



**RELATIONSHIP BETWEEN PEDOMETER-DETERMINED PHYSICAL  
ACTIVITY AND LOW BACK PAIN IN MIDDLE AGED FINNISH  
POPULATION (30-45): “THE YOUNG FINNS STUDY”**

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ABSTRACT

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## ABSTRACT

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Undoubtedly, modern sedentary lifestyle is a severe threat factor for various health-related concerns. Engagement in regular physical activity is requisite to achieve physiological and psychological health benefits and to alleviate the risk for many undesirable health outcomes including musculoskeletal, cardiovascular disease, obesity, hypertension, and diabetes. Staying physically active is recommended in the deterrence and management of low back pain. Lately, an alternative guideline about physical activity has been introduced, which is more realistic than the 30 minutes/day recommendation. This guideline says that attaining 10,000 steps/day improves health. Therefore, pedometers have become popular tool to measure ambulatory activities objectively throughout the day in the form of steps count. Moreover, they provide a valid and accurate measure of activities in free-living condition. Furthermore, pedometers are simple to utilize, relatively inexpensive and good tools to use in large population based studies. The aim of the current study is to find the relation between pedometer-determined physical activity in the form of daily steps count and low back pain in middle aged Finnish population (30-45 year old participants).

The data has drawn from the latest follow up in 2007 of an extensive interdisciplinary longitudinal research project "The Young Finns Study". All the same subjects who participated first time in this study in 1980 and had a permanent address in Finland (n=3596) were invited to participate in the latest follow up in 2007. Among those, 2204 (65%) individuals filled out the questionnaire. From 2204 participants, 1874 completed the pedometer study. Complete data was received from 1866 (Female=1067, Men=799) participants. Women were more physically active than men. Chi square test revealed that there were no differences in back pain between different physical activity groups either in females or in males. In female, association between back pain and BMI was weak whereas in men, some association was seen between back pain and occupation. Regression analyses showed that physical activity did not increase the risk of having back pain, however, adding factor such as body mass index slightly increased the risk in women. On the other hand, active men were having risk for low back pain twice when it was compared with low active men. Adding factor like body mass index, education, and occupation did not show any risk for low back pain in men.

In conclusion, this study did not support the idea of U-shaped relation (i.e. both inactivity and excessive activities) between different levels of physical activity and low back pain in males and females. Active males were at higher risk of having back pain than non-active ones.

**Keywords:** Physical activity, Low back pain, Pedometers, Daily steps count, Middle-aged Finnish cohort group

## 1. INTRODUCTION:

It is frequently suggested that physical activity (PA) is an imperative aspect in the prevention and management of low back pain. The importance of increased level of physical activity in the management of low back pain cannot be ruled out, however, the contribution of PA on back pain management is still uncertain. (Heneweer, Vanhees, & Picavet, 2009.) Moreover, according to Arnau et al. (2006) the importance of physical activity and exercise has been recognized as a principal strategy for the primary care management of, not only in acute, but also in chronic non-specific low back pain (NSLBP). The benefits of physical activity for health and well being cannot be ignored (Telama et al., 2005). This is the reason why staying active in early life and discouragement of bed rest are all key features of primary care low back pain management in older age (Arnau et al., 2006; Van Tulder et al., 2006).

Modern sedentary lifestyle forms a severe risk factor for low back pain. Although the working conditions have been much better lately, still, work loss due to low back pain is increasing (Steenstra, Verbeek, Heymans, & Bongers, 2005). According to Haneweer et al. (2009), leisure time physical activities give better prognosis for preventing back pain disability later in life. They further explained that graded and moderate physical activity is recommended for the functional restoration regarding back pain. Moreover, Lin et al. (2011), described that persons with non-specific low back pain mostly report impaired ability to perform activities of daily living. The effect of pain on a person's daily functioning can be expressed as a person's level of disability or a reduction of physical functioning. It is assumed that persons who feel disabled and report more daily life restrictions due to low back pain are those who are less physically active during their life span.

In the management of non-specific low back pain, the significance of physical activity is recognized and increase in the level of physical activity has been an important part of the recommendations in the management of low back pain (Van Tulder, Koes, & Bouter, 1995). However, physical activity is considered to be both a risk factor (Hoogendoorn, van Poppel, Bongers, Koes, & Bouter, 1999; Hoogendoorn, Bongers, Vet de, Van Mechelen, & Bouter, 2002; Jacob, Baras, Zeev, & Epstein, 2004; Kujala et al., 1996) and

a preventive factor (Auvinen, Tammelin, Taimela, Zitting, & Karppinen, 2008; Hartvigsen & Christensen, 2007; Herreby, Hesselose, Kjer, & Neergaard, 1997; Hurwitz, Morgenstern, & Chias, 2005; Mikkelsen, Nupponen, Kaprio, Kautiainen, & Kujala, 2006; Sjolie, 2004) for low back pain. People working in physically demanding jobs that put high levels of stress on their backs are more at risk of developing back problems (Hoogendoorn et al., 2002; Jacob et al., 2004; Kujala et al., 1996).

Telama et al. (2005), reported that childhood physical activity is a good predictor for well-being later in life. Being continuously physically active may lead to high intrinsic motivation and a high level of motor skills that, in turn, increase the probability of being active in later life. Furthermore, Hasenbring and Verbunt (2010) explained that individuals suffering from low back pain often have a fear-avoidance attitude towards physical activity, which is the reason why; acute pain can be transferred into chronic back pain. This, in turn, creates more limitations to perform any type of physical activity. Additionally, it is assumed that those who fear from pain mostly avoid painful activities, resulting in gaining weight, losing mobility and strength and finally ending up as chronic sufferers (Hasenbring & Verbunt, 2010).

The aim of the current research is to describe the relationship between pedometer-determined physical activity and low back pain among middle aged Finnish population cohort groups. The research is carried out within the ongoing longitudinal study, “The Young Finns Study”.

## 2. PHYSICAL ACTIVITY

Caspersen, Powell, and Christenson (1985) defined physical activity as “any bodily movement produced by skeletal muscles that result in energy expenditure” (pp. 126). The definition itself is very broad which includes various activities like occupational, sports, household activities and many others. Physical activity is often mixed with the terms, for example, exercise and physical fitness (Caspersen et al. 1985). The problems associated with being physically inactive are rather acute (Biddle & Mutrie, 2001; Department of Health, 2010; Dunn, Anderson, & Jakicic, 1998). Undeniably, among all age groups, socio-economic statuses, genders’ sedentary behaviors and physical inactivity has been established to be a risk factor for health (Sallis & Owen, 1999; Van Der Horst, Paw, Twisk, & Van Mechelen, 2007). Blair, Kohl, Gordon, and Paffenbarger (1992), stated that to improve the general well being and avoid major health risks, development of physically active attitude is very significant. In previous studies, various health factors such as improvement in heart diseases, stroke risk, cancer and reduced symptoms of diabetes type 2 are strongly correlated with physical activity (Biddle & Mutrie, 2008).

### 2.1. Exercise and Physical activity

Physical activity should be separated from exercise since PA is broad category which includes even the simplest movement, for example, writing (Caspersen et al., 1985). Both these terms are quite different, however, they have been considered to have same sense. Exercise is a structured set of movements, whereas physical activity is any movement that requires energy consumption (Taylor, 1983). US Department of Health and Human Services (2008), stated that physical activity is not planned or regular set of movements thus; the purpose is not aimed at developing muscle strength or losing weight. Moreover, they described that exercise is purposeful activity which is normally aimed to develop physical fitness which, in turn, directly associated with health and well-being. Health does not necessarily mean only the absence of disease but also the continuation and enhancement of well-being (Bouchard & Shephard, 1994).



## 2.2. Physical inactivity/Sedentary behavior

The term physical inactivity is commonly used interchangeably with the familiar term sedentary behavior (Tudor-Locke & Myers, 2001). Tudor-Locke and Myers (2001), defined an inactive individual “a person who does not meet the exercise-fitness guidelines and public health guidelines” (pp. 92). Nevertheless, recently the definition of sedentary behavior became more different from physical inactivity (Marshall & Welk, 2008). Department of Health (2010), defined sedentary behaviors are those patterns which consists of just laying or sitting with minimal expenditure of energy. Pate, O’Neill, and Lobello (2008), defined sedentary behavior as “activities that do not increase expenditure of energy above the resting level and includes activities such as sleeping, sitting, lying down, and watching television, and other forms of screen-based entertainment” (pp.174). To understand the real sense of physical inactivity, it is very important to separate two concepts i.e., absence of physical activity and physical inactivity/sedentary behavior (Biddle et al, 2008, 2004).

## 2.3. Physical activity guidelines

It is need of the hour to promote and maintain good health especially; adults aged between 18-65 should maintain active and healthy lifestyle. Performing moderate intensity aerobic physical activity for at least 30 minutes for five days/week or vigorous physical activity for at least 20 minutes for three days/week is good to gain maximum health related benefits for adults. (National Health Service, 2015.) On the other hand, Office of Disease Prevention and Health Promotion (2016), stated that combinations of moderate and vigorous physical activity is also useful, for example, a person can perform brisk walking for 30 minutes twice during the week and 20 minutes running or jogging for 20 minutes for another two days. However, these moderate to vigorous intensity physical activities should not be mixed with the light daily activities. These daily activities (self-care, washing dishes) probably do not show any health related benefits.

“Furthermore, at least twice each week adults will benefit by performing activities using the major muscles of the body that maintain or increase

muscular strength and endurance. Because of the dose-response relation between physical activity and health, persons who wish to further improve their personal fitness, reduce their risk of musculoskeletal problems, chronic diseases and disabilities, or prevent unhealthy weight gain will likely benefit by exceeding the minimum recommended amount. For older adults (over 65s, or those aged 50–64 with chronic conditions such as arthritis), the recommendation is the same, with balance exercises also recommended. It is also the case that goals below this threshold may be necessary for older adults who have physical impairments or functional limitations. Children aged 6–17, on the contrary, should do at least an hour of physical activity every day. This can include either moderate-intensity aerobic activity or vigorous-intensity activity. Muscle-strengthening activities and bone-strengthening activities are also recommended on at least three days a week.”

(Christine, 2011, pp. 08)

#### 2.4. Physical activity level

Several recommendations have been presented to achieve good health and to promote an active life style. For example, according to Hatano (1993) 10,000 steps daily are very effective to maintain healthy life style with pedometers. In Japanese households, even today, the concept of achieving 10,000 steps/day is still familiar. It is estimated that total of 300-400 kcal/day energy is spent if someone takes 10,000 steps per day. Tudor-Locke and Basset (2004), then, established a 5-level index to measure the physical activity level of an individual by pedometers. According to them, some persons can be characterized as sedentary and some as highly active in terms of the number of steps taken during a day, as described below:

- Sedentary (<5000 steps)
- Low active (5000-7499 steps)
- Somewhat active (7500-9999 steps)
- Active (10000-12499 steps)
- Highly active (>12500 steps)

## 2.5. Benefits of physical activity

The benefits of physical activity cannot be ignored. According to Bouchard and Shephard (1994), routinely engagement in physical activity is said to be beneficial for over 25 chronic health problems. The study notes that involvement in regular physical activity regimen is one of the most important things a person can do for his/her better health. In addition, Christine (2011), states that benefits of physical activity have been considered to be effective across total lifespan, and the benefits are equally evident in young and old. Christine's review (2011) indicates that physical activity improves educational attainment in children as well as prevents obesity. However, in older adults, engagement in routine physical activity/walk and exercise on a regular basis leads to improved functional abilities, reduce musculoskeletal problems, and is related to increased longevity. Centers for Disease Control and Prevention (2015) stated the following major benefits of being physically active; reduce risk of low back pain, lessen the risk of cancers, decrease risk of heart diseases, control weight, minimize the risk of metabolic problems, improve chances of live longer and healthy lifestyle, improves the strength of bones and muscles, enhance mental health, lowers the risk of diabetes, improves mood status, and better ability to do daily activity and avoid falls.

Moreover, according to Tudor-Locke and Myers (2001), many health related advantages could be gained if somebody accumulates 10 000 steps throughout the day. There is a growing concept that 10,000 steps per day is a kind of physical activity which is good indicator for better health. It is easy to remember and the physical activity goals can be set with the help of achieving total steps per day. Furthmore, Hatano (1993) stated that individuals reaching to this level of physical activity have less musculoskeletal problem, less body fat and lower/maintained blood pressure when compared with their less active counterparts.

## 2.6. Physical activity as a risk factor

In recent years, physical activity is considered to be a risk factor for many medical conditions within all age cohorts. For instance, high level of physical activity has been suggested as a risk factor for lower back pain in children and adolescents (Kopeck, Sayre

& Esdaile, 2003; Kujala, Taimela, & Viljanen, 1996,1999; Newcomer & Sinaki., 1996; Troussier, Davoine, De Gaudemaris, Fauconnier, & Phelip, 1994). Moreover, Balague, Nordin, Skovron, Dutoit, Yee, and Waldburger (1994), found a relationship between participation in competitive sport and low back pain. This association has been confirmed by other groups but only in boys. Kujala et al. (1992), then, showed that athletes with low back pain train more than athletes without low back pain during the past year.

Furthermore, in a 3-year longitudinal follow-up study of adolescents, Kujala et al. (1996) found that prolonged low back pain was more common with athletes than non-athletes. However, many researchers have reported no relation between physical activity and back pain (Haneweer et al. 2009). Wedderkopp, Leboeuf-Yde, Andersen, Froberg, and Hansen, (2003) used an accelerometer as an objective measure of physical activity in their cross-sectional study and found no association between physical activity and back pain. A low level of physical activity is considered to be a risk factor for all age groups i.e. adolescents, middle aged and older. Kopec, Sayre and Esdaile (2003), stated that sedentary or inactive life style is also major risk factor for low back pain especially in the later stage of life.

## 2.7. Factors influencing physical activity

There are many factors which influence either directly or indirectly on the effectiveness and benefits of physical activity. Among the major factors are, for instance, gender, age group, occupation, socioeconomic status, education and days of the week.

*Gender:* It is commonly assumed that men are physically more active than women and that they perform more physical activities than women (Miller & Brown, 2004; Sequeira, Rickenbach, Wietlisbach, Tullen & Schutz, 1995; Tudor-Locke & Bassett, 2004; Wyatt, Peters, Reed, Barry & Hill, 2005). However, now a day, participation of women in different games and physical activities cannot be ignored. Now it is quite difficult to distinguish which gender is better for doing more physical activities. In Finland, for example, women are more physically active than men when it comes to daily steps and aerobic steps (Hirvensalo et al., 2011).

*Age groups:* Age plays an important role in performing physical activity. Younger people tend to be more active than older (De Cocker, et al., 2007; McCormack, Giles-Corti, & Milligan, 2006; Payn, Pfeiffer, Hutto, Vena, LaMonte, & Blair, 2008). Sequeira et al. (1995), found that in young age everyone is highly motivated. Moreover, they have more muscular power and endurance to participate in various kinds of physical activities than older adults.

*Socioeconomic status:* Having low income also put a negative influence on performing physical activities. Person with more income and time finds it easy to go to the club and gym, for example, to do routinely physical activities (Wyatt et al., 2005).

*Occupation:* Employed persons tend to perform more physical activities than unemployed persons (De Cocker et al., 2007) whereas those employed in blue-collar occupations take more steps than those in white-collar occupations (McCormack et al., 2006; Miller & Brown, 2004).

*Education:* Low educational level has been inversely associated with daily physical activity (De Cocker et al., 2007; Tudor-Locke et al., 2004).

*Days of the week:* Day of the week has also been shown to influence daily physical activity. Several studies have indicated that participants are significantly less active physically when measured with pedometers on weekends compared with weekdays (Miller & Brown, 2004; Tudor-Locke et al., 2004). However, some persons like to go for physical training on weekends rather than on week days because they are free on weekends and very busy on week days.

## 2.8. Measurement of physical activity/assessing PA

### 2.8.1. Subjective measure

Without doubt, lack of physical activity leads to major health related risks but there were no standardized approaches available to measure physical activity at international level (Booth, 2000; Pereira, FitzerGerald, & Gregg, 1997). In the year 1998, international consensus group met in Geneva to develop self-reported levels of physical activity which would be suitable for all the population in different countries around the globe. Initially, eight versions of the International Physical Activity Questionnaire (IPAQ) were developed in year 1998-1999, with four short and four long versions of the

questionnaire. These could be administered by telephone interview or self-administration. The reliability and validity study was done in year 2000 to determine the measurement accuracy of the questionnaire in 14 different centers of 12 countries (Booth et al., 2003).

Loney, Standage, Thompson, Sebire, and Cumming (2011) stated that physical activity logs/diaries, survey, and questionnaires all fall into the category of subjective measure of physical activity. Self-report is a subjective technique of measuring used to self-recall by the respondents who are participating in certain research project. Further, to report physical activities, respondents use diaries or survey. They further explained that self-report measure is comparatively inexpensive and suitable for larger population, nevertheless, the major disadvantages of measuring physical activity via self-report method is that it gives poor estimation of intensity and duration of physical activity (Loney et al. 2011).

#### 2.8.2. Objective measure

*Pedometer:* It is simple instrument to measure physical activity objectively. Especially they are used to measure physical activity in relatively larger population based studies. These are simple to use, and refer to collect daily number of steps, aerobic steps and aerobic minutes. In addition, the method is relatively inexpensive and, therefore, suitable to measure physical activity in a large population. (De Cocker, Cardon, & De Bourdeaudhuij, 2007; Hatano, 1993; Sequeira, Rickenbach, Wietlisbach, Tullen, & Schutz, 1995.) In a way, pedometers share many similarities with accelerometers; however, the main difference is data storage and data providence. Pedometers mostly count only the step counts or walking. These days' pedometers are the tool commonly used in assessing physical activity in different research programs, especially, where walking data is required (Welk, 2002). Bassett (2000), stated that pedometers are normally attached with the waist belt during walking and they are triggered by vertical acceleration. Additionally, with each step taken one event is recorded when arms move up and down like pendulum. Pedometers are electronic devices which record steps over a given period of time.

## 2.9. Assessing walking as physical activity

According to Casperson et al. (1985) physical activity is defined as “any bodily movement produced by skeletal muscles that result in energy expenditure” (pp. 126). Exercise is a general term meaning structured or planned activities and repetitive bodily movements that are performed for improving or maintaining fitness and skills. Examples include circuit training at the gym, yoga, jogging or organized sports (Jackson, 2004). Neslson et al. (2007), said that without deliberately performing any physical activity individuals can also be physically active, for instance, when going out for grocery shopping and running in the stores to find the needy stuff. Physical activity, in terms of walking is a form of physical activity which can be done for the purpose of exercise or it is just a mode of transportation. Furthermore, for older people American heart association recommended moderate physical activity instead of vigorous one to keep on doing their normal physical activity for better health and motivation (Neslson et al., 2007).

### 2.9.1. Assessing walking activity

Walking activity can be measured both objectively and subjectively. To assess walking activity by counting number of steps each day objectively, pedometers and accelerometers are used (Ewald, McEvoy, & Attia, 2010; Hall & McAuley, 2010). According to Togo et al. (2008), measurement accuracy is the strength of pedometer or accelerometer, however, walking activity can be different in different season which, in turn, gives lots of inconsistency in walking activity. They explained further that to get the maximum accuracy for pedometers, it is very important to measure walking activity in different seasons of the years.

## 2.10. Individual factors associated with walking activity

### 2.10.1. Age, gender, cohort

Age, gender and different cohort groups' factors are very important in measuring physical activity. Several longitudinal studies have shown that, in general, physical activity declines with age (Armstrong & Morgan, 1998; Bannett, 1998; Mäkilä,

Hirvensalo & Parkatti, 2010). Men are considered to be more physically active and involve in different kinds of activities (Annear et al., 2009), however, women are reported to be declined faster from involving in physical activity than men (Mäkilä et al., 2010). Armstrong & Morgan (1998) noticed that women like to do physical activities indoor whereas men are more prone to do physical activities outside. Moreover, walking is equally popular in both men and women among all age groups and it is considered to be a common type of PA, nevertheless, cohort differences are essential. Furthermore, Leisure time walking activity survey in United States among adult between 1987-2000 revealed that older age groups are more active. Simpson et al. (2003), found that among older adults, walking activity was similar whereas when it is seen in younger adults, it was found that women were more physical active than men. Hirvensalo, Lintunen and Rantanen (2000) observed that older women who were more physically active had fewer musculoskeletal and cardiovascular diseases than less active women, though, this difference was not significant in men. However, when these health related benefits of physical activity are ignored, the gender differences become insignificant (Shaw, Liang, Krause, Gallant & McGeever, 2010). According to Borodulin, Laatikainen, Juolevi and Jousilahti (2008) leisure time physical activity was more in younger cohorts, yet, prevalence of strenuous PA and occupational PA was decreased. The reason could be that younger cohort are not engaged so much in physically straining work and mostly they commute by car which, in turn, provide them with more opportunity to do leisure time physical activities (Borodulin et al., 2008).

#### 2.10.2. Socioeconomic status and Occupation

Income, education and occupational categories are determinants of socioeconomic status which are strongly associated with physical activity. Older people with a higher income tend to be more physically active than those with lower income in a cross sectional study by De Melo, Menec, Porter, and Ready (2010). On the contrary, walking is not much influenced by occupational status and education although it is a form of physical activity that is easy to access and do. In a cohort study by Michael, Perdue, Orwoll, Stefanick, Marshall, and Osteoporotic Fractures Men (2010), it was observed that there was a relationship between walking and neighborhood socioeconomic after a 4-6 years follow



up. Moreover, compared with individual socioeconomic status, neighborhood socioeconomic may influence more on walking habit. In addition, only in the higher socioeconomic status, close access to recreational activities was associated to walking.

### 2.10.3. Health and functional ability

Physical activity is a good indicator to measure chronic health condition and functional ability. In the Evergreen study conducted in Jyväskylä, Finland, during an 8 years follow up it was seen that women who maintained higher physical activity level had less musculoskeletal problems and cardiovascular diseases, however, in men the association between physical activity and health factors were not found. (Hirvensalo, et al., 2000.) Simonsick, Guralnik, Volpato, Balfour and Fried (2005), found a positive association between physical activity and health status objectively. Also, positive association between physical activity and health status was present subjectively (Diehr & Hirsch, 2010). Cross sectional study revealed that musculoskeletal pain increased the risk of being physically inactive (Salpakoski et al., 2011). Better functional ability is linked to higher walking activity. Likewise, increased walking activity is directly proportional with better health and functional capacity. (Simonsick, et al., 2005.) Rantanen et al. (1999) suggested that there is a danger of a vicious cycle as lower functional ability increases the risk of physical inactivity, which may contribute to development of diseases.

### 3. LOW BACK PAIN

Any pain or discomfort which is localized above the inferior gluteal fold and below the costal margin is referred to as back pain. It can be with or without having pain in the leg region (Van Tulder et al., 2006). Low back pain is considered to be very common health problem (Brooks, 2006; Picavet & Schouten, 2003). According to Picavet and Schouten (2003), low back pain is a frequent reason to seek medical care. The occurrence of low back pain annually ranges between 25% - 60 %. Moreover, it is a common musculoskeletal disorder affecting 80% of people at some point in their lives (Andersson, 1999). It accounts for more sick leave and disability than any other medical condition. It can be acute, sub-acute or chronic in duration (Hendrick et al., 2011). Low back pain is the primary cause for activity limitation in both men and women and the second most frequent cause, after upper respiratory infections, for physician visits (Jacob et al., 2004). However, the prevalence of low back in Finland remained stable from last 30 years despite several efforts have been made to decrease its prevalence and influence (Hakala, Rimpelä, A. Salminen, Virtanen, & Rimpelä, M. 2002; Heistaro, Vartiainen, Heliövaara, & Puska, 1998; Leino, Berg, & puska, 1994).

#### 3.1. Types of low back pain

*Acute low back pain:* According to Van Tulder et al. (2006), acute low pain is referred to as pain that has duration of discomfort episode persists for less than six weeks.

*Sub-acute low back pain:* They explained sub-acute low back pain as type of back pain which continues between six and 12 weeks.

*Chronic low back pain:* They explained chronic pain as, any discomfort which last for 12 or more than 12 weeks fall into the category of chronic pain.

*Recurrent low back pain:* Van Tulder et al. (2006) stated that new episode of pain in the low part of the body after having six months of pain free period.

*Nonspecific low back pain:* Any kind of low back pain which is undefined or continues without any know underlying pathology, for example, infection, osteoporosis, fracture, and inflammatory conditions (Van Tulder et al., 2006).

### 3.2. Chronic pain and quality of life

It is believed that chronic pain has negative influence on quality of life (Schlenk et al., 1997), likewise, it has adverse concerns for general health and well-being (Becker et al., 1998). Moreover, according to Gureje, Von Korff, Simon, and Gater (1997) chronic pain has deteriorated consequences for social and psychological health. Pain related fear, depression and catastrophizing effects play a significant role in the fundamental model of chronic pain and it is based on a psychosocial approach. Additionally, chronic pain is interconnected to high levels of anxiety, social and occupational dysfunction, and depression (Crombez, Vlaeyen, Heuts, & Lysens, 1999b; Sullivan & Loeser, 1992; Turk & Okifuji, 1996). To describe the relationship between depression, anxiety, social and occupational dysfunction, fear avoidance models have been developed (Lethem, Slade, Troup, & Bentley, 1983; Vlaeyen & Linton, 2000; Vlaeyen, Kole-Snijders, Boeren, & Van Eek, 1995). These models, certainly, helped in understanding the phenomenon of fear of movement or fear of re-injury. Also they described the catastrophizing effects of chronic pain on quality of life. Vlaeyen and Linton (2000), described that fear of movement or re-injury leads to avoidance behavior, disability, disuse and depression.

### 3.3. Fear-avoidance model

Lethem et al. (1983), develop a model to explain why and how some individuals develop chronic pain symptoms. This model is called “fear avoidance model”. The main idea of the model was to understand the concept “fear of pain”. Evidences have identified fear avoidance responses as an important mediator for the development and maintenance of chronic back pain and other physical disability. Whenever there is any injury, the person starts to have a painful experience. This painful experience can be catastrophizing and non-catastrophizing. If the painful response is non-catastrophizing, then a person starts to feel better (confrontation) after short time and he/she does not get any chronicity of the injury. It starts to come towards recovery and person can perform daily life physical activities and sports activities without any fear. On the contrary, if this painful stimulus lasts for longer time then it normally starts to put its catastrophizing effects. These catastrophizing effects, in turn, create a negative impact of an injury in a persons’ mind. They start to have a fear of pain. Slowly, they stop or avoid doing any physical activity

which can, they think, be harmful for them. At last they have chronic pain stimulus which ultimately restrict their normally body movement and refrain them from doing any physical activities (Lethem et al., 1983). Moreover, this chronicity put its negative influence in the form of mental depression, movement restriction, disability, lack of exercise and disuse (Vlaeyen, Kole-Snijders, Boeren, & Van Eek, 1995).



Fig 1. Cognitive-behavioral model of fear of movement/(re) injury. Reprinted from *Pain*, Vol. 62, Vlaeyen et al., “Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance”, pp. 363–372.

#### 4. RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND LOW BACK PAIN

The importance of daily physical activity in the management of low back pain is highly acknowledged, and enhancing the level of daily physical activity has become an important factor in managing chronic low back pain (Van Tulder et al., 1995).

Nonetheless, the contribution of physical activity level in the management of low back pain is not clear (Auvinen et al., 2008). The relationship between physical activity and low back pain is still vague (Campello, Nordin, & Weiser, 1996). According to Heneweer, Vanhees and Picavet (2009), there is no such clear evidence that back pain is reduced or increased with performing physical activity. Sometimes, it reduces with physical activity and on the contrary, it increases with physical activity.

Additionally, it also depends upon gender and age group. Telama et al. (2005) reported that physical activities performed in young age or adolescent are good predictors for the better health status in the late ages. Hendrick et al. (2011), explained that older adults are better off if they already engaged in physical activities or sports activities in their young age. Staying active and doing regular physical activity is often said to be a significant factor for preventing and managing low back pain. The relationship between physical activity and low back pain could be a U-shaped relationship i.e., both excessive activity and inactivity are equally harmful or risk factors for having low back pain at some stage of life (Heneweer et al., 2009).

Moreover, dimensions, intensity and duration of physical activity is not correlated with back pain, however, only engaging in sport activity is referred to have less back pain. Involvement of physical fitness exercise (muscle training and aerobic) are associated with having less back pain (Heneweer et al., 2009, 2011, 2012). On the other hand, it is suggested that being physically inactive/sedentary lifestyle is a major risk for having low back pain (Hildebrandt, Bongers, Dul, Van Dijk, & Kemper, 2000).

According to Kerns and Haythornthwaite (1988), free-living physical activity can be defined as a person's everyday activity in their usual environment. There are some evidences that patients with chronic low back pain who have elevated level of depressive symptoms have lower levels of free-living physical activity than patients with chronic low back pain who do not have elevated level of depressive symptoms (Kerns &

Haythornthwaite, 1988). The descriptive characteristic showed that more people in the distressed group were unemployed compared to the non-distressed group. There is an evidence to show that employment status and type of occupation can affect a person's level of free living physical activity (Ryan et al., 2009).

The great attention is paid to create strategies for preventing the negative consequences of chronic low back pain. A probably new view has come which states that to be active or perform physical activities on regular basis is the key element of active self-management in chronic low back pain population (Liddle, Gracey, & Baxter, 2007). The effect of pain on the physical activity level of patients and common population with low back pain is largely based upon the deconditioning model of low back pain, both acute and chronic pain (Wittink, Michel, Wagner, Sukiennik, & Rogers, 2000).

There are many studies in which it is described that participating in physical activity is very good for acute or chronic low back pain but from the literature it is not very clear that both entities have significant correlation (Haneweer et al. 2009). Clinical guideline advocate exercise and activity in the management of low back pain but the link between levels of physical activity and outcomes is unclear (Jacob et al., 2004). It is found that low levels of physical activity were associated with higher levels of low back pain (Heneweer et al., 2009). Advice to stay active and discouragement of bed rest are all key features of primary care low back pain management guidelines (Koes, van Tulder, Ostelo, Burton, & Waddell, 2001), however, effective strategies to manage low back pain and prevent recurrence and chronicity are indefinable (Kent, & Keating, 2008).

## 5. AIM AND PURPOSE

The primary aim of the study was to explore the relationship between pedometer determined physical activity (daily step count) and low back pain among middle aged Finnish population cohort group. The purpose was to see if the correlation between physical activity and low back pain is U-shaped i.e., too less or too much physical activity is risk for having low back pain. The main research question was:

What is the relationship between physical activity, education, body mass index, employment status, occupation and low back pain among middle-aged Finnish cohort groups?

## 6. METHODS

### 6.1. Participants

The data has drawn from an extensive interdisciplinary longitudinal research project “The Young Finns Study”. The study started in 1980 and the participants were randomly selected from different cities of Finland namely Helsinki, Tampere, Turku, Kuopio, and Oulu. Until now, there have been several follow-ups in this study and the last follow up was performed in 2007. The subjects who participated in last follow up were at the age of 30, 33, 36, 39, 42, and 45 years. All the same subjects who participated first time in this study in 1980 and had a permanent address in Finland (n=3596) were invited to participate in the latest follow up in 2007. Among those, 2204 (65%) individuals filled out the questionnaire (Peruskyselylomake, 2007) and participated in laboratory examinations. From those participants, 1874 completed the pedometer study. Complete data was received from 1866 participants.

Pedometers were used first time in the latest follow up in a large sample of Finnish population in “The Young Finns study” to measure daily steps count and aerobic steps. All the participants gave written informed consent and study protocol was reviewed by the ethical committee of participating universities.

### 6.2. Assessment of physical activity

Physical activity was assessed in terms of total daily steps and aerobic steps taken by the participants (n=1874) with pedometers attached with their belt or waistband.

#### 6.2.1. Pedometer

The Omron walking Style One (HJ-152R-E) pedometer was used to collect the data. It is a simple device to measure total numbers of daily steps, aerobic steps and aerobic minutes. It is relatively inexpensive; therefore, appropriate to use in population-based studies. Aerobic steps are robotically calculated by monitor as those taken during uninterrupted walking of >10 min with the speed of >60 steps/ min. The accuracy of pedometer measuring total steps over 1000 meters at normal waking speed was 1.3%, in brisk walking 0.1%, and in stair walking 0.9% of the real steps in a sample of 30 adults



of different fitness level in the Kuortane Sport Institute (Kuortane testing laboratory Seinäjoki, 2007). Moreover, the comparison was done of the total steps taken with Omron Walking Style One pedometers with the steps calculated by ActiGraph accelerometers (GT1M) in a sample of 7 subjects for 6-7 consecutive days. The Spearman's rank correlation coefficient was 0.942 ( $p < 0.001$ ) and Kendalls' tau was 0.803 ( $p < 0.001$ ), (Hirvensalo et al., 2011).

### 6.3. Evaluation of low back pain

Information on low back pain (LBP) was gathered by means of questionnaire (Peruskyselylomake, 2007) in the latest follow up of "The Young Finns Study". Participants were asked to give the answer of the question regarding low back pain 'have you ever experienced low back pain'? The answer was coded into 1 (No) and 2 (Yes). Total of 2230 participants replied this question.

### 6.4. Procedure

This study followed a methodology adopting cross-sectional research design. After the field study visit that incorporated laboratory assessment, participants were asked to attach the pedometer while waking hours with their belt or waistband always at the same position for seven days continuously and to keep a record of pedometer data. Pedometer logs were used to record the total number of steps/day, aerobic steps and aerobic minutes. Furthermore, the participants were instructed to record the time of pedometer removal. All the participants were asked to keep their normal daily activities while wearing pedometers and to remove the device only during bathing or swimming. Participants could also report comments or problems of the pedometer usage in the pedometer log, and had the option to contact the researchers too.

Each participant was provided with a padded mail bag and a self-addressed stamped envelope at the start of pedometer study. They were asked to send the pedometer along with pedometer log to the research center on day eighth of the study. Subjects mentioned many reasons for not being able to participate or wear the pedometer on daily basis. The primary reasons as mentioned by the participants were; broken pedometers ( $n=23$ ) or lost ( $n=52$ ), illness ( $n=30$ ), or other reasons such as untypical day ( $n=22$ ). The rest of the

participants (n=203) did not send the pedometer data to research center or decided not to participate in this study.

#### 6.5. Data usage and measurement of variables

All the subjects who had recorded the data for at least 4 days were included in all analyses. Issues ranging from sickness or injury status, exceptional steps, and problems with the usage of pedometer were also valued and compensated with the mean of other days. The final sample size after adjustment was 1866 (99% of the subjects who completed the pedometer study, n=1874).

Distributions of mean total steps were evaluated for normality. Years of education were divided into two different levels:  $\leq 12$  years (comprehensive school + high school/vocational school), and  $> 12$  years (polytechnic or university). Employment status was classified in to three categories: 1= full-time working; 2= part time working and student; 3= unemployed and housewife or father; 4= disability support pension and others. Occupation was coded into four headings: 1= manual (unspecialized and unskilled worker); 2= low manual (public servants, specialized, and skilled worker; 3= high non-manual (professors, administrators, and managers); 4= not employed. Body mass index (BMI) was classified as: 1= normal weight (18.50-24.99 kg/m<sup>2</sup>); 2= underweight ( $< 18.50$  kg/m<sup>2</sup>); 3= overweight ( $\geq 25$  kg/m<sup>2</sup>); 4= obese ( $\geq 30$  kg/m<sup>2</sup>). Total number of steps was divided according to five activity levels proposed by Tudor-Locke & Basset (2004) and Hatano (1993): inactive ( $< 5000$  steps), low active (5000-7499), somewhat active (7500-9999), active (10,000-12,499), and highly active ( $> 12,500$ ).

#### 6.6. Statistical analysis

Cross tabulation was used to describe the baseline characteristics according to gender. Differences between men and women in all the variables included in the study were examined with chi-square test for categorical variables. Logistic regression analysis was conducted for the men and women explaining the odd ratio of experiencing low back pain while doing different stages of physical activity. The model was adjusted for gender and age. Furthermore, added suspected risk components of physical activity such as

body mass index, education and occupation. The data was analyzed with PASW statistics 17 for Windows.

## 7. RESULTS

Fig. 1 shows that women took more total daily steps count than men. There is not so much difference between women and men in the age group of 30, 33 and 36 but the difference is very prominent in the age group of 39, 42 and 45 among females and males. Women and men are equally inactive in the age between 30-36 but men are less active in the age group of 39, 42 and 45. Females are more highly active than males in both cohort groups.

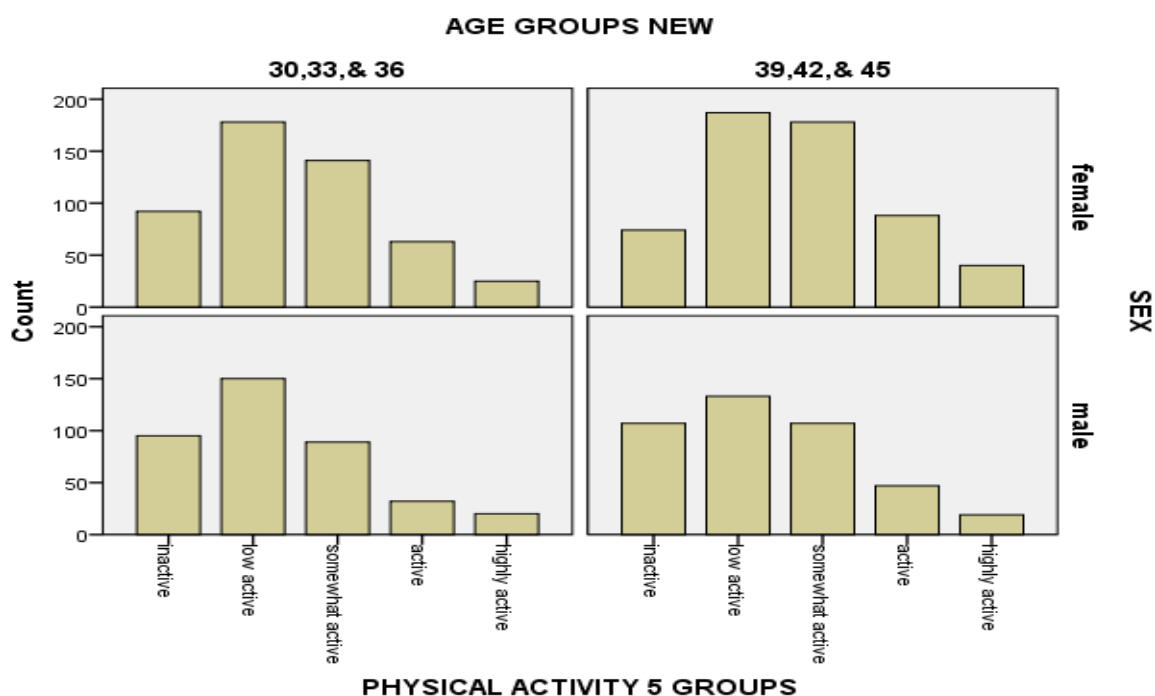


Fig. 1. Total Daily Steps Count

Characteristics according to gender are presented in Table 1. Age groups are almost equally distributed among females and males. Years of education was statistically significant ( $p < 0.05$ ) when compared with gender. Women had a higher level of education than men. The result also shows a statistically significant difference in employment status, occupation and physical activity when compared with gender ( $p = < 0.001$ ). Women took more daily mean aerobic steps compared with men. Females were

more often unemployed or not working than men. More inactive participants are observed in men than in women.

Table 1. Baseline characteristic by gender

		Women	Men	P-value <sup>a</sup>
		N= 1067	N=799	
		f (%)	f (%)	
Age				
	30-36	499 (47)	386 (48)	
	39-45	568 (53)	413 (52)	
Years of education				
	≤12	180 (17)	253 (32)	
	>12	884 (83)	544 (68)	
				<0.001
Employment status				
	Full-time working	744 (70)	665 (84)	
	Part-time working and student	103 (10)	36 (05)	
	Unemployed, housewives & fathers	121 (11)	27 (03)	
	Disability support pension & others	95 (09)	66 (08)	
				<0.001
Occupation				
	Manual	539 (53)	411 (53)	
	Low manual	162 (16)	104 (14)	
	High non-manual	186 (18)	212 (28)	
	Not employed	133 (13)	43 (06)	
				<0.001
Physical activity				
	Total Number of step			
	Inactive	166 (16)	202 (25)	
	Low active	365 (34)	283 (35)	
	Somewhat active	319 (30)	196 (25)	
	Active	151 (14)	79 (10)	
	Highly active	65 (06)	39 (05)	
				<0.001
		Mean ± SD	Mean ± SD	
	Aerobic steps <sup>b</sup>	2322 ± 2141	1413 ± 1805	<0.001

<sup>a</sup> Chi-square test

<sup>b</sup> Independent t-test

Table 2. reveals that there were no differences in back pain between different physical activity groups either in females or in males. It is evident from the table that the back pain was somewhat associated with BMI in females ( $p= 0.093$ ). Age groups and employment status has no association when it was compared with back pain, however, back pain has reported a significant association with years of education in females ( $p< 0.05$ ). Most of the participants who reported back pain are manual employees (female=53% and male=55%), however, only in male somewhat association is evident between back pain and occupation ( $p= 0.081$ ).

Table 2. Association of back pain with physical activity and baseline characteristics among middle aged Finnish population

	Back Pain					
	Women		P-value <sup>a</sup>	Men		P-value <sup>a</sup>
	N= 1067			N=799		
	f (%)		f (%)			
No Pain	Pain	No Pain	Pain			
<b>Physical activity</b>						
Inactive	24 (15)	142 (16)	0.575	39 (26)	163 (25)	0.585
Low active	62 (39)	303 (34)		58 (39)	225 (35)	
Somewhat active	42 (26)	276 (30)		36 (24)	159 (24)	
Active	20 (13)	130 (14)		10 (7)	69 (11)	
Highly active	12 (7)	53 (6)		6 (4)	33 (5)	
<b>BMI</b>						
Normal weight	95 (61)	466 (52)	0.093	56 (38)	243 (38)	0.147
Underweight	3 (2)	16 (2)		2 (1)	3(1)	
Over weight	44 (28)	256 (29)		57 (39)	294 (45)	
Obese	15 (10)	152 (17)		33 (22)	105 (16)	
<b>Age</b>						
30-36	73(46)	424 (47)	0.774	69 (46)	317 (49)	0.576
39-45	87 (54)	481 (53)		80 (54)	332 (51)	
<b>Years of education</b>						
≤12	15 (09)	165 (18)	0.006	40 (27)	212 (33)	0.161
>12	144 (91)	740 (82)		109 (73)	435 (67)	
<b>Employment status</b>						
Full-time working	116 (72)	628 (70)	0.816	125 (85)	539 (84)	0.918
Part time working & student	16 (10)	87 (10)		06 (04)	30 (05)	
Unemployed, housewives & fathers	16 (10)	105 (11)		06 (04)	21 (03)	

Disability support pension & Others	12 (08)	83 (09)		11 (07)	55 (09)	
Occupation						
Manual	75 (51)	464 (53)	0.895	64 (45)	346 (55)	0.081
Low manual	26 (18)	136 (16)		21 (15)	83 (13)	
High non-manual	28 (19)	158 (18)		50 (36)	162 (26)	
Not employed	18 (12)	115 (13)		06 (04)	37 (06)	

<sup>a</sup>Chi-square test.

Table 3. shows the regression analysis of the association of back pain among women and physical activity. Among women, physical activity does not increase the risk of having back pain. However, adding factors such as body mass index does slightly increase the risk of having back pain among women. Obese physically active women are two times at risk of reporting lower back pain. (OR. 2.10, CI 1.17-3.37). On the other hand, suspected risk factors that could have increase the risk of women reporting lower back pain such as years of education and occupation does not significantly change the risk of them reporting back pain.

Table 3. Factors associated with back pain in logic regression analyses among women

	Model 1		Model 2		Model 3		Model 4	
	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
<b>Physical activity</b>								
inactive	1							
low active	0.83	(0.50-1.38)	0.85	(0.50-1.43)	0.89	(0.52-1.51)	0.97	(0.57-1.66)
somewhat active	1.12	(0.65-1.92)	1.17	(0.67-2.04)	1.20	(0.68-2.09)	1.34	(0.76-2.38)
active	1.10	(0.58-2.10)	1.23	(0.64-2.39)	1.24	(0.64-2.40)	1.46	(0.73-2.94)
highly active	0.75	(0.35-1.61)	0.79	(0.37-1.72)	0.81	(0.37-1.75)	0.81	(0.37-1.78)
<b>BMI</b>								
normal weight			1					
underweight			1.13	(0.32-3.97)	1.00	(0.28-3.56)	0.93	(0.26-3.32)
over weight			1.19	(0.81-1.76)	1.17	(0.79-1.73)	1.12	(0.74-1.67)
obese			2.10	(1.17-3.75)	2.18	(1.20-3.97)	2.03	(0.74-1.67)

**Years of education**

>12	1			
<12	0.45	(0.25-0.81)	0.49	(0.27-0.88)

**Occupation**

Manual			1	
Low manual			0.94	(0.57-1.55)
High non-manual			1.06	(0.65-1.73)
not employed			1.17	(0.65-2.10)

Model 1: adjusted for age, Model 2: Model 1 + adjustment for BMI, Model 3: Model 2 + adjusted for years of education, Model 4: Model 3 + adjusted for occupation

Table 4. indicates the binary logistic regression analysis of the association of back pain among men and physical activity. Physically active men are having risk for low back pain twice when it compared with low active men. However, adding factors such as body mass index does not increase the risk of having low back pain in men (OR.1.26, CI 0.84-1.92). The risk factors of having low back pain like years of education and occupation does not show significant values when it is adjusted for age and BMI.

Table 4. Factors associated with back pain in logic regression analyses among men

		Model 1		Model 2		Model 3		Model 4	
		OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
<b>Physical activity</b>									
	inactive	1							
	low active	0.92	(0.59-1.45)	0.86	(0.55-1.37)	0.87	(0.55-1.38)	0.89	(0.55-1.43)
	somewhat active	1.06	(0.64-1.75)	1.01	(0.60-1.68)	1.02	(0.61-1.70)	1.00	(0.59-1.70)
	active	1.67	(0.79-3.53)	1.57	(0.73-3.35)	1.57	(0.74-3.37)	1.39	(0.64-3.02)
	highly active	1.32	(0.52-3.36)	1.27	(0.49-3.28)	1.30	(0.50-3.37)	1.04	0.39-2.74)
<b>BMI</b>									
	normal weight			1					
	underweight			0.35	(0.06-2.20)	0.36	(0.06-	0.32	(0.05-



				2.28)		2.02)
				(0.83-		(0.86-
	over weight	1.26	(0.84-1.92)	1.26	1.91)	2.03)
				(0.47-		(0.45-
	obese	0.79	(0.48-1.30)	0.77	1.27)	1.26)
<b>Years of education</b>						
	>12			1		
	<12			0.71	(0.47-	(0.51-
					1.06)	1.28)
<b>Occupation</b>						
	Manual					1
						(0.42-
	Low manual					1.37)
						(0.40-
	High non-manual					1.00)
						(0.51-
	Not employed					3.21)
						1.28

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Model 1: adjusted for age, Model 2: Model 1 + adjustment for BMI, Model 3: Model 2 +  
adjusted for years of education, Model 4: Model 3 + adjusted for occupation

## 8. DISCUSSION

The major finding of this study was that women were physically more active than men. In particular, the cohort group of 39, 42, 45 years of age took more daily number of steps when it was compared with the same age cohort in men. The women were more highly active (>12500 steps/day) in the same cohort group, however, the difference was not so much when it was seen in the age cohort of 30, 33, 36 years in both men and women. This supports the previous data in Finland that women are more physically active than men when it comes to daily number of steps (Hirvensalo, et al., 2011) nevertheless, most of the studies in other countries support the idea that men are more physically active (Miller & Brown, 2004; Sequeira et al., 1995; Tudor-Locke et al., 2004; Wyatt et al., 2005). Age plays an important role in performing physical activities. Younger people tend to be more active than older (De Cocker et al., 2007; Payn et al., 2008), though, in the study it was found that comparatively older cohort group (39, 42, 45) of females were more physically active than younger cohort (30, 33, 36) of both men and women. One reason could be that women in the age group of 36, 42, 45 are well settled in life, having job, family and children. They may be more used to walking to go for grocery, drop and pick up their children to school. Whereas, the younger cohort is still in the phase of making their career or studying, and newly mothers. This might be the reason why they do not find much time to go out for walking. On the other hand, men mostly choose other ways to stay physically active if they do not go out for walking since they have more variety in doing physical activity, for example, supervised exercise or gym training (Mäkilä et al., 2010).

Quantifiable walking measure are provided by pedometers, they allow participants to track and record progress from a baseline reference point whereas supervised exercise or gym trainings are not tracked with pedometers (Braveta et al., 2007). Studies have shown that immediate feedback from the pedometers enable participants to set realistic goals, raise awareness of current walking behaviours (Rooney, Smalley, Larson, & Havens, 2003), to motivate (Blamey & Mutrie, 2004), and to increase walking behaviors (Moreau et al., 2001).

It the study, it was observed that there were no differences in back pain between different physical activity groups either in females or in males which means that being inactive or

highly active does not associate with low back pain. It supports the findings of Wedderkopp et al. (2003) who objectively measured physical activity with accelerometer but found no association with low back pain. On the other hand, current findings contrast the idea of U-shaped curve hypothesized by Campello et al. (1996) and later proved by Haneweer et al. (2009) and Kopec et al. (2003) that too little or too much activity levels are equally dangerous for having low back pain. Moreover, current study found a weak positive association between low back pain and body mass index. This finding was in line with the study by Dijken, Fjellman-Wiklund & Hildinsson (2008). In the population, more people were present with higher incidence of body mass index over 25 and it was bit higher among those women who experience low back pain. Different definition to measure body mass index might have changed the results in current findings. In the study, body mass index was calculated into four categories i.e., normal weight, underweight, overweight and obese, however, it could also be calculated in three categories i.e.,  $< 25$ ,  $\geq 25-29$  and  $> 30$ . In addition, back pain has reported a significant association with years of education in females. Female individuals who reported more low back pain were highly educated which does not coincide with the findings of Dijken et al. (2008) who stated that individuals experience with low back pain were not much educated. One reason of positive association between low back pain and years of education could be that people need to sit for longer time to study. Sitting posture might not have been very well which constantly put some pressure on their backs and ultimately they start to have low back pain. In addition, most of the participants who reported low back pain are manual employees (female=53% and male=55%), however, only in male somewhat association was evident between back pain and occupation. It correlates with the previous studies, which showed that people who work in physical demanding jobs and put high level of stress on their backs are more at risk of developing back problems (Hoogendoorn et al. 2002; Jacob et al., 2004; Kujala et al. 1996). Logistic regression analysis to find the association of back pain among women and different level of physical activity did not bring any risk of having back pain. This finding is in accordance with the finding of Wedderkopp et al. (2003) who objectively measured physical activity with accelerometer but found no association with low back pain in either gender. Contrarily, current findings were not matching with the outcomes of Haneweer et al. (2009) and U-shaped hypothesis (Campello et al., 1996). However, adding factors such

as body mass index slightly increased the risk of having back pain among women. Obese but physically active women were two times at risk of reporting lower back pain. This finding is in line with the study by Dijken, Fjellman-Wiklund & Hildinsson (2008). On the other hand, suspected risk factors that could have increased the risk of women reporting lower back pain such as years of education and occupation did not significantly change the risk of having back pain.

Furthermore, binary logistic regression analysis to find the association of back pain and different level of physical activity among men showed that active men were having two times more risk for low back pain when it compared with low active men. These findings do not either support the idea that both physical activity and physical inactivity are equal risk factors for having low back pain (Kopeck et al., 2003). Moreover, adding factors such as body mass index did not increase the risk of having low back pain in men. The risk factors of having low back pain like years of education and occupation also did not show significant values when it was adjusted for age and body mass index.

### 8.1. Limitations and strengths

In the current study, number of limitations were observed which are very important to mention because they might be having some significance on the overall statistical results. First and foremost, it is very important to mention that the data was collected between October 2007 and February 2008. The weather conditions are very severe and the road /pavements are full of snow in these months. In those harsh conditions the walking activity would be limited. For example, data collected in USA in winter times showed lower steps count (Wyatt et al., 2005) whereas data collected in spring time in Switzerland (Sequeira et al., 1995) and Belgian cohorts (De Cocker et al., 2007) found higher number of steps count. In winter times, most of the people prefer to do their physical activities indoors. The number of steps taken would be much higher if the data would have been collected in spring/summer time. It might have different results regarding the relationship between steps count and back pain.

Secondly, the pedometers also determined the aerobic steps and aerobic minutes. Aerobic steps are continuous walking for at least 10 minutes with the pace of 60 or more steps per minutes, calculated with the help of Omron Style Pedometer (Hirvensalo et al., 2011).

However, these data were not analyzed in this study. Therefore, in a future study the inclusion of aerobic steps and aerobic minutes may give better insight the relationship between physical activity and health related benefits.

Thirdly, among 2204 participants who filled out basic questionnaire, only 1874 participants took part in pedometer study. This missing number of participants would have some influence on statistical values. Moreover, those who participated in pedometers might have taken higher number of steps since they were more motivated in walking than rest of the population. As it has also been shown in other study that motivational factor increases the level of physical activity and health related benefits (Bravata et al., 2007). Also back pain variable was measured in current study with only “No and Yes”. More detailed questions may have some importance in further analysis.

Lastly, the generalizability of the current study findings is not possible although the sample size was quite big. Since the participants who took part in this study were in their midlife so the generalizability is only possible to the same cohorts, not the other age group population. Despite above-mentioned limitations, the strengths of the study cannot be underestimated. Current research in itself is distinctive since the data has drawn from on-going longitudinal study because it targets a specific age cohort group. The group, perhaps, had not been studied before in the context of physical activity (steps count) and low back pain in Finland. Besides, this study also addressed the association and risk of having low back pain with pedometer-determined physical activity in both genders. In addition, the Omron Walking Style One pedometer calculated accurate number of steps taken by the participants comparing with other measuring tool of physical activity objectively for the same number of days (Hirvensalo et al., 2011).

## 8.2. Implications and future research

It is very important to address the above mentioned limitations, for future research. Mainly, calculating physical activity in spring/summer time would give better insight of walking behavior of respondents. Also, the back pain variable could be explored further. For example, asking about intensity and duration, aggravating and relieving factors of low back pain from participants may give better understanding to investigate the association of physical activity and low back pain. Making a control group from large sample size and

then regular follow-ups with the same group would help in finding the relationship between variables in more detailed manner. Moreover, it is very important to consider about aerobic steps and aerobic minutes in future study. It will be a unique study since, to the best of author's knowledge, no study has been done to investigate the association of pedometer-determined aerobic steps & minutes and low back pain in Finland.

### 8.3. Conclusion

In conclusion, the current study does not support the idea of U-shaped relationship between physical activity and low back pain i.e., too less or too much physical activity are both risk factors for having low back pain. In fact, more physically active men ( $\geq 10,000$ -12,499 steps/day) are having risk for low back pain twice when it compared with low active males (5000-7499 steps/day). As far as women are concerned, physical activity levels did not increase the threat of having back pain, however, adding factors like body mass index slightly increased the risk. Whereas, education level and occupation did not put any statistical significant risk for having low back pain in both men and women.

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