# Physical Activity and the Association With Self-Reported Impairments, Walking Limitations, Fear of Falling and Incidence of Falls in Persons With Late Effects of Polio.

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# Physical activity and the association with self-reported impairments, walking limitations, fear of falling and incidence of falls in persons with late effects of polio

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Running title: Determinants of physical activity in late effects of polio

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**ABSTRACT**

The purpose of this study was to determine the association between physical activity and self-reported disability in ambulatory persons with mild to moderate late effects of polio (N=81, mean age 67 years). The outcome measures were: Physical Activity and Disability Survey (PADS), a pedometer, Self-reported Impairments in Persons with Late Effects of Polio Scale (SIPP), Walking Impact Scale (Walk-12), Falls Efficacy Scale - International (FES-I) and self-reported incidence of falls. The participants were physically active on average 158 minutes per day and walked 6212 steps daily. Significant associations were found between PADS and Walk-12 ($r = -0.31$, $p < 0.001$), and between the number of steps and SIPP, Walk-12 and FES-I ($r = -0.22$ to $-0.32$, $p < 0.05$). Walk-12 and age explained 14% of the variance in PADS and FES-I explained 9% of the variance in number of steps per day. Thus, physical activity was only weakly to moderately associated with self-reported disability.

**Key words:** Outcome Assessment; Self-report; Exercise; Post poliomyelitis syndrome; Rehabilitation; Walking

## 1. Introduction

Decades after an acute paralytic poliomyelitis infection, many people experience new symptoms or impairments referred to as late effects of polio or post-polio syndrome (Lexell, 2014). Late effects of polio are one of the most common neuromuscular conditions that can lead to a life-long disability. Usual impairments that persons with late effects of polio perceive are muscle weakness, muscle fatigue, general fatigue, and pain during activity and cold intolerance (Lexell & Brogardh, 2012). Muscle weakness in the lower limbs can lead to limitations in walking ability (Horemans, Bussmann, Beelen, Stam, & Nollet, 2005) and an increased risk of falls (Lord, Allen, Williams, & Gandevia, 2002). Nearly 95% of people with late effects of polio report fear of falling (Brogardh & Lexell, 2014; Legters, Verbus, Kitchen, Tomecsko, & Urban, 2006), and approximately 50% to 84% report falling one or more times per year (Bickerstaffe, Beelen & Nollet, 2010; Brogardh & Lexell, 2014; Silver & Aiello, 2002).

The impairments following late effects of polio, together with walking limitations, fear of falling and risk of falls, potentially affect the possibility to be physically active. Physical activity (PA) is a central component in preserving health and enhancing quality of life (Boslaugh & Andresen, 2006). Among people with late effects of polio, two studies have reported that impairments such as pain, fatigue and reduced muscle strength were associated with lower rates of daily PA (Klein, Braitman, Costello, Keenan, & Esquenazi, 2008; Willen & Grimby, 1998). Another study found only weak associations between knee muscle strength, gait performance and PA in ambulatory persons with late effects of polio (Winberg, Flansbjer, Rimmer, & Lexell, 2014). Since it is still unclear what factors mediate daily PA in persons with late effects of polio, there is a need to further explore the association between self-reported disability and PA in this population. Self-reports focus on the person's own perception of their everyday difficulties and provide a wider and deeper understanding of their perceived disability, and are therefore important to use as a complement to objective outcome measures (Marshall, Haywood & Fitzpatrick, 2006).

The aim of this study was to examine the association between the level of PA (assessed subjectively and objectively) and self-reported impairments, walking limitations, fear of falling and incidence of falls in ambulatory persons with late effects of polio.

## 2. Methods

### *2.1. Participants*

Community dwelling ambulatory persons with mild to moderate late effects of polio was selected from the database at a post-polio rehabilitation clinic in a university hospital in Southern Sweden. The database has existed since 2003 and included at the time of recruitment (January 2012) 300 persons, 130 men and 170 women, meeting the following inclusion criteria of being 50 to 80 years of age and able to walk at least 300 m with or without mobility devices and/or orthotics. The exclusion criteria were: i) using a wheelchair as the main mode of transportation, and ii) any condition, such as severe joint problems, cardiovascular or pulmonary diseases or respiratory insufficiency due to late effects of polio, that could affect mobility and PA. We randomly selected and invited 102 persons to participate in the present study and 81 persons accepted the invitation (response rate 79%). There was no significant difference regarding age between the 81 participants, and the 21 non-participants and the 198 eligible persons, respectively.

All participants had a confirmed history of acute poliomyelitis affecting the lower limbs, with new symptoms after a period of functional stability. An electromyogram had been recorded in the lower limbs as part of the initial routine clinical examination and verification of prior polio, and there were no other diseases that could explain their new symptoms.

Oral and written information about the purpose of the study was provided to each participant who gave their written informed consent. The study was approved by the Regional Ethical Review Board in Lund, Sweden (Dnr 2013/427).

### *2.2. Measurements of physical activity*

Physical activity was assessed with the Swedish version of the Physical Activity and Disability Survey (PADS-S) (Winberg, Flansbjer, Carlsson, Rimmer, & Lexell, 2014) and by a pedometer (Yamax SW 200, Tokyo, Japan).

The PADS is a 31-item self-report questionnaire developed to provide a measure of the day-to-day level of PA in people with chronic conditions and low levels of PA (Rimmer, Riley & Rubin, 2001). The participants report their PA behavior in the following four subscales: exercise (structured and repeated with an emphasis on improving or maintaining fitness), leisure time PA (unstructured PA performed infrequently and for leisure), household PA (low-level intensity activities performed indoors and outdoors in conjunction to the home) and work-related PA (activities during work). The participants were

asked to report the amount of time spent performing PA within each area during the last year. Data were then converted into minutes per day for each subscale and used to calculate the sum score of PADS. The original PADS has shown good psychometric properties (Rimmer, Riley & Rubin, 2001), and has been used in persons with multiple sclerosis, arthritis, stroke and late effects of polio (Greene et al., 2006; Kayes et al., 2007; Rimmer, Hsieh, Graham, Gerber, & Gray-Stanley, 2010; Winberg, Flansbjer, Carlsson et al., 2014).

The pedometer was used to measure the number of steps during three ordinary days (weekdays as well as weekends). Three days is recommended by Tudor-Locke, Hart & Washington (Tudor-Locke, Hart & Washington, 2009) to represent an objective count of the participants' daily PA. From these counts, the mean number of steps per day was calculated. The Yamax pedometer is considered to have good validity and reliability (Tudor-Locke, Williams, Reis, & Pluto, 2002) and has previously been used in persons with late effects of polio (Klein, Braitman, Costello et al., 2008; Klein, Keenan, Esquenazi, Costello, & Polansky, 2004; Winberg, Flansbjer, Carlsson et al., 2014).

### *2.3. Measurements of self-reported disability*

#### *2.3.1. Self-reported Impairments in Persons with Late Effects of Polio (SIPP)*

Self-reported impairments were assessed with the SIPP, which is a 13-item scale. The participants rate how much they have been bothered during the past two weeks by various impairments, directly (i.e. muscle weakness, fatigue) or indirectly (i.e. sensory disturbances, mood swings), related to late effects of polio (Brogårdh, Lexell & Lundgren-Nilsson, 2012). The items consider: muscle weakness, muscle fatigue, muscle and/or joint pain during physical activity and at rest, sensory disturbance, breathing difficulties during physical activity and at rest, cold intolerance, general fatigue, sleep disturbances, concentration difficulties, memory difficulties and mood swings. There are 4 response options, ranging from 1 (not at all) to 4 (extremely). The sum score is calculated by adding the score for each item and ranges from 13 to 52 points. A higher score indicates that the participant is more bothered by post-polio related impairments. SIPP has good psychometric properties; it is Rasch-analyzed and unidimensional which allows sum score and parametric analyses (Brogårdh, Lexell & Lundgren-Nilsson, 2012).

#### *2.3.2. Walking Impact Scale (Walk-12)*

Walking limitations were assessed with the Walk-12, which consists of 12 items and asks about limitations during the past two weeks in activities related to walking, running, climbing

stairs, balance, distance and effort, need for support indoors and outdoors, gait quality aspects and concentration when walking. The Walk-12 was originally developed to assess self-perceived walking limitations in persons with multiple sclerosis (Hobart, Riazi, Lamping, Fitzpatrick, & Thompson, 2003) and has then been developed into a generic version (Holland, O'Connor, Thompson, Playford, & Hobart, 2006). There are 5 response options, ranging from 1 (not at all) to 5 (extremely). The sum score of the Walk-12 is generated and reported on a 0-100 scale (yielding a value of self-perceived walking limitation in percent) in which 0 indicates no limitation and 100 indicates maximum limitation. The score, in percentage, is obtained by using the following equation: 100 x (mean value of the 12 items–1) / (5-1). The Walk-12 has been used in persons with stroke, Parkinson's disease and in persons with late effects of polio, and the psychometric properties have been found to be good (Bladh et al., 2012; Brogårdh, Flansbjer & Lexell, 2012; Brogårdh, Flansbjer, Espelund & Lexell, 2013; Graham & Hughes, 2006; Holland, O'Connor, Thompson et al., 2006).

*2.3.3. Falls Efficacy Scale – International (FES-I)*

Fear of falling was assessed with the Falls Efficacy Scale-International (FES-I). It was developed by the Prevention of Falls Network Europe (ProFaNE) group and asks how concerned the participants are about falling when performing 16 daily activities (Yardley et al., 2005). The FES-I consists of the following items: cleaning the house, getting dressed/undressed, preparing simple meals, taking a bath or a shower, going to the shop, getting in or out of a chair, going up or down stairs, walking around outside, reaching up or bending down, answering the telephone, walking on a slippery surface, visiting a friend/relative, going to a place with crowds, walking on an uneven surface, walking up or down a slope and going out to a social event. There are 4 response options, ranging from 1 (not at all concerned) to 4 (very concerned). The sum score is calculated by adding the score for each item and ranges from 16 to 64 points. A higher score indicates that the participant is more concerned about falling. FES-I has been shown to have good psychometric properties (Yardley, Beyer, Hauer et al., 2005) and is commonly used to assess fear of falling in elderly, and in persons with different neurological diseases (Bladh, Nilsson, Carlsson, & Lexell, 2013; Blennerhassett, Dite, Ramage, & Richmond, 2012; Brogardh & Lexell, 2014; Moore et al., 2011).

*2.3.4. Incidence of falls*

The participants reported the incidence of falls by responding to a question regarding the occurrence of falls during the past year. A fall was defined as an event which results in a person coming to rest inadvertently on the ground or floor or other lower level (World Health Organization, 2014). Fall incidence was subsequently dichotomized as 'yes' (one or more falls during the past year) or 'no' (no falls during the past year).

*2.4. Procedure*

Data for the PADS were collected through an interview by the first author while the participants responded to the SIPP, the Walk-12, the FES-I and fall incidence on their own. After the interview, each participant received information about the pedometer. They were carefully instructed on how to wear the pedometer, clipped to their clothing (either side) and close to the anterior iliac spine, from the time they woke up in the morning to the time they went to bed at night. The pedometers were returned by post in a prepaid envelope, together with the records of their daily counts. The total time for the interview and the ratings was 2 hours.

*2.5. Data analysis*

Descriptive statistics (mean, SD and frequencies) were calculated for the participants' characteristics and for the PADS, the number of steps, the SIPP, the Walk-12, the FES-I, and the incidence of falls.

The association between the PADS (the sum score and the score of each subscale), the number of steps and the sum score of SIPP, Walk-12 and FES-I were analyzed with the Pearson's correlation coefficient (r). The association between the PADS (the score of each subscale and the sum score), the number of steps and each item in the SIPP (13 items), the Walk-12 (12 items), the FES-I (16 items) and falls incidence were analyzed with the Spearman rank correlation coefficient (rho).

To explore how much the level of PA was explained by the SIPP, the Walk-12, the FES-I and falls incidence multivariate regression analyses were conducted. The sum of PADS and the number of steps were the dependent variables whereas the outcomes of self-reported disability were the independent variables. Since age has been shown to be an indicator of PA in persons with late effects of polio (Winberg, Flansbjer, Carlsson et al., 2014), and sex and Body Mass Index (BMI) has been found to be associated with PA in persons with other

disabilities (Bauman et al., 2012), these variables were also included in the analyses. As the sample consisted of 81 individuals, we kept the number of independent variables below 10 individuals per variable as recommended in the literature (Tabachnick & Fidell, 2007 ). Before the regression analyses the independent variables were checked for multi-collinearity; only small to moderate correlations were found (r = 0.25 to 0.44, $p < 0.05$). From the full models, variables were omitted one by one starting with the variable with the greatest p-value, until all remaining variables had a p-value less than 0.05.

The $R^2$ value represents the proportionate contribution of the independent variables to the variance of the dependent variable and the adjusted $R^2$ value was used here to correct for multiple variables. The suitability of this approach – the aptness of the linear model and the normality of the residuals – was addressed in scatterplots of the residuals and predicted values, in normal probability plots and in Q-Q plots. The aptness of this model and the suitability was not rejected, confirming that the linear model could be applied for this sample.

All calculations were performed using IBM SPSS Statistics version 21 (IBM Corporation, Armonk, New York, United States). Significance levels less than 0.05 represented statistical significance.

## 3. Results

Of the 81 participants, 38 were women and 43 were men, their mean age was 67 years (SD 6, range 54 to 80) and the mean time since onset of new symptoms was 16 years (SD 9, range 1 to 46 years). The mean BMI was 27 (SD 4, range 18 to 38). A majority (n=53) was retired and the remainder worked full time or part-time. Eighteen participants used a mobility device (a cane, crutch or rollator), 17 walked with an ankle foot orthotic (AFO) and four participants walked with a knee-ankle foot orthotic (KAFO).

### *3.1. Physical activity*

The participants were physically active on average 158 minutes (SD 91, range 17 to 438) per day according to the PADS score and walked on average 6212 steps per day (SD 3208, range 122 to 16 016). The detailed results from the PADS, the four subscales and the sum score of PADS, are presented in Figure 1. Most of the PA was performed in household activities (73%) (e.g., doing laundry, cleaning, gardening and maintaining a house). Sixteen percent of the PA was performed in leisure PA and the participants reported low levels of PA in structured exercise (6%) and work-related PA (5%).

***Insert Figure 1 about here***

*3.2. Self-reported disability*

*3.2.1. Self-reported Impairments in Persons with Late Effects of Polio (SIPP)*

Data for the SIPP are presented in Table 1; for brevity we only report the results on response options 3 (quite a bit) and 4 (extremely). The mean score of the self-reported impairments was 26 points out of 52 (SD 7, range 13 to 41). The most difficult impairments (rated as 'quite a bit' or 'extremely') that the participants reported were: muscle and/or joint pain during physical activity (61%), muscle weakness (53%), muscle fatigue (51%) and general fatigue (47%).

***Insert Table 1 about here***

*3.2.2. Walking Impact Scale (Walk-12)*

In Table 2, data for the Walk-12 are presented; for brevity we only report the results on response options 4 (quite a bit) and 5 (extremely). The mean score of the self-reported walking limitations was 48% (SD 28, range 0 to 100%). A large majority (75%) of the participants reported limitations ('quite a bit' or 'extremely') in their ability to run. Over 40% reported limitations ('quite a bit' or 'extremely') in their ability to climb stairs, in their walking speed and walking distance and their ability to walk smoothly, and increased concentration and effort when walking.

***Insert Table 2 about here***

*3.2.3. Falls Efficacy Scale – International (FES-I)*

In Table 3, data for the FES-I are presented; for brevity we only report the results on response options 3 (fairly concerned) and 4 (very concerned). The mean score in FES-I was 28 points out of 64 (SD 9, range 16 to 54). The most difficult activities (reported as 'fairly concerned' or 'very concerned') were walking on slippery surface (69%), walking on uneven surface (60%), walking up or down a slope (52%) and going up or down stairs (35%).

***Insert Table 3 about here***

*3.2.4. Incidence of falls*

Fifty participants (62%) reported at least one fall whereas 38% reported no falls during the past year.

*3.3. Associations between PA and self-reported disability*

In Table 4 the associations between the measures of PA (PADS and the number of steps) and the sum score of the SIPP, the Walk-12, the FES-I are presented (numbers in brackets refer to the items in each scale; cf. Table 1-3).

The sum score of SIPP was significantly and negatively associated with the number of steps (r = -0.23, $p < 0.05$), indicating that participants who reported more impairments were less physically active. Some items in the SIPP were significantly and positively associated with the PADS household subscale (item 4, 8, 10, 11, 12) and the sum of PADS (item 8, 11, 12), but negatively associated with the number of steps (item 1, 7).

The sum score of Walk-12 was significantly and negatively associated with the leisure subscale, the sum of PADS and the number of steps (r = -0.22 to -0.31, $p < 0.05$); participants who reported more limitations in Walk-12 were less physically active. Some items in the Walk-12 were significantly and negatively associated with the PADS leisure subscale (item 2, 12), the sum of PADS (item 1, 4, 7, 10, 12) and the number of steps (item 1, 4, 6, 10, 12).

The sum score of FES-I was significantly and negatively associated with the PADS leisure subscale and the number of steps (r = -0.26 to -0.32, $p < 0.05$), indicating that participants who were more concerned about falling were less physically active. Some items in the FES-I were significantly and positively associated with the PADS exercise subscale (item 2, 3, 4) and the household subscale (item 4) but negatively associated with the leisure subscale (item 1, 5, 6, 7, 8, 14, 15), the work subscale (item 3, 10) and the number of steps (item 1, 2, 3, 5, 6, 7, 13, 14, 15).

The falls incidence was not significantly correlated with PADS or with the number of steps, indicating that the occurrence of one or more falls during the past year did not influence the participants' level of PA.

***Insert Table 4 about here***

*3.4. Multivariate regression analyses*

In Table 5, the results from the final model in the multivariate linear regression analyses are presented. Walk-12 ($p < 0.01$, B -1, 95% CI -1.68 to -0.33) and age ($p < 0.05$, B 4.1, 95% CI

0.82 to 7.28) were significantly associated with the sum of PADS and explained 14% of the variance. FES-I ($p < 0.01$, B -109.6, 95% CI -183.98 to -35.17) was significantly associated with the number of steps and explained 9% of the variance.

***Insert Table 5 about here***

## 4. Discussion

The aim of this study was to determine the association between the level of PA in ambulatory persons with mild to moderate late effects of polio and their self-reported impairments, walking limitations, fear of falling, and incidence of falls. Self-reported outcome measures were used as they provide a broader dimension of perceived disability and are recommended as a complement to objective outcome measures (Marshall, Haywood & Fitzpatrick, 2006). The participants were physically active almost three hours per day, and walked around 6200 steps per day. More than 50% reported reduced muscle strength, muscle fatigue and muscle and/or joint pain during physical activity, walking limitations and fear of falling. The associations between PA and self-reported disability were generally low to moderate. The multivariate regression analyses revealed that walking limitations together with age explained the variance in PADS and fear of falling explained the variance in number of steps per day, but the strength of these relationships were weak to moderate.

Most of the participants performed their PA in household chores and a small amount of the PA was performed in leisure activities and formal exercise (Figure 1). Their number of steps per day was just above the expected mean value of the number of steps per day in persons with other neuromuscular diseases, as being described in a review by Tudor-Locke (Tudor-Locke et al., 2011). This is higher than the normative values for older adults (above 60 years of age) who have an average number of steps ranging from 2 749 to 4 490 (Tudor-Locke et al., 2013). There are several probable reasons for why the participants in our study walked more. We had a sample with no participants above 80 years of age. Another reason may be cultural as this study was performed on a Swedish sample where older persons are often recommended walking as a way to stay physically active, particularly if they have a mild to moderate disability. Walking is also identified as the most frequently occurring activity in this population (Winberg, Flansbjer, Carlsson et al., 2014).

The impairments the participants reported as most difficult (reduced muscle strength, muscle fatigue and pain) have previously been found to be negatively associated with PA (Jensen et al., 2011; Klein, Keenan, Esquenazi et al., 2004; Willen & Grimby, 1998).

However, it has also been shown that more sedentary persons with late effects of polio perceive greater pain and fatigue (Rekand et al., 2004), but the number of impairments do not seem to correlate with the frequency and the intensity of PA (Klein, Keenan, Esquenazi et al., 2004). In the present study, the sum score of SIPP was negatively associated with the number of steps ($r = -0.23$, $p < 0.05$), indicating that participants who perceived greater impairments walked less. This is in agreement with the general contention that impairments associated with late effects of polio affect the level of PA.

Some items in the SIPP (muscle and/or joint pain at rest, cold intolerance, sleep disturbances, concentration and memory difficulties) were, somewhat unexpectedly, positively associated with the household subscale and with the sum of PADS. Sleep disturbances, concentration and memory difficulties are not a direct consequence of the acute polio infection, but may be reported by people with late effects of polio. A plausible explanation is therefore that persons who are active, or try to be active in daily activities, are also more bothered by these impairments. These people may have adapted coping strategies in order to still manage their household activities (Ahlstrom & Karlsson, 2000), despite reporting these impairments. Other impairments that are also not directly a consequence of the acute polio infection are sensory disturbances (for example carpal tunnel syndrome or other nerve entrapments) and mood swings. None of them were associated with any of the PA measures. Even though they may be reported by people with late effects of polio, the results indicate that they are not important for the level of PA.

More than 40% of the participants reported walking limitations (rated as quite a bit or extremely) and the sum score of Walk-12 was negatively associated with both measures of PA. The participants who reported more limitations in walking were less physically active. This was not unexpected since the association between PA and walking limitations has been described previously in persons with stroke and multiple sclerosis (English, Manns, Tucak, & Bernhardt, 2014; Rosenberg, Bombardier, Hoffman, & Belza, 2011). Walking is the most frequently occurring type of activity within the leisure subscale (Winberg, Flansbjer, Carlsson et al., 2014) and restrictions in walking related activities are commonly reported in household management in persons with late effects of polio (Appelin, Lexell & Månsson Lexell, 2014; Trojan & Cashman, 2005). Several items in the Walk-12 were significantly and negatively associated with the leisure subscale, the sum of PADS and the number of steps, but, surprisingly, we found no association with the household subscale. A plausible explanation is that walking within household activities was performed only at short distances.

Persons with late effects of polio who report fear of falling and have experienced falls reduce their mobility and avoid activities in daily life (Bickerstaffe, Beelen & Nollet, 2010). The participants in our study were not very concerned about falling when performing daily activities (the mean value of FES-I was 28 points out of 64 points), although the most difficult activities they reported were related to walking. A majority of the items in FES-I (n=11) were negatively associated with the leisure subscale, the work subscale and the number of steps. This is not surprising since the FES-I contain five walking related items (out of 16) and targets fear of falling in relation to activities (Bladh, Nilsson, Carlsson et al., 2013). In healthy older adults (mean age 74 years) the mean value of FES-I is 29 points, similar to our participants (Moore, Ellis, Kosma et al., 2011). In the present study there was no significant correlation between PA and incidence of falls, even if the occurrence of falls (60%) was considerably higher than in older adults (fall frequency 20-40%) (Gillespie et al., 2012).

To assess how much the participants' self-reported disability influenced their PA, a linear regression model was used. The Walk-12 and age explained 14% of the variance in the sum of PADS and the FES-I explained 9% of the variance in the number of steps. Overall, the variability in PADS and number of steps was explained only to a small degree by the perceived level of disability. Younger persons and those who perceived more walking limitations and fear of falling were less physically active. This suggests that there are other factors, beyond self-reported disability, associated with the level of PA. In persons with other disabilities (Ellis et al., 2011; Rimmer & Rowland, 2008) personal factors such as motivation and self-efficacy, and environmental factors have been found to be associated with PA, and these need to be further explored among people with late effects of polio.

### *4.1. Strengths and limitations*

The independent variables used here are all self-reports with good psychometric properties and represent different domains of the International Classification of Functioning, Disability and Health (World Health Organization, 2001), and have all been used in persons with late effects of polio. Self-reports are important as they provide a measure of the person's own perception, although they have an inherent limitation as they are subjective. The PADS is a validated instrument that captures low levels of PA and is specifically developed for persons with chronic conditions. However, the recall period for PADS is one year, which may have affected the possibility to recall activity performed during a year, and thereby the accuracy of data. On the other hand, it makes it possible to compare levels of PA during all seasons of the year. Pedometers are considered less valid during slow walking which may also have affected

our results (Kenyon, McEvoy, Sprod, & Maher, 2013; Tudor-Locke, Williams, Reis et al., 2002). In addition, pedometers may undercount the number of steps in people with neurological disabilities (Elsworth et al., 2009), which means that the participants' daily number of steps could have been somewhat higher. The participants in the present study were selected from a database at a post-polio clinic. Since they were all ambulant and mildly to moderately affected by their prior polio, our results cannot be generalized to the entire population of persons with late effects polio. A larger sample size with a broader spectrum of disability may therefore have allowed more detailed inferences.

## 5. Conclusions

Physical activity in ambulatory persons with late effects of polio is weakly to moderately associated with self-reported walking limitations and fear of falling. These factors need attention in clinical settings, and by reducing them, people with late effects of polio may increase their level of physical activity and maintain an active and healthy lifestyle. The weak to moderate association between self-reported disability and the level of PA suggests that other factors, such as personal and environmental barriers and facilitators, may also be related to the level of PA among people with late effects of polio.

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**Declaration of interest**

None

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**LEGEND**

**Figure 1** The average number of minutes of physical activity in 81 persons with late effects as assessed by the Physical Activity and Disability Survey (PADS; the four subscales and the sum score).

**Table 1.** Self-reported impairments assessed by the Self-reported Impairments in Persons with late effects of Polio (SIPP) in the 81 persons with late effects of polio.

| Total score (Mean, SD, range)* | 26 (7, 13-41) | |
|---|---|---|
| Item No; (%) | Quite a bit | Extremely |
| 1. Muscle weakness | 36 | 17 |
| 2. Muscle fatigue | 30 | 21 |
| 3. Muscle and/or joint pain during physical activity | 27 | 34 |
| 4. Muscle and/or joint pain during rest | 21 | 5 |
| 5. Sensory disturbance | 9 | 5 |
| 6. Breathing difficulties at rest | 3 | - |
| 7. Breathing difficulties during physical activity | 15 | 7 |
| 8. Cold intolerance | 22 | 14 |
| 9. General fatigue | 33 | 14 |
| 10. Sleep disturbance | 12 | 11 |
| 11. Concentration difficulties | 10 | 3 |
| 12. Memory difficulties | 10 | 1 |
| 13. Mood swings | 16 | 5 |

*Possible scoring range 13-52 points, higher=worse.

Response options were: (1) not at all, (2) a little, (3) quite a bit, (4) extremely.

**Table 2.** Self-reported walking limitations assessed by the Walking Impact Scale (Walk-12) in the 81 persons with late effects of polio.

| Total score (Mean, SD, range)* | 48 (28, 0-100) | |
|---|---|---|
| Item No; (%) | Quite a bit | Extremely |
| 1. Limited your ability to walk | 21 | 15 |
| 2. Limited your ability to run | 16 | 59 |
| 3. Limited your ability to climb up or down stairs | 33 | 15 |
| 4. Made standing when doing things more difficult | 11 | 10 |
| 5. Limited your balance when standing or walking | 24 | 5 |
| 6. Limited how far you are able to walk | 30 | 20 |
| 7. Increased the effort needed for you to walk | 24 | 19 |
| 8. Made it necessary for you to use support when walking indoors, e.g. holding on to furniture, using a stick etc. | 6 | 5 |
| 9. Made it necessary for you to use support when walking outdoors, e.g. using a stick or frame etc.? | 12 | 14 |
| 10. Slowed down your walking | 27 | 14 |
| 11. Affected how smoothly you walk | 28 | 14 |
| 12. Made you concentrate on your walking | 27 | 15 |

*Possible scoring range 0-100%, higher=worse.

Response options were: (1) not at all, (2) a little, (3) moderately, (4) quite a bit and (5) extremely.

**Table 3.** Fear of falling assessed by the Falls Efficacy Scale-International (FES-I) in the 81 persons with late effects of polio.

| Total score (Mean, SD, range)* | 28 (9, 16-54)* | |
|---|---|---|
| Item No; (%) | Fairly concerned | Very concerned |
| 1. Cleaning the house (e.g. sweep, vacuum or dust) | 11 | 6 |
| 2. Getting dressed or undressed | 5 | - |
| 3. Preparing simple meals | 3 | - |
| 4. Taking a bath or a shower | 7 | 3 |
| 5. Going to the shop | 5 | 1 |
| 6. Getting in or out of a chair | 9 | 3 |
| 7. Going up or down stairs | 20 | 15 |
| 8. Walking around in the neighborhood | 17 | 4 |
| 9. Reaching for something above your head or on the ground | 11 | 6 |
| 10. Going to answer the telephone before it stops ringing | 5 | - |
| 11. Walking on a slippery surface (e.g. wet or icy) | 22 | 47 |
| 12. Visiting a friend or relative | 6 | 1 |
| 13. Going to a place with crowds | 10 | 5 |
| 14. Walking on an uneven surface (e.g. rocky ground, poorly maintained pavement) | 32 | 28 |
| 15. Walking up or down a slope | 30 | 22 |
| 16. Going out to a social event (e.g. religious service, family gathering or club meeting) | 5 | 3 |

*Possible scoring range 16-64 points, higher=worse.

Response options were (1) not at all concerned, (2) somewhat concerned, (3) fairly concerned and (4) very concerned.

**Table 4.** Correlations (Pearson's r) between the PADS (the sum score and the score of each subscale), the number of steps (pedometer) and the sum score of SIPP, Walk-12, and FES-I in the 81 persons with late effects of polio.

| | PADS | | | | | Pedometer |
|---|---|---|---|---|---|---|
| | **Exercise** | **Leisure** | **Household** | **Work** | **Sum of PADS** | |
| SIPP | -0.06 | -0.19 | 0.19 | -0.13 | 0.04 | -0.23* |
| Walk-12 | -0.07 | -0.28* | -0.16 | -0.11 | -0.31** | -0.22* |
| FES-I | -0.02 | -0.26* | 0.11 | -0.02 | 0.00 | -0.32** |

SIPP, Self-reported Impairments in Persons with Late Effects of Polio; Walk-12, Walking Impact Scale; FES-I, Falls Efficacy Scale – International; PADS, Physical Activity and Disability Survey

* $p<0.05$, ** $p<0.01$

**Table 5.** The results of the multivariate linear regression analyses for the 81 persons with late effects of polio.

| Dependent variable | Variables in final model | p-value | B | 95% CI | Adj $R^2$ |
|---|---|---|---|---|---|
| PADS | Walk-12 | 0.01 | -1.0 | -1.68 to -0.33 | 0.14 |
| | Age | 0.02 | 4.1 | 0.82 to 7.28 | |
| Number of steps | FES-I | 0.01 | -109.6 | -183.98 to -35.17 | 0.09 |

B= unstandardized coefficient, 95 CI= 95 % Confidence Interval, Adj $R^2$= Adjusted $R^2$, determination coefficient

PADS, Physical activity and disability survey; Walk-12, The Walking Impact Scale; FES-I, Falls Efficacy Scale – International

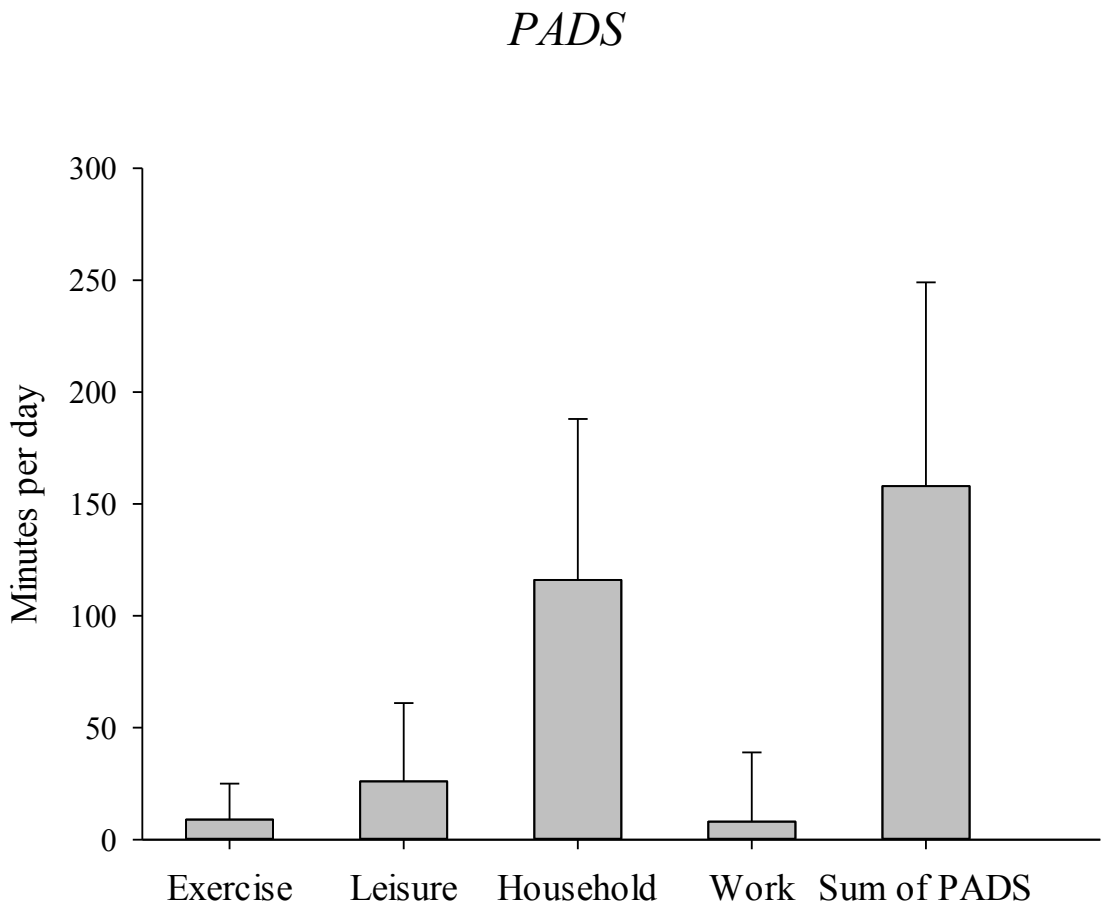
PADS
Minutes per day
300
250
200
150
100
50
0
Exercise
Leisure
Household
Work
Sum of PADS

***Figure 1***