, θα μετράω αντίστροφα μέχρι το τέλος της δοκιμασίας. Τότε θα πρέπει να σταματήσεις και να παραμείνεις απόλυτα ακίνητος/η ώστε να σημειώσω τη θέση σου με ακρίβεια».

«Θυμήσου ότι ο στόχος είναι να διανύσεις όσο το δυνατόν μεγαλύτερη απόσταση μέσα σε έξι λεπτά, ωστόσο μην τρέξεις ούτε να κάνεις βάδην».

«Ξεκίνα τώρα ή όποτε νιώθεις έτοιμος/η».

A.9

STANDARD PHRASES OF ENCOURAGEMENT DURING THE 6MWT IN ENGLISH

After the first minute: *"You are doing well. You have 5 minutes to go."*

After the second minute: *"Keep up the good work. You have 4 minutes to go."*

After the third minute: *"You are doing well. You have 3 minutes to go."*

After the fourth minute: *"Keep up the good work. You have only 2 minutes to go."*

After the fifth minute: *"You are doing well. You have only 1 minute to go."*

Fifteen seconds before completion of the test: *"In a moment I'm going to tell you to stop. When I do, just stop right where you are and I will come to you."*

The research assistant begins to count down out loud from 10 to 0 sec before the end of the test.

When the sixth minute is completed: *"Stop!"*

A.10

STANDARD PHRASES OF ENCOURAGEMENT DURING THE 6MWT IN GREEK

After the first minute: *«Τα πας καλά. Έχεις ακόμα πέντε λεπτά».*

After the second minute: *«Συνέχισε έτσι. Έχεις ακόμα τέσσερα λεπτά».*

After the third minute: *«Τα πας καλά. Έχεις ακόμα τρία λεπτά».*

After the fourth minute: *«Συνέχισε έτσι. Έχεις μόνο δύο λεπτά ακόμα».*

After the fifth minute: *«Τα πας καλά. Έχεις μόνον ένα λεπτό ακόμα».*

Fifteen seconds before completion of the test: *«Σε λίγο θα σου πω να σταματήσεις. Εκείνη τη στιγμή, σταμάτα ακριβώς εκεί που βρίσκεσαι και θα έρθω εγώ σε σένα».*

The research assistant begins to count down out loud from 10 to 0 sec before the end of the test.

When the sixth minute is completed: *"Σταμάτα!"*

A.11

TEN-POINT CATEGORY-RATIO (CR-10) BORG SCALE IN ENGLISH

0	Nothing at all
0.3	
0.5	Extremely weak
0.7	
1	Very weak
1.5	
2	Weak
2.5	
3	Moderate
4	
5	Strong
6	
7	Very strong
8	
9	
10	Extremely strong
11	
↗	
•	Absolute Maximum

A.12

TEN-POINT CATEGORY-RATIO (CR-10) BORG SCALE IN GREEK

0	Καμία αίσθηση δυσκολίας
0.3	
0.5	Πάρα πολύ ελαφριά
0.7	
1	Πολύ ελαφριά
1.5	
2	Ελαφριά
2.5	
3	Μέτρια
4	
5	Δύσκολη
6	
7	Πολύ δύσκολη
8	
9	
10	Πάρα πολύ δύσκολη
11	
↗	
•	Μέγιστη

A.13

VERBAL INSTRUCTIONS FOR THE EMPLOYMENT OF THE CR-10 BORG SCALE IN ENGLISH

"This is a scale for rating perceived exertion. Perceived exertion is the overall effort or distress of your body during exercise or physical activity. It is based on the physical sensations a person experiences during physical activity, including increased heart rate, increased respiration or breathing rate, increased sweating, and muscle fatigue. The number 0 represents no exertion and the number 10 represents the greatest amount of exertion that you have ever experienced. You will be asked to select a number that indicates your rating of perceived exertion at the beginning and at the end of the 6-MWT, because your own perception is an important complement to the physiological measurements we are going to take".

"During the 6-MWT I want you to pay close attention to how hard you feel the exercise is. This feeling should reflect your total amount of exertion and fatigue, combining all sensations and feelings of physical stress, effort, and fatigue. Don't concern yourself with any one factor such as leg pain, shortness of breath or exercise intensity, but try to concentrate on your total, inner feeling of exertion. Try to appraise your feeling of exertion as honestly as possible, without thinking about what the actual physical load is. Your own feeling of effort and exertion is important, not how it compares to other people's feeling. Try not to underestimate or overestimate your feelings of exertion; be as accurate as you can. Look at the scale and the expressions and then give a number".

Immediately after the completion of the 6MWT:

"Now, please grade your level of exertion using this scale".

A.14

VERBAL INSTRUCTIONS FOR THE EMPLOYMENT OF THE CR-10 BORG SCALE IN GREEK

«Αυτή είναι μια κλίμακα αξιολόγησης του αντιλαμβανόμενου αισθήματος κόπωσης. Το αντιλαμβανόμενο αίσθημα κόπωσης είναι η συνολική προσπάθεια ή δυσφορία του σώματός σου κατά τη διάρκεια της άσκησης ή της φυσικής δραστηριότητας. Βασίζεται στις σωματικές αισθήσεις που βιώνει κανείς κατά τη διάρκεια της φυσικής δραστηριότητας, συμπεριλαμβάνοντας την αύξηση των καρδιακών παλμών και των αναπνοών, την αύξηση της εφίδρωσης και την μυϊκή κόπωση. Ο αριθμός μηδέν (0) αντιπροσωπεύει την μηδενική κόπωση και ο αριθμός δέκα (10) αντιπροσωπεύει τη μέγιστη κόπωση που έχεις νιώσει ποτέ. Θα σου ζητηθεί να επιλέξεις έναν αριθμό ο οποίος θα υποδεικνύει το βαθμό της αντιλαμβανόμενης κόπωσης πριν την έναρξη και κατά την ολοκλήρωση της εξάλεπτης δοκιμασίας βάδισης, διότι η δική σου αντίληψη είναι σημαντικό συμπληρωματικό στοιχείο στις φυσιολογικές μετρήσεις στις οποίες θα υποβληθείς».

«Κατά τη διάρκεια της εξάλεπτης δοκιμασίας βάδισης θέλω να δώσεις ιδιαίτερη προσοχή στο πόσο δύσκολη βρίσκεις την δοκιμασία. Αυτό το αίσθημα θα πρέπει να αντιστοιχεί στο συνολικό αίσθημα προσπάθειας και κόπωσης, συνδυάζοντας όλες τις αισθήσεις και τα συναισθήματα του σωματικού στρες, της προσπάθειας και της κόπωσης. Μη εστιάσεις την προσοχή σου σε κάποιο συγκεκριμένο παράγοντα, όπως για παράδειγμα στον πόνο στα πόδια σου, στην δύσπνοια ή στην ένταση της δοκιμασίας, αλλά προσπάθησε να συγκεντρωθείς στην συνολική, εσωτερική αίσθηση κόπωσης. Προσπάθησε να αξιολογήσεις το αίσθημα της κόπωσης με όσο το δυνατόν μεγαλύτερη ειλικρίνεια, χωρίς να σκέφτεσαι ποια θα ήταν αντικειμενικά η σωματική φόρτιση. Η δική σου αίσθηση προσπάθειας και κόπωσης είναι σημαντική, όχι το πώς αυτή συγκρίνεται με την αίσθηση των άλλων. Προσπάθησε να μην υποτιμήσεις, ούτε να υπερτιμήσεις το αίσθημα κόπωσης: να είσαι όσο το δυνατόν πιο ακριβής. Κοίτα την κλίμακα και τις εκφράσεις δίπλα στους αριθμούς και διάλεξε έναν αριθμό».

Immediately after the completion of the 6MWT:

«Τώρα, σε παρακαλώ, δώσε μου το βαθμό της κόπωσής σου χρησιμοποιώντας αυτή την κλίμακα».

℘ APPENDIX B ☙

ADDITIONAL RESULTS

DESCRIPTIVE STATISTICS

Table B.1 *First 6-MWT results of the subjects (N=62) in relation to gender*

	ALL SUBJECTS (*N*=62) 100%		MALES (*n*=27) 34%		FEMALES (*n*=35) 56%	
	Mean (±SD)	**Min-Max**	**Mean (±SD)**	**Min-Max**	**Mean (±SD)**	**Min-Max**
FIRST SIX-MINUTE WALK TEST						
6-MWD$_1$ (m) ⊢	547.74 (±106.72)	279.55-723.20	598.19 (±75.69)	(394.30-723.20)	508.83 (±111.69)	279.55-678.30
DWP$_1$ (m · kg) ⊨	47884.33 (±15144.60)	19754.80-82951.0	58284.95 (±11199.28)	(36918.89-82951.04)	39861.00 (±12783.39)	(19754.80-65308.20)
PHYSIOLOGICAL MEASUREMENTS						
Heart Rate (b · min^{-1})						
HR$^1_{rest}$ †	80.03 (±13.21)	51-120	79.19 (±15.56)	51-120	80.69 (±11.25)	61-104
HR$^1_{end}$ †	121.24 (±23.24)	77-174	119.15 (±26.89)	77-174	122.86 (±20.23)	83-167
Systolic Blood Pressure (mmHg)						
SBP$^1_{rest}$ ‡	117.58 (±15.67)	88-160	125.33 (±14.44)	100-160	111.60 (±14.01)	88-140
SBP$^1_{end}$ ‡	137.44 (±20.87)	100-206	143.48 (±19.94)	100-206	132.77 (±20.63)	100-175
Diastolic Blood Pressure (mmHg)						
DBP$^1_{rest}$ ‡	77.85 (±10.25)	56-100	82.30 (±9.66)	65-100	74.43 (±9.45)	56-91
DBP$^1_{end}$ ‡	84.15 (±10.63)	57-100	86.59 (±10.22)	65-110	82.26 (±10.70)	57-100
Ratings of Perceived Exertion						
RPE$^1_{rest}$ ‖	0 (±0)	0-0	0 (±0)	0-0	0 (±0)	0-0
RPE$^1_{end}$ ‖	1.92 (± 1.21)	0.5-4.0	1.98 (±1.15)	0.5-4.0	1.87 (±1.27)	0.5-4.0

⁎***Definition of abbreviations and symbols:*** **N** = number of subjects in total, **n** = number of subjects in subgroups, **SD** = standard deviation, **Min** = minimum, **Max** = maximum, **6-MWD** = six-minute walk distance, **m** = metres, **DWP** = Distance-Weight product, **HR** = heart rate, **b · min^{-1}** = beats per minute, **SBP** = systolic Blood Pressure, **DBP** = diastolic blood pressure, **mmHg** =milimetres mercury, **RPE** = ratings of perceived exertion.

⊢ 6-MWD is expressed in metres and presented as the mean ± standard deviation.

⊨ DWP is expressed in metres · kilogrammes and presented as the mean ± standard deviation.

† HR is expressed in beats per minute and presented as the mean ± standard deviation.

‡ SBP and DBP is expressed in milimetres mercury and presented as the mean ± standard deviation.

‖ RPE is presented as the mean ± standard deviation.

Table B.2 *First 6-MWT results of the subjects in relation to BMI classification*

	NORMAL (*N*=21) 34%		**OVERWEIGHT (*n*=21) 34%**		**OBESE (*n*=20) 32%**	
	Mean (±SD)	**Min-Max**	**Mean (±SD)**	**Min-Max**	**Mean (±SD)**	**Min-Max**
FIRST SIX-MINUTE WALK TEST						
6-MWD$_1$ (m) ⊦	540.94 (±108.43)	316.70-678.30	576.79(±99.64)	325.31-675.00	524.39(±110.38)	279.55-723.20
DWP$_1$ (m · kg) ⊧	33787.34(±8099.80)	19754.80-52751.40	51199.12 (±11038.85)	232747.63-64192.50	59205.67(±13127.31)	31589.15-82951.04
PHYSIOLOGICAL MEASUREMENTS						
Heart Rate (b · min^{-1})						
HR$^1_{rest}$ †	76.29 (±9.28)	62-92	73.76 (±11.36)	51-103	90.55 (±12.56)	65-120
HR$^1_{end}$ †	114.76 (±15.97)	77-138	115.14 (±24.90)	80-167	134.45 (±23.26)	87-174
Systolic Blood Pressure (mmHg)						
SBP$^1_{rest}$ ‡	107.00 (±12.81)	88-139	115.38 (±11.39)	90-140	131.00 (±12.65)	110-160
SBP$^1_{end}$ ‡	126.52 (±18.99)	100-165	134.76 (±16.10)	110-170	151.70 (±19.80)	125-206
Diastolic Blood Pressure (mmHg)						
DBP$^1_{rest}$ ‡	69.38 (±7.87)	56-93	79,14 (±8.44)	65-95	85.40 (±7.48)	74-100
DBP$^1_{end}$ ‡	76.05 (±8.85)	57-95	84.52 (±8.89)	65-100	92.25 (±7.46)	80-100
Ratings of Perceived Exertion						
RPE$^1_{rest}$ ‖	0 (±0)	0-0	0 (±0)	0-0	0 (±0)	0-0
RPE$^1_{end}$ ‖	1.79 (±1.10)	0.5-4.0	1.36 (±1.08)	0.5-4.0	2.65 (±1.12)	0.5-4.0

⁕***Definition of abbreviations and symbols:*** **N** = number of subjects in total, **n** = number of subjects in subgroups, **SD** = standard deviation, **Min** = minimum, **Max** = maximum, **6-MWD** = six-minute walk distance, **m** = metres, **DWP** = Distance-Weight product, **HR** = heart rate, **b · min^{-1}** = beats per minute, **SBP** = systolic Blood Pressure, **DBP** = diastolic blood pressure, **mmHg** =milimetres mercury, **RPE** = ratings of perceived exertion.

⊦ 6-MWD is expressed in metres and presented as the mean ± standard deviation.

⊧ DWP is expressed in metres ·kilogrammes and presented as the mean ± standard deviation.

† HR is expressed in beats per minute and presented as the mean ± standard deviation.

‡ SBP and DBP is expressed in milimetres mercury and presented as the mean ± standard deviation.

‖ RPE is presented as the mean ± standard deviation.

Table B.3 *Second 6-MWT results of the subjects (N=62) in relation to gender*

	ALL SUBJECTS (*N*=62) 100%		**MALES (*n*=27) 34%**		**FEMALES (*n*=35) 56%**	
	Mean (±SD)	**Min-Max**	**Mean (±SD)**	**Min-Max**	**Mean (±SD)**	**Min-Max**
SECOND SIX-MINUTE WALK TEST						
6-MWD$_2$ (m) ⊦	585.69(±102.14)	290.00-750.50	635.01(±63.10)	533.30-750.50	547.65(±110.70)	290.00-722.20
DWP$_2$ (m · kg) ⊧	50808.52(±14946.53)	24163.00-86025.00	61367.69(±10899.27)	43307.97-86025.00	42662.88 (±12374.05)	24163.00-69221.80
PHYSIOLOGICAL MEASUREMENTS						
Heart Rate (b · min^{-1})						
HR$^2_{rest}$ †	82.35 (±13.69)	58-121	81.07 (±14.90)	58-121	83.34 (±12.81)	62-109
HR$^2_{end}$ †	128.29 (±23.86)	81-182	124.85 (±25.77)	81-182	130.94 (±22.29)	88-171
Systolic Blood Pressure (mmHg)						
SBP$^2_{rest}$ ‡	116.63 (±15.20)	83-152	124.52 (±13.76)	100-152	110.54 (±13.49)	83-140
SBP$^2_{end}$ ‡	138.32 (±19.66)	100-179	143.30 (±16.91)	110-176	134.49 (± 20.97)	100-179
Diastolic Blood Pressure (mmHg)						
DBP$^2_{rest}$ ‡	77.50 (±11.10)	53-104	82.48 (±9.85)	68-104	73.66 (±10.59)	53-100
DBP$^2_{end}$ ‡	83.39 (±10.52)	60-108	85.26 (±11.97)	60-108	81.94 (±9.16)	64-99
Ratings of Perceived Exertion	-	-	-	-	-	-
RPE$^2_{rest}$ ‖	0 (±0)	0-0	0 (±0)	0-0	0 (±0)	0-0
RPE$^2_{end}$ ‖	2.46 (±1.31)	0.5-6.0	2.46 (± 1.41)	0.5-6.0	2.46 (±1.24)	0.5-5.0

⁕***Definition of abbreviations and symbols:*** **N** = number of subjects in total, **n** = number of subjects in subgroups, **SD** = standard deviation, **Min** = minimum, **Max** = maximum, **6-MWD** = six-minute walk distance, **m** = metres, **DWP** = Distance-Weight product, **HR** = heart rate, **b · min^{-1}** = beats per minute, **SBP** = systolic Blood Pressure, **DBP** = diastolic blood pressure, **mmHg** =milimetres mercury, **RPE** = ratings of perceived exertion.

⊦ 6-MWD is expressed in metres and presented as the mean ± standard deviation.

⊧ DWP is expressed in metres ·kilogrammes and presented as the mean ± standard deviation.

† HR is expressed in beats per minute and presented as the mean ± standard deviation.

‡ SBP and DBP is expressed in milimetres mercury and presented as the mean ± standard deviation.

‖ RPE is presented as the mean ± standard deviation.

Table B.4 *Second 6-MWT results of the subjects in relation to BMI classification*

	NORMAL (*N*=21) 34%		**OVERWEIGHT (*n*=21) 34%**		**OBESE (*n*=20) 32%**	
	Mean (±SD)	**Min-Max**	**Mean (±SD)**	**Min-Max**	**Mean (±SD)**	**Min-Max**
SECOND SIX-MINUTE WALK TEST						
6-MWD₂ (m) ⊦	591.47 (±96.96)	372.00-722.20	625.22 (±88.77)	531.00-750.50	538.12 (±105.64)	290.00-750.00
DWP₂ (m · kg) ⊧	36909.51 (±7502.81)	25296.00-53898.00	55258.21 (±12428.00)	24163.00-77846.25	60730.31 (±12504.56)	32770.00-86025.00
PHYSIOLOGICAL MEASUREMENTS						
Heart Rate (b · min⁻¹)						
HR^2_{rest} †	77.43 (±9.13)	61-97	75.95 (±11.00)	58-99	94.25 (±12.86)	69-121
HR^2_{end} †	125.95 (±21.42)	97-171	118.90 (±21.69)	81-163	140.60 (±24.21)	88-182
Systolic Blood Pressure (mmHg)						
SBP^2_{rest} ‡	105.95 (±13.86)	83-152	115.33 (±11.48)	100-139	129.20 (±10.31)	115-148
SBP^2_{end} ‡	129.10 (±19.20)	100-163	135.62 (±17.06)	110-167	150.85 (±16.70)	125-179
Diastolic Blood Pressure (mmHg)						
DBP^2_{rest} ‡	68.71 (±7.86)	53-92	77.00 (±7.66)	62-90	87.25 (±9.12)	71-104
DBP^2_{end} ‡	78.76 (±9.96)	64-108	80.95 (±10.03)	60-100	90.80 (±7.530)	75-107
Ratings of Perceived Exertion	-	-	-	-	-	-
RPE^2_{rest} ‖	0 (±0)	0-0	0 (±0)	0-0	0 (±0)	0-0
RPE^2_{end} ‖	2.48 (±1.29)	1.0-6.0	1.69 (±1.19)	0.5-4.0	3.25 (±0.97)	1.0-5.0

⁎***Definition of abbreviations and symbols:*** **N** = number of subjects in total, **n** = number of subjects in subgroups, **SD** = standard deviation, **Min** = minimum, **Max** = maximum, **6-MWD** = six-minute walk distance, **m** = metres, **DWP** = Distance-Weight product, **HR** = heart rate, **b · min⁻¹** = beats per minute, **SBP** = systolic Blood Pressure, **DBP** = diastolic blood pressure, **mmHg** =milimetres mercury, **RPE** = ratings of perceived exertion.

⊦ 6-MWD is expressed in metres and presented as the mean ± standard deviation.

⊧ DWP is expressed in metres ·kilogrammes and presented as the mean ± standard deviation.

† HR is expressed in beats per minute and presented as the mean ± standard deviation.

‡ SBP and DBP is expressed in milimetres mercury and presented as the mean ± standard deviation.

‖ RPE is presented as the mean ± standard deviation.

Table B.5 *Best 6-MWT results of the subjects (N=62) in relation to gender*

	ALL SUBJECTS (*N*=62) 100%		**MALES (*n*=27) 34%**		**FEMALES (*n*=35) 56%**	
	Mean (±SD)	**Min-Max**	**Mean (±SD)**	**Min-Max**	**Mean (±SD)**	**Min-Max**
BEST SIX-MINUTE WALK TEST						
6-MWD$_{best}$ (m) ⊦	587.52 (±101.94)	290-750.50	639.26 (±59.85)	533.30-750.50	547.60 (±110.17)	290-722.20
DWP$_{best}$ (m · kg) ⊧	51035.67 (± 15252.98)	24163-86025	61870.05 (±11288.59)	43307.97-86025.00	42677.72 (±12443.18)	24163.00-69221.80
PHYSIOLOGICAL MEASUREMENTS						
Heart Rate (b · min^{-1})						
HR$^{best}_{rest}$ †	81.45 (±13.33)	58-120	80.44 (±14.81)	58-120	82.23 (±12.23)	62-109
HR$^{best}_{end}$ †	127.93 (±23.21)	81-182	124.59 (±25.68)	81-182	130.51 (±21.13)	87-171
Systolic Blood Pressure (mmHg)						
SBP$^{best}_{rest}$ ‡	116.93 (±15.46)	83-152	124.67 (±14.06)	100-152	110.97 (±13.92)	83-140
SBP$^{best}_{end}$ ‡	138.22 (±19.57)	100-179	142.89 (±17.27)	110-176	134.63 (±20.71)	100-179
Diastolic Blood Pressure (mmHg)						
DBP$^{best}_{rest}$ ‡	77.47 (±11.00)	53-104	82.78 (±10.10)	68-104	73.37 (±9.97)	53-91
DBP$^{best}_{end}$ ‡	84.00 (±10.90)	64-110	86.11 (±12.05)	65-110	82.37 (±9.80)	64-100
Ratings of Perceived Exertion						
RPE$^{best}_{rest}$ ‖	0 (±0)	0-0	0 (±0)	0-0	0 (±0)	0-0
RPE$^{best}_{end}$ ‖	2.40 (±1.31)	0.5-6.00	2.37 (±1.43)	0.5-6.0	2.42 (±1.24)	0.5-5.0

⁎***Definition of abbreviations and symbols:*** **N** = number of subjects in total, **n** = number of subjects in subgroups, **SD** = standard deviation, **Min** = minimum, **Max** = maximum, **6-MWD** = six-minute walk distance, **m** = metres, **DWP** = Distance-Weight product, **HR** = heart rate, **b · min^{-1}** = beats per minute, **SBP** = systolic Blood Pressure, **DBP** = diastolic blood pressure, **mmHg** =milimetres mercury, **RPE** = ratings of perceived exertion.

⊦ 6-MWD is expressed in metres and presented as the mean ± standard deviation.

⊧ DWP is expressed in metres · kilogrammes and presented as the mean ± standard deviation.

† HR is expressed in beats per minute and presented as the mean ± standard deviation.

‡ SBP and DBP is expressed in milimetres mercury and presented as the mean ± standard deviation.

‖ RPE is presented as the mean ± standard deviation.

Table B.6 *IPAQ results of the subjects (N=62) in relation to gender*

	ALL SUBJECTS (*N*=62) 100%		**MALES (*n*=27) 34%**		**FEMALES (*n*=35) 56%**	
	Median or N (%) or Mean (±SD)	**(Min-Max)**	**Median or N (%) or Mean (±SD)**	**(Min-Max)**	**Median or N (%) or Mean (±SD)**	**(Min-Max)**
IPAQ CATEGORICAL SCORES						
Highly active †	15 (24%)	–	6 (22%)	–	9 (26%)	–
Moderately active †	24 (39%)	–	11 (41%)	–	13 (37%)	–
Sedentary †	23 (37%)	–	10 (37%)	–	13 (37%)	–
IPAQ CONTINUOUS SCORES						
PA scores (METs · min · week^{-1})						
$TotPA_{score}$ ‡	839.50	(0.00 – 10788.00)	720.00	(0.00 – 10788.00)	1155.00	(0.00 – 8620.00)
$VigPA_{score}$ ‡	0.00	(0.00 – 9600.00)	0.00	(0.00 – 9600.00)	0.00	(0.00 – 3840.00)
$ModPA_{score}$ ‡	200.00	(0.00 – 4800.00)	240.00	(0.00 – 4800.00)	160.00	(0.00 – 4800.00)
$WalkPA_{score}$ ‡	297.00	(0.00 – 4620.00)	297.00	(0.00 – 1188.00)	297.00	(0.00 – 4620.00)
SITHOURS⊥	6.48 (±3.04)	(2.00 – 13.00)	6.52 (±3.31)	(2.00 – 13.00)	6.46 (±2.87)	(2.00 – 13.00)

⁎***Definition of abbreviations and symbols:*** **N** = number of subjects in total, ***n*** = number of subjects in subgroups, **SD** = standard deviation, **Min** = minimum, **Max** = maximum, **PA** = physical activity, **$TotPA_{score}$** = total physical activity score, **$VigPA_{score}$** = vigorous physical activity score, **$ModPA_{score}$** = moderate physical activity score, **$WalkPA_{score}$** = walking physical activity score, **SitHours** = sitting hours, **METs** = resting metabolic equivalents (1 MET = 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$), **min** = minutes.
† IPAQ categorical scores are presented as N(%); the number of subjects and (percentage of the total number of subjects).
‡ IPAQ total, vigorous, moderate and walking data are expressed as physical activity scores in METs · min · week^{-1} and presented as the median and (minimum – maximum) values.
⊥ Sitting hours are presented as the mean ± standard deviation.

Table B.7 *Tests of normality for the 6-MWT-related variables*

Tests of Normality[b,c,d]

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	BMI Classification	Statistic	df	Sig.	Statistic	df	Sig.
Best 6-Minute Walk Distance (m)	Normal	,245	21	,002	,849	21	,004
	Overweight	,172	21	,104	,844	21	,003
	Obese	,153	20	,200*	,950	20	,365
Best 6-Minute Walk Distance-Weight Product (m · kg)	Normal	,082	21	,200*	,973	21	,792
	Overweight	,097	21	,200*	,977	21	,874
	Obese	,126	20	,200*	,959	20	,529
Heart Rate (bpm) Before Best 6-MWT	Normal	,083	21	,200*	,980	21	,925
	Overweight	,149	21	,200*	,917	21	,076
	Obese	,097	20	,200*	,984	20	,972
Heart Rate (bpm) After Best 6-MWT	Normal	,102	21	,200*	,957	21	,453
	Overweight	,114	21	,200*	,968	21	,690
	Obese	,135	20	,200*	,954	20	,431
Percent of age-predicted HRmax	Normal	,140	21	,200*	,946	21	,285
	Overweight	,139	21	,200*	,952	21	,375
	Obese	,139	20	,200*	,956	20	,467
Systolic Blood Pressure (mmHg) Before Best 6-MWT	Normal	,232	21	,005	,806	21	,001
	Overweight	,155	21	,200*	,947	21	,299
	Obese	,158	20	,200*	,951	20	,376
Systolic Blood Pressure (mmHg) After Best 6-MWT	Normal	,125	21	,200*	,951	21	,356
	Overweight	,155	21	,200*	,941	21	,232
	Obese	,135	20	,200*	,946	20	,304
Diastolic Blood Pressure (mmHg) Before Best 6-MWT	Normal	,155	21	,200*	,922	21	,095
	Overweight	,129	21	,200*	,957	21	,457
	Obese	,161	20	,182	,952	20	,403
Diastolic Blood Pressure (mmHg) After Best 6-MWT	Normal	,142	21	,200*	,895	21	,028
	Overweight	,100	21	,200*	,975	21	,838
	Obese	,110	20	,200*	,976	20	,879
Ratings of Perceived Exertion After Best 6-MWT	Normal	,263	21	,001	,845	21	,003
	Overweight	,291	21	,000	,839	21	,003
	Obese	,273	20	,000	,895	20	,033

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

b. Ratings of Perceived Exertion Before Best 6-MWT is constant when BMI Classification = Normal. It has been omitted.

c. Ratings of Perceived Exertion Before Best 6-MWT is constant when BMI Classification = Overweight. It has been omitted.

d. Ratings of Perceived Exertion Before Best 6-MWT is constant when BMI Classification = Obese. It has been omitted.

Table B.8 *Tests of homogeneity of variance for the 6-MWT-related variables*

Test of Homogeneity of Variance[a,b,c]

		Levene Statistic	df1	df2	Sig.
Best 6-Minute Walk Distance (m)	Based on Mean	,382	2	59	,684
	Based on Median	,241	2	59	,787
	Based on Median and with adjusted df	,241	2	57,990	,787
	Based on trimmed mean	,361	2	59	,699
Best 6-Minute Walk Distance-Weight Product (m · kg)	Based on Mean	1,470	2	59	,238
	Based on Median	1,451	2	59	,243
	Based on Median and with adjusted df	1,451	2	48,055	,244
	Based on trimmed mean	1,474	2	59	,237
Heart Rate (bpm) Before Best 6-MWT	Based on Mean	,732	2	59	,485
	Based on Median	,568	2	59	,570
	Based on Median and with adjusted df	,568	2	55,144	,570
	Based on trimmed mean	,677	2	59	,512
Heart Rate (bpm) After Best 6-MWT	Based on Mean	,266	2	59	,768
	Based on Median	,252	2	59	,778
	Based on Median and with adjusted df	,252	2	58,342	,778
	Based on trimmed mean	,268	2	59	,766
Percent of age-predicted HRmax	Based on Mean	,116	2	59	,891
	Based on Median	,169	2	59	,845
	Based on Median and with adjusted df	,169	2	57,521	,845
	Based on trimmed mean	,107	2	59	,899
Systolic Blood Pressure (mmHg) Before Best 6-MWT	Based on Mean	,199	2	59	,820
	Based on Median	,161	2	59	,851
	Based on Median and with adjusted df	,161	2	42,313	,852
	Based on trimmed mean	,189	2	59	,828
Systolic Blood Pressure (mmHg) After Best 6-MWT	Based on Mean	,191	2	59	,827
	Based on Median	,178	2	59	,837
	Based on Median and with adjusted df	,178	2	58,117	,837
	Based on trimmed mean	,203	2	59	,817
Diastolic Blood Pressure (mmHg) Before Best 6-MWT	Based on Mean	,501	2	59	,609
	Based on Median	,450	2	59	,640
	Based on Median and with adjusted df	,450	2	58,114	,640
	Based on trimmed mean	,494	2	59	,613
Diastolic Blood Pressure (mmHg) After Best 6-MWT	Based on Mean	,021	2	59	,979
	Based on Median	,032	2	59	,969
	Based on Median and with adjusted df	,032	2	57,522	,969
	Based on trimmed mean	,021	2	59	,979
Ratings of Perceived Exertion After Best 6-MWT	Based on Mean	,767	2	59	,469
	Based on Median	,227	2	59	,797
	Based on Median and with adjusted df	,227	2	57,221	,797
	Based on trimmed mean	,583	2	59	,561

a. Ratings of Perceived Exertion Before Best 6-MWT is constant when BMI Classification = Normal. It has been omitted.

b. Ratings of Perceived Exertion Before Best 6-MWT is constant when BMI Classification = Overweight. It has been omitted.

c. Ratings of Perceived Exertion Before Best 6-MWT is constant when BMI Classification = Obese. It has been omitted.

Table B.9 *Tests of normality for the IPAQ-related variables*

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	BMI Classification	Statistic	df	Sig.	Statistic	df	Sig.
Vigorous Physical Activity	Normal	,354	21	,000	,573	21	,000
	Overweight	,476	21	,000	,490	21	,000
	Obese	,356	20	,000	,554	20	,000
Moderate Physical Activity	Normal	,296	21	,000	,643	21	,000
	Overweight	,302	21	,000	,628	21	,000
	Obese	,295	20	,000	,603	20	,000
Walking Physical Activity	Normal	,377	21	,000	,603	21	,000
	Overweight	,290	21	,000	,580	21	,000
	Obese	,193	20	,050	,862	20	,009
Sitting hours	Normal	,119	21	,200*	,951	21	,359
	Overweight	,209	21	,017	,916	21	,071
	Obese	,113	20	,200*	,952	20	,405
Total Physical Activity Score (METs·min/week)	Normal	,237	21	,003	,788	21	,000
	Overweight	,306	21	,000	,718	21	,000
	Obese	,280	20	,000	,713	20	,000

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table B.10 *Tests of homogeneity of variance for the IPAQ-related variables (Levene's statistic)*

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Vigorous Physical Activity	Based on Mean	5,535	2	59	,006
	Based on Median	1,547	2	59	,221
	Based on Median and with adjusted df	1,547	2	35,001	,227
	Based on trimmed mean	3,333	2	59	,043
Moderate Physical Activity	Based on Mean	1,016	2	59	,368
	Based on Median	,474	2	59	,625
	Based on Median and with adjusted df	,474	2	53,550	,625
	Based on trimmed mean	,751	2	59	,476
Walking Physical Activity	Based on Mean	5,898	2	59	,005
	Based on Median	1,321	2	59	,275
	Based on Median and with adjusted df	1,321	2	29,664	,282
	Based on trimmed mean	3,673	2	59	,031
Sitting hours	Based on Mean	,114	2	59	,892
	Based on Median	,077	2	59	,926
	Based on Median and with adjusted df	,077	2	58,150	,926
	Based on trimmed mean	,122	2	59	,885
Total Physical Activity Score (METs·min/week)	Based on Mean	1,482	2	59	,236
	Based on Median	,664	2	59	,518
	Based on Median and with adjusted df	,664	2	55,072	,519
	Based on trimmed mean	1,285	2	59	,284

∞ APPENDIX C ∞

ADDITIONAL MATERIALS

C.1

RESEARCH ETHICS COMMITTEE APPROVAL DOCUMENT

Technological Educational Institute of Lamia
School of Health and Caring Professions
Department of Physiotherapy

ETHICAL COMMITTEE

Dr Ioannis Poulis MA, PhD
Lecturer in Physiotherapy

Department of Physiotherapy
3rd km, Old National Road
351 00, Lamia
+30 22310 60205
ipoulis@teilam.gr

Lamia, July 30, 2008

Reference Number 10

Today, Wednesday 30th July, 2008, at 13.30pm, at the office of the Lecturer in Physiotherapy, Ioannis Poulis, the meeting of the Ethical Committee of the Department of Physiotherapy was convened.

In accordance with the decision of the General Meeting of the Department of Physiotherapy (ref. 607/08-04-04), the Ethical Committee consists of the following members:

Dr Ioannis Poulis
Dr Nikolaos Strimpakos
Dr Gewrgios Paras

Following detailed study of the application by Mrs Athinais - Georgia Psyhogiou (number 727/09-06-08), titled:

Physical activity and health-related physical fitness in relation to obesity status among young Greek adults

and based on the information included in the application form, the Ethical Committee comprised of the above, has decided that:

Since the research proposal conforms to the national standards of physiotherapeutic ethics and safeguards the respect of the volunteers included in the study, it has been granted the approval of the Ethical Committee of The Department of Physiotherapy.

The members:

Dr Ioannis Poulis Dr Nikolaos Strimpakos Dr Gewrgios Paras

C.2

PREPARTICIPATION SCREENING QUESTIONNAIRE IN ENGLISH

PRE-PARTICIPATION HEALTH SCREENING QUESTIONNAIRE

ASSESS YOUR HEALTH STATUS BY MARKING ALL TRUE STATEMENTS

(All information collected here will remain confidential) DATE: ___ /___ /_____

■ SECTION I – PERSONAL INFORMATION

Full name:		
Gender: ♀ ☐ ♂ ☐	**Age:**	**Date of birth:**
☎:		:

■ SECTION II – HEALTH INFORMATION

	Yes	No	Explain "yes" answers
Have you ever been hospitalised?	☐	☐	
Have you ever had surgery?	☐	☐	
Are you presently taking any medications or pills?	☐	☐	
Have you ever passed out during or after exercise?	☐	☐	
Have you ever been dizzy during or after exercise?	☐	☐	
Have you ever had chest pain during or after exercise?	☐	☐	
Do you have trouble breathing or do you cough during or after exercise?	☐	☐	
Do you tire more quickly than your friends during exercise?	☐	☐	
Have you ever had high blood pressure (>140/90mmHg)?	☐	☐	
Have you ever had racing of your heart or skipped heartbeats?	☐	☐	
Has anyone in your family died of heart problems or a sudden death before age 55?	☐	☐	
Have you ever had a head injury?	☐	☐	
Have you ever been knocked out or unconscious?	☐	☐	
Have you ever had a seizure?	☐	☐	
Have you ever had burning or cramping sensation in your legs when walking short distances?	☐	☐	
Have you ever been dizzy or passed out in the heat?	☐	☐	
Do you use any special equipment (pacemaker, hearing aid, prosthetic joins etc.)?	☐	☐	
Have you had any problems with your eyes or vision?	☐	☐	
Do you have any hearing problems?	☐	☐	
Do you have any musculoskeletal or rheumatologic problems that limit your physical activity?	☐	☐	
Do you have any neurological problems that limit your physical activity?	☐	☐	
Do you have a history of drug or alcohol abuse?	☐	☐	
Have you been ill (i.e. a cold or a fever) during the last four weeks?	☐	☐	
Are you pregnant?	☐	☐	

Check if you have ever had any of the following:

	Yes	No	Explain "yes" answers
Lung disease	☐	☐	
Heart disease	☐	☐	
Vascular disease	☐	☐	
Anaemia	☐	☐	
Diabetes	☐	☐	
Thyroid disease	☐	☐	
Cancer / tumors	☐	☐	
Other disease	☐	☐	

SECTION III – SMOKING HABITS (from fields 1, 2 and 3 choose only one)

1. No, I have never smoked in my entire life ☐
2. No, I don't smoke any more, I have quitted smoking ☐
   - 2.1 At what age did you start smoking? ☐
   - 2.2 How many cigarettes did you smoke per day? ☐
   - 2.3 How long has it been since you quitted smoking? ☐
3. Yes, I smoke ☐
   - 3.1 At what age did you start smoking? ☐
   - 3.2 How many years has it been since you have been smoking daily? ☐
   - 3.3 Cigarettes / week: <7 ☐ Cigarettes / day: 1-10 ☐ 11-20 ☐ 21-30 ☐ 31-40 ☐ >40 ☐
4. Does your mother smoke? Yes ☐ No ☐
5. Does your father smoke? Yes ☐ No ☐
6. Do others smoke in your home environment? Yes ☐ No ☐
7. Do others smoke in your educational environment? Yes ☐ No ☐
8. Do others smoke in your job (if you are currently working) environment? Yes ☐ No ☐

SECTION IV – STATEMENT OF ACCURACY

I hereby state that to the best of my knowledge, my answers to the above questions are correct.

DATE: ___ /___ /_____ SIGNATURE OF PARTICIPANT: _____

C.3

PREPARTICIPATION SCREENING QUESTIONNAIRE IN GREEK

ΕΡΩΤΗΜΑΤΟΛΟΓΙΟ ΔΙΑΛΟΓΗΣ ΥΓΙΩΝ ΕΘΕΛΟΝΤΩΝ

ΑΞΙΟΛΟΓΕΙΣΤΕ ΤΗΝ ΚΑΤΑΣΤΑΣΗ ΤΗΣ ΥΓΕΙΑΣ ΣΑΣ ΣΗΜΕΙΩΝΟΝΤΑΣ ΤΙΣ ΣΩΣΤΕΣ ΑΠΑΝΤΗΣΕΙΣ

(Οι πληροφορίες που θα συλλεχθούν θα παραμείνουν απόρρητες) ΗΜ/ΝΙΑ: ___ /___ /_____

■ ΤΟΜΕΑΣ Ι – ΠΡΟΣΩΠΙΚΕΣ ΠΛΗΡΟΦΟΡΙΕΣ

Ονοματεπώνυμο:		
Φύλο: ♀ ☐ ♂ ☐	Ηλικία:	Ημ/νία γέννησης:
☎:	📱:	

■ ΤΟΜΕΑΣ ΙΙ – ΠΛΗΡΟΦΟΡΙΕΣ ΣΧΕΤΙΚΑ ΜΕ ΤΗΝ ΥΓΕΙΑ

	Ναι	Όχι	Εάν ναι εξήγησε
Έχεις νοσηλευτεί ποτέ;	☐	☐	
Έχεις υποβληθεί ποτέ σε χειρουργική επέμβαση;	☐	☐	
Ακολουθείς κάποια φαρμακευτική αγωγή;	☐	☐	
Έχεις χάσει ποτέ τις αισθήσεις σου κατά τη διάρκεια ή μετά από άσκηση;	☐	☐	
Έχεις νιώσει ποτέ ζάλη κατά τη διάρκεια / μετά από άσκηση;	☐	☐	
Έχεις νιώσει ποτέ πόνο στο στήθος κατά τη διάρκεια ή μετά από άσκηση;	☐	☐	
Δυσκολεύεσαι να αναπνέεις ή βήχεις κατά τη διάρκεια ή μετά από άσκηση;	☐	☐	
Κουράζεσαι γρηγορότερα απ' ότι οι φίλοι σου κατά τη διάρκεια της άσκησης;	☐	☐	
Είχες ποτέ υψηλή αρτηριακή πίεση (>140/90mmHg);	☐	☐	
Έχεις νιώσει την καρδιά σου να χτυπάει υπερβολικά δυνατά και γρήγορα;	☐	☐	
Έχει σημειωθεί αιφνίδιος θάνατος ή θάνατος από καρδιοπάθεια πριν την ηλικία των 55 στην οικογένειά σου;	☐	☐	
Είχες ποτέ κάποιο τραυματισμό στο κεφάλι;	☐	☐	
Έχεις ποτέ πέσει αναίσθητος μετά από χτύπημα ή χωρίς εμφανή αιτία;	☐	☐	
Είχες ποτέ κάποιες κρίσεις;	☐	☐	
Έχεις νιώσει ποτέ κάψιμο ή κράμπες στα πόδια σου μετά από σύντομο περπάτημα;	☐	☐	
Έχεις νιώσει ποτέ ζάλη ή έχεις λιποθυμήσει λόγω υπερβολικής ζέστης;	☐	☐	
Χρησιμοποιείς ειδικό εξοπλισμό (π.χ. βηματοδότη, ακουστικό βαρηκοΐας, τεχνητό μέλος κλπ.);	☐	☐	
Έχεις προβλήματα με τα μάτια σου ή την όρασή σου;	☐	☐	
Έχεις προβλήματα ακοής;	☐	☐	
Έχεις κάποιο μυοσκελετικό ή ρευματολογικό πρόβλημα που παρεμποδίζει την σωματική σου δραστηριότητα;	☐	☐	
Έχεις κάποιο νευρολογικό πρόβλημα που παρεμποδίζει την σωματική σου δραστηριότητα;	☐	☐	
Έχεις ιστορικό κατάχρησης ναρκωτικών ή αλκοόλ;	☐	☐	
Έχεις αρρωστήσει (π.χ. κρύωμα ή πυρετό) τις τελευταίες τέσσερις εβδομάδες;	☐	☐	
Είσαι έγκυος;	☐	☐	

Σημείωσε αν είχες ποτέ κάτι από τα παρακάτω:

	Ναι	Όχι	Εάν ναι, εξήγησε
Πνευμονοπάθεια	☐	☐	_____
Καρδιοπάθεια	☐	☐	_____
Αγγειοπάθεια	☐	☐	_____
Αναιμία	☐	☐	_____
Διαβήτη	☐	☐	_____
Θυρεοειδοπάθεια	☐	☐	_____
Καρκίνο / όγκοι	☐	☐	_____
Άλλες παθήσεις	☐	☐	_____

■ ΤΟΜΕΑΣ III – ΚΑΠΝΙΣΜΑ (από τα τεδία 1, 2 και 3 επιλέξτε μόνο ένα)

1. Όχι, δεν έχω καπνίσει ποτέ ☐
2. Όχι, δεν καπνίζω πλέον, αλλά κάπνιζα παλαιότερα ☐
   - 2.1 Σε ποια ηλικία αρχίσατε το κάπνισμα; ☐
   - 2.2 Πόσα τσιγάρα ημερησίως καπνίζατε; ☐
   - 2.3 Για πόσα χρόνια έχετε σταματήσει το κάπνισμα; ☐
3. Ναι, καπνίζω ☐
   - 3.1 Σε ποια ηλικία αρχίσατε το κάπνισμα; ☐
   - 3.2 Πόσα χρόνια καπνίζετε κάθε ημέρα; ☐
   - 3.3 Τσιγάρα / εβδομάδα: <7 ☐ Τσιγάρα / ημέρα: 1-10 ☐ 11-20 ☐ 21-30 ☐ 31-40 ☐ >40 ☐
4. Η μητέρα σου καπνίζει; Ναι ☐ Όχι ☐
5. Ο πατέρας σου καπνίζει; Ναι ☐ Όχι ☐
6. Στο χώρο του σπιτιού σου οι άλλοι καπνίζουν; Ναι ☐ Όχι ☐
7. Στο χώρο των σπουδών σου οι άλλοι καπνίζουν; Ναι ☐ Όχι ☐
8. Στο χώρο της εργασίας σου (εάν εργάζεσαι) οι άλλοι καπνίζουν; Ναι ☐ Όχι ☐

■ ΤΟΜΕΑΣ IV – ΔΗΛΩΣΗ ΑΚΡΙΒΕΙΑΣ ΔΗΛΩΘΕΝΤΩΝ ΣΤΟΙΧΕΙΩΝ

Δηλώνω υπεύθυνα ότι, βάσει όσων γνωρίζω, οι απεντήσεις στις παραπάνω ερωτήσεις είναι σωστές.

ΗΜ/ΝΙΑ: ____ /____ /_____ ΥΠΟΓΡΑΦΗ ΣΥΜΜΕΤΕΧΟΝΤΟΣ: _____

C.4

PARTICIPANT'S INSTRUCTIONS SHEET IN ENGLISH

PARTICIPANT'S INSTRUCTIONS SHEET

(please read it before the day of testing)

☞ **The following instructions will help you prepare adequately for the testing session, which will take place on ___ /___ /_____.**

- You should refrain from ingesting food – especially salty food –, alcohol, or caffeine, or from using tobacco products within 3 hours of testing.
- You should be rested for the assessment, avoiding significant exertion or exercise within 24 hours of the assessment.
- Clothing should permit freedom of movement (e.g. shorts and t-shirt) and include walking or running shoes. It would be preferable to wear loose-fitting clothes and avoid restrictive undergarments.
- Drink ample fluids over the 24-hour period preceding the testing session to ensure normal hydration before testing.

Please contact the investigator if you have further questions

Investigator's telephone number:_____

Investigator's email: _____

C.5

PARTICIPANT'S INSTRUCTIONS SHEET IN GREEK

ΟΔΗΓΙΕΣ ΠΡΟΣ ΣΥΜΜΕΤΕΧΟΝΤΕΣ

(παρακαλώ διάβασέ το πριν την αξιολόγηση)

☞ Οι παρακάτω οδηγίες θα σε βοηθήσουν να προετοιμαστείς κατάλληλα για την αξιολόγηση, η οποία θα πραγματοποιηθεί στις ___ /___ /_____.

- Επί 3 ώρες πριν την αξιολόγηση να παραμείνεις νηστικός/η αποφεύγοντας ιδιαίτερα το αλάτι, το αλκοόλ και την καφεΐνη, ενώ ταυτόχρονα απόφυγε το κάπνισμα.

- Θα πρέπει να είσαι ξεκούραστος/η για την αξιολόγηση, αποφεύγοντας έντονη προσπάθεια ή άσκηση 24 ώρες πριν την αξιολόγηση.

- Φόρεσε ρούχα που επιτρέπουν ελευθερία κινήσεων (π.χ. σορτς και φανέλα) και αθλητικά παπούτσια. Θα ήταν προτιμότερο να φορέσεις άνετα ρούχα και να αποφύγεις περιοριστικά εσώρουχα.

- Στο 24-ωρο που θα προηγηθεί της αξιολόγησης κατανάλωσε άφθονα υγρά ώστε να εξασφαλίσεις επαρκή ενυδάτωση πριν την αξιολόγηση.

Παρακαλώ επικοινώνησε με την ερευνήτρια σε περίπτωση που έχεις απορίες

Τηλέφωνο ερευνήτριας: _____

Email ερευνήτριας _____

C.6

PARTICIPANT'S INFORMATION SHEET IN ENGLISH

PARTICIPANT'S INFORMATION SHEET

PHYSICAL ACTIVITY AND FUNCTIONAL CAPACITY AMONG NORMAL-WEIGHT, OVERWEIGHT AND OBESE GREEK YOUNG ADULTS

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Don't hesitate to ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for taking the time to read this.

■ **What is the purpose of the study?**

The aim of the study is to investigate possible differences between normal-weight, overweight and obese Greek young adults aged 18 to 30 years in relation to their physical activity level and functional capacity status. Body composition will, also, be assessed.

■ **Why have I been approached?**

You have been chosen because you fit the study's target age group.

■ **Do I have to take part?**

It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep, you will be provided with written instructions about what to do next and you will be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time without giving a reason ard without suffering any consequences.

■ **What will happen to me if I take part?**

If you decide to take part, you will be given this information sheet to keep and asked to fill in a pre-participation health screening questionnaire. If you are eligible to participate in the study, you will be given written instructions about what to do next and a testing date will be set. Prior to testing, you will be asked to sign the consent form. This will give your consent for attending the testing session during which you will be subjected to anthropometric (assessment of body weight and height, waist and hip circumferences) and physiological measurements (assessment of heart rate, arterial blood pressure and perceived exertion), you will be asked to fill in the International Physical Activity Questionnaire and you will perform a six-minute walk test, twice. The written instructions provided to you will help you prepare adequately for the testing session. This session will last about one and a half hours and will be held by the researcher, while a research assistant will be present.

■ **What are the possible disadvantages and risks of taking part?**

There are no disadvantages or risks foreseen in taking part in the study.

■ **What are the possible benefits of taking part?**

Apart from helping shape young Greeks' physical activity profile and provide information regarding their functional capacity and body composition, by taking part in this study, you will, also, get feedback on the aforementioned parameters, giving you the opportunity to make changes, if required, towards a healthier lifestyle.

■ **Will my taking part in the study be kept confidential?**

All information which is collected about you during the course of the research will be kept strictly confidential so that only the researcher carrying out the research will have access to such information. All data will be coded and study results will be displayed in an aggregate form.

■ **What will happen to the results of the research study?**

The results will be presented in the researcher's academic dissertation for the degree of Master of Science in Cardiovascular Rehabilitation. Individuals who participate will not be identified in any subsequent report or publication.

■ **Who is organising and funding the research?**

The research is organised by the researcher and will be carried out with her own expenses.

■ **Who may I contact for further information?**

If you would like more information about the research before you decide whether or not you would be willing to take part, please contact the researcher:

***Athinais Georgia Psichogiou*, PT**

Postgraduate Student at the University of Chester, UK

Email: 0720401@chester.ac.uk

Thank you for your interest in this research.

C.7

PARTICIPANT'S INFORMATION SHEET IN GREEK

ΈΝΤΥΠΟ ΕΝΗΜΕΡΩΣΗΣ ΥΠΟΨΗΦΙΟΥ ΕΘΕΛΟΝΤΗ

ΣΩΜΑΤΙΚΗ ΔΡΑΣΤΗΡΙΟΤΗΤΑ ΚΑΙ ΛΕΙΤΟΥΡΓΙΚΗ ΙΚΑΝΟΤΗΤΑ ΦΥΣΙΟΛΟΓΙΚΟΥ ΒΑΡΟΥΣ, ΥΠΕΡΒΑΡΩΝ ΚΑΙ ΠΑΧΥΣΑΡΚΩΝ ΝΕΑΡΩΝ ΕΝΗΛΙΚΩΝ ΕΛΛΗΝΩΝ

Σας γίνεται πρόταση να συμμετάσχετε σε μια ερευνητική εργασία. Πριν αποφασίσετε, είναι σημαντικό να κατανοήσετε γιατί πραγματοποιείται η συγκεκριμένη έρευνα και τι θα συμπεριλαμβάνει. Παρακαλώ, αφιερώστε λίγο χρόνο για να διαβάσετε προσεκτικά τις παρακάτω πληροφορίες, ενώ είστε ελεύθεροι να συζητήσετε σχετικά με την εργασία και με άλλους. Μη διστάσετε να ρωτήσετε σε περίπτωση που έχετε κάποια απορία ή που χρειάζεστε περισσότερες πληροφορίες. Έχετε στη διάθεσή σας όσο χρόνο χρειάζεστε προκειμένου να αποφασίσετε εάν θέλετε ή όχι να συμμετάσχετε στην έρευνα.

Σας ευχαριστώ για το χρόνο σας

■ Ποιος είναι ο σκοπός της έρευνας;

Σκοπός της έρευνας αποτελεί η διερεύνηση των πιθανών διαφορών ανάμεσα σε φυσιολογικού-βάρους, υπέρβαρους και παχύσαρκους νεαρούς ενήλικες Έλληνες ηλικίας 18 έως 30 ετών, σε σχέση με το επίπεδο της φυσικής τους δραστηριότητας και της λειτουργικής τους ικανότητας. Επιπλέον, θα αξιολογηθεί η σωματική τους σύνθεση.

■ Γιατί προσεγγίστηκα;

Σας προσεγγίσαμε διότι ανήκετε στην ηλικιακή ομάδα που αποτελεί το αντικείμενο της παρούσας εργασίας.

■ Είμαι υποχρεωμένος/η να συμμετάσχω;

Εξαρτάται εξολοκλήρου από εσάς το αν θα συμμετάσχετε ή όχι στην παρούσα έρευνα. Εάν αποφασίσετε να συμμετάσχετε στην έρευνα, θα κρατήσετε αυτό το έντυπο ενημέρωσης, θα σας δοθούν, επιπλέον, γραπτές οδηγίες σχετικά με το τι θα πρέπει να κάνετε στο εξής και θα σας ζητηθεί να υπογράψετε μια δήλωση συγκατάθεσης. Η απόφασή σας να συμμετάσχετε στην έρευνα δεν είναι δεσμευτική, καθώς διατηρείτε το δικαίωμα να αποσυρθείτε σε οποιαδήποτε φάση της έρευνας επιθυμείτε, χωρίς να χρειάζεται να δώσετε καμία εξήγηση και χωρίς να έχετε καμία επίπτωση.

■ Τι θα μου συμβεί εάν συμμετάσχω στην έρευνα;

Εάν αποφασίσετε να λάβετε μέρος στην έρευνα, θα κρατήσετε το παρόν έντυπο ενημέρωσης και θα σας ζητηθεί να συμπληρώσετε ένα ερωτηματολόγιο διαλογής υγιών εθελοντών. Εφόσον πληροίτε τις προϋποθέσεις, θα συμπεριληφθείτε στην έρευνα, θα σας δοθούν εγγράφως οδηγίες σχετικά με το τι θα κάνετε στο εξής και θα σας ανακοινωθεί μια ημερομηνία εξέτασης. Πριν την αξιολόγηση, θα σας ζητηθεί να υπογράψετε το έντυπο συγκατάθεσης. Υπογράφοντας, δίνετε τη συγκατάθεσή σας προκειμένου να παραβρεθείτε σε μια συνεδρία αξιολόγησης, κατά τη διάρκεια της οποίας θα υποβληθείτε σε σωματομετρικές (βάρος και ύψος σώματος, περιφέρεια μέσης και γλουτών) και φυσιολογικές (μέτρηση καρδιακής συχνότητας, αρτηριακής πίεσης και αντιλαμβανόμενου αισθήματος κόπωσης) μετρήσεις. Θα σας ζητηθεί να συμπληρώσετε το ερωτηματολόγιο «International Physical Activity Questionnaire» και θα πραγματοποιήσετε μια εξάλεπτη δοκιμασία βάδισης. Οι γραπτές οδηγίες που θα σας δοθούν θα σας βοηθήσουν ώστε να προετοιμαστείτε κατάλληλα για την συνεδρία αξιολόγησης. Η συνεδρία αυτή θα διαρκέσει περίπου μιάμιση ώρα και θα πραγματοποιηθεί από την ερευνήτρια, παρουσία μιας ερευνητικής βοηθού.

■ **Ποιο είναι τα πιθανά μειονεκτήματα ή οι κίνδυνοι που σχετίζονται με την συμμετοχή μου στην έρευνα;**

Δεν προβλέπονται κάποια μειονεκτήματα ή κίνδυνοι που να σχετίζονται με τη συμμετοχή σας στην έρευνα.

■ **Ποια είναι τα πλεονεκτήματα που σχετίζονται με τη συμμετοχή μου στην έρευνα;**

Πέρα από το ότι θα βοηθήσετε να σχηματιστεί μια εικόνα σχετικά με τη σωματική δραστηριότητα, τη λειτουργική ικανότητα και τη σωματική σύνθεση των νεαρών Ελλήνων, η συμμετοχή σας στην παρούσα έρευνα, θα δώσει σχετικές πληροφορίες και για το άτομό σας, παρέχοντάς σας την ευκαιρία να δρομολογήσετε ίσως κάποιες αλλαγές με στόχο ένα πιο υγιεινό τρόπο ζωής.

■ **Η συμμετοχή μου στην έρευνα θα παραμείνει εμπιστευτική;**

Όλες οι πληροφορίες που θα συλλεχθούν κατά τη διάρκεια της έρευνας θα παραμείνουν απολύτως εμπιστευτικές και θα είναι προσβάσιμες μόνο από την ερευνήτρια. Όλα τα δεδομένα θα κωδικοποιηθούν και τα αποτελέσματα της έρευνας θα παρουσιαστούν αθροιστικά.

■ **Τι θα συμβεί με τα αποτελέσματα της έρευνας;**

Τα αποτελέσματα της έρευνας θα παρουσιαστούν στην διπλωματική διατριβή της ερευνήτριας, η οποία εκπονείται με στόχο την απόκτηση του τίτλου Master of Science στην Καρδιαγγειακή Αποκατάσταση. Σε οποιαδήποτε σχετική μελλοντική εργασία ή δημοσίευση θα διατηρηθεί η ανωνυμία των συμμετεχόντων.

■ **Ποιος οργανώνει και χρηματοδοτεί την έρευνα;**

Η έρευνα οργανώθηκε και χρηματοδοτήθηκε από την ερευνήτρια.

■ **Με ποιον μπορώ να επικοινωνήσω για περαιτέρω πληροφορίες;**

Αν χρειάζεστε περαιτέρω πληροφορίες σχετικά με την έρευνα προκειμένου να αποφασίσετε εάν επιθυμείτε ή όχι να συμμετάσχετε, παρακαλώ επικοινωνήστε με την ερευνήτρια:

Αθηναΐς Γεωργία Ψυχογιού, ΦΘ

Μεταπτυχιακή Φοιτήτρια στο Πανεπιστήμιο

του Chester της Μεγάλης Βρετανίας

Email: 0720901@chester.ac.uk

Σας ευχαριστώ για το ενδιαφέρον σας.

C.8

INFORMED CONSENT FORM IN ENGLISH

INFORMED CONSENT FORM

PHYSICAL ACTIVITY AND FUNCTIONAL CAPACITY AMONG NORMAL-WEIGHT, OVERWEIGHT AND OBESE GREEK YOUNG ADULTS

	Please initial box
▪ I confirm that I have read and understand the "Participant's Information Sheet" for the above study.	☐
▪ I have been given the opportunity to ask questions about the study and I had sufficient information to give informed consent.	☐
▪ I understand that my participation in the study is absolutely voluntary	☐
▪ I understand that I am free to withdraw from the study at any time without being obliged to provide any explanation or suffer any consequences.	☐
▪ I understand that anonymity will be ensured and that all personal identifiers will be destroyed after the end of the study	☐
▪ I agree to take part in the above study.	☐

_____	___/___/_____	_____
Full name of participant	Date	Signature
_____	___/___/_____	_____
Full name of researcher	Date	Signature

C.9

INFORMED CONSENT FORM IN GREEK

ΔΗΛΩΣΗ ΣΥΓΚΑΤΑΘΕΣΗΣ ΥΠΟΨΗΦΙΟΥ ΕΘΕΛΟΝΤΗ

ΦΥΣΙΚΗ ΔΡΑΣΤΗΡΙΟΤΗΤΑ ΚΑΙ ΛΕΙΤΟΥΡΓΙΚΗ ΙΚΑΝΟΤΗΤΑ ΦΥΣΙΟΛΟΓΙΚΟΥ ΒΑΡΟΥΣ, ΥΠΕΡΒΑΡΩΝ ΚΑΙ ΠΑΧΥΣΑΡΚΩΝ ΝΕΑΡΩΝ ΕΝΗΛΙΚΩΝ ΕΛΛΗΝΩΝ

Παρακαλώ σημειώστε

- Επιβεβαιώνω ότι έχω διαβάσει και κατανοώ το «έντυπο ενημέρωσης υποψηφίου εθελοντή» για την παραπάνω έρευνα. ☐
- Επιβεβαιώνω ότι μου δόθηκε η ευκαιρία να κάνω ερωτήσεις σχετικά με την έρευνα και ότι έλαβα επαρκείς πληροφορίες ώστε να δώσω συγκατάθεση. ☐
- Κατανοώ ότι η συμμετοχή μου στην παραπάνω έρευνα είναι απόλυτα εθελοντική. ☐
- Κατανοώ ότι είμαι ελεύθερος/η να αποσυρθώ σε οποιαδήποτε φάση της έρευνας επιθυμώ χωρίς να δώσω οποιαδήποτε εξήγηση και χωρίς να έχω καμία επίπτωση. ☐
- Κατανοώ ότι θα διατηρηθεί η ανωνυμία μου και ότι όλα τα προσωπικά μου δεδομένα θα διαγραφούν κατά την ολοκλήρωση της έρευνας. ☐
- Συμφωνώ να συμμετάσχω στην έρευνα. ☐

_____	____/____/_____	_____
Ονοματεπώνυμο εθελοντή	Ημερομηνία	Υπογραφή

_____	____/____/_____	_____
Ονοματεπώνυμο ερευνήτριας	Ημερομηνία	Υπογραφή

C.10

RESEARCHER'S GENERAL REPORT SHEET IN ENGLISH

RESEARCHER'S GENERAL REPORT SHEET

STUDY IDENTIFICATION NUMBER: ____ DATE: ___ /___ / _____

STUDY GROUP: ____

▪ SECTION I – SUBJECT CHARACTERISTICS

Gender: ♀ ☐ ♂ ☐	Age (years):	WC (cm):	HC (cm):
BH (cm):	BW (kg):	BMI ($kg \cdot m^{-2}$):	WHR:
Smoking status: Never smoker ☐	Former smoker ☐	Occasional smoker ☐	Current smoker ☐

▪ SECTION II – INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ)

IPAQ scores (MET · min · week^{-1})	Vigorous PA:	Moderate PA:	Walking PA:
PA level: High ☐ Moderate ☐ Low ☐		Sitting Hours:	

▪ SECTION III – SIX-MINUTE WALK TEST (6MWT)

1st 6MWD:	1st 6MDWP:	2nd 6MWD:	2nd 6MDWP:
Completed the tests: With ☐ Without ☐ interruption		Total number of interruptions:	

▪ Symptoms after the completion of the 1st 6MWT:

Leg pain ☐ Shortness of breath ☐ Dizziness ☐ Other ☐ – Explain: _____

▪ Symptoms after the completion of the 2nd 6MWT:

Leg pain ☐ Shortness of breath ☐ Dizziness ☐ Other ☐ – Explain: _____

▪ Physiological measurements:

	Before the 1st 6MWT	After the 1st 6MWT		Before the 2nd 6MWT	After the 2nd 6MWT
HR			HR		
SBP			SBP		
DBP			DBP		
RPE			RPE		

C.11

RESEARCHER'S GENERAL REPORT SHEET IN GREEK

ΓΕΝΙΚΟ ΚΑΤΑΓΡΑΦΙΚΟ ΔΕΛΤΙΟ

ΚΩΔΙΚΟΣ ΣΥΜΜΕΤΕΧΟΝΤΟΣ: ☐ ΗΜΕΡΟΜΗΝΙΑ: ___ /___ / _____

ΟΜΑΔΑ: ☐

■ ΤΟΜΕΑΣ Ι – ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ ΣΥΜΜΕΤΕΧΟΝΤΟΣ

Φύλο: ♀ ☐ ♂ ☐	**Ηλικία** (χρόνια):	**WC** (cm):	**HC** (cm):
BH (cm):	**BW** (kg):	**BMI** ($kg \cdot m^{-2}$):	**WHR:**
Κάπνισμα: Ποτέ ☐	Όχι πια ☐	Περιστασιακά ☐	Καπνιστής/ρια ☐

■ ΤΟΜΕΑΣ ΙΙ – INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ)

IPAQ scores ($MET \cdot min \cdot week^{-1}$)	**Vigorous PA:**	**Moderate PA:**	**Walking PA:**
PA level: High ☐	Moderate ☐	Low ☐	**Sitting Hours:**

■ ΤΟΜΕΑΣ ΙΙΙ – ΔΟΚΙΜΑΣΙΑ 6-ΛΕΠΤΩΝ ΒΑΔΙΣΗΣ (6MWT)

1ος 6MWD:	**1η 6MDWP:**	**2η 6MWD:**	**2η 6MDWP:**
Ολοκλήρωσε τα τεστ: Με ☐ Χωρίς ☐ διακοπή		**Συνολικός αριθμός διακοπών:**	

- **Συμπτώματα μετά την ολοκλήρωση της 1ης 6MWT:**

Πόνος στα πόδια ☐ Δύσπνοια ☐ Ζάλη ☐ Άλλο ☐ ➡ Εξηγείστε: _____

- **Συμπτώματα μετά την ολοκλήρωση της 2ης 6MWT:**

Πόνος στα πόδια ☐ Δύσπνοια ☐ Ζάλη ☐ Άλλο ☐ ➡ Εξηγείστε: _____

- **Φυσιολογικές μετρήσεις:**

	Πριν την 1η 6MWT	Μετά την 1η 6MWT		Πριν την 2η 6MWT	Μετά τη 2η 6MWT
HR			**HR**		
SBP			**SBP**		
DBP			**DBP**		
RPE			**RPE**		