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Health-promoting Physical Activity During the Covid-19 Pandemic in Swedish Adults – Prevalence and Associated demographic factors.

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ABSTRACT

The Covid-19 pandemic prompted significant lifestyle changes, including physical inactivity and remote working. This cross-sectional study aimed to explore the prevalence of health-promoting physical activity (PA) and its association with demographic factors and remote working among Swedish adults (18-64 years) using secondary data collected during the Covid-19 pandemic. Health-promoting PA(HPPA) was defined according to WHO guidelines, and demographic factors were identified with the theoretical understanding of the Social ecological model for PA. Binary logistic regression was used to study the associations between demographic factors gender, age & occupation, and HPPA. Of the sample (n= 776), 50.3% were males, and the mean age was 43.6 years. The prevalence of health-promoting PA was 55 % in the total sample, 61% in males, and 48% in females. In occupation, the prevalence of HPPA was 63% in students and 49% in non-Manual workers. In logistic regression analysis, the odds of HPPA were lower in females (OR = 0.56; 95% CI 0.42- 0.75) than in males. In occupation, the odds of engaging in HPPA were lower in non-Manual workers (OR= 0.47, 95% CI, 0.27-0.81) than in students/others. In conclusion, slightly more than half of the Swedish adults had health-promoting physical activity during covid 19 pandemic. However, HPPA was less common among females and non-Manual workers compared to males and students/others.

Keywords –Covid-19 pandemic, demographic factors, physical activity, WHO guidelines

CONTENTS

1 INTRODUCTION

Physical activity (PA) is a lifestyle habit that benefits an individual's physical and mental health and reduces the risk of developing non-communicable diseases (Lee et al., 2012; WHO, 2018; WHO, 2022c). Global data shows that most adults lack adequate physical activity (PA) (Hallal et al., 2012; WHO, 2022c). As a result, non-communicable diseases have increased globally, causing significant health-related consequences (Lee et al., 2012). A study that reported data from 122 countries of adults (15 years and older) reported 31.1% of physical inactivity in 2012 (Hallal et al., 2012,) and another study reported 27.5% of insufficient physical activity worldwide (Guthold et al., 2016) and WHO reports on physical inactivity 2022 quotes this study stating that the situation remains unchanged (WHO, 2022a). Physical activity behavior relies on numerous individual and societal factors (Hallal et al.,2012; Sallis et al., 2015). Understanding the factors influencing PA is essential to find solutions to develop interventions and improve health-promoting physical activity. Health-promoting physical activity improves individual health and well-being and reduces health-related risks (WHO,2020) and can take different forms varying in intensity, duration, and frequency. World Health Organization (WHO) provides the health-promoting physical activity guideline. The physical activity levels stated in the guidelines are identified through evidence to enhance various aspects of health, including cardiovascular fitness, muscular strength and endurance, flexibility, and body composition (WHO, 2020). Some of these factors are modifiable (behavioral, organizational, and environmental), while some remain invariable such as age, gender, disability, and ethnicity (Sallis., 2015; Whitehead & Dahlgren, 2006; WHO, 2018). WHO's global action plan on PA reveals that only one in four adults engage with health-promoting PA (WHO, 2018; WHO, 2022c). Health-promoting PA, by evidence, reduces many health risks, including Non-Communicable Diseases (NCD), some cancers, and obesity (Lee et al., 2012; Rippe, 2018).

Even though the world is now resolving the health and lifestyle-related consequences of the Covid-19 pandemic with pharmacological strategies of developed vaccines, drastic measures were taken to prevent the disease from spreading (Wilder-Smith & Freedman, 2020). Local and international containment strategies and social isolation were imposed in many nations limiting traveling and encouraging remote working and studying when possible (BBC, 2020). Technological advancements have transformed living and working conditions considered convenient with hidden consequences. During the Covid-19 pandemic, such technology-driven methods were in use to connect people for work and entertainment even though it further impacted physical activity and sedentary behavior (Bloom, 2020; Ipsen et al., 2021; Tavares et al., 2017)

The Covid-19 pandemic significantly affected physical activity levels globally due to measures taken to limit disease (Tison et al., 2020). Since the Covid-19 pandemic, many studies have shown that PA has reduced in general populations worldwide (Lesser et al., 2020; Ráthonyi et

al., 2021; Tison et al., 2020; Wilms et al., 2022). In addition, some studies have shown how the individual and environmental factors influenced PA during the Covid-19 in selected populations (Alqahtani et al., 2021; Ammar et al., 2020; Nomura & Araki, 2022). Even though the world is recovering, regaining the pre-covid state in many social and cultural contexts while loosening tight social isolation measures and practices, remote working & studying is encouraged and sustained globally.

2 BACKGROUND

2.1 Physical Activity

Physical activity is defined as any movement produced by skeletal muscles that spend energy (WHO, 2018). Adequate physical activity can be achieved through various daily activities involving skeletal muscle movements and energy expenditure. Physical activity is characterized by Frequency, Intensity, Time, and Type, also called FITT principles (WHO, 2018). The intensity of PA depends on the effort needed to perform the PA. Many types of PA have various ranges of intensity, such as aerobics, strengthening, flexing, or balancing exercises. Time is also crucial in health-promoting PA, where the duration and how often it is performed. PA can be achieved as a part of daily manual work where lifting, walking, farming, and even domestic tasks could be with the PA component (WHO, 2018), while some are done for entertainment or enjoyment, like walking, cycling, track and field sports, and through recreational forms, yoga, dancing, Zumba, or tai chi (NHS UK, 2021).

PA has various purposes, such as improving physical fitness and health, reducing mental health-related stress, and managing adequate body weight (Rodgers et al., 2004; Stamatakis et al., 2019). In addition, evidence shows that regular PA is essential in preventing and treating mortalities and morbidities related to non-communicable diseases such as coronary heart disease, hypertension, stroke, and diabetes mellitus (Lee et al., 2012; Ripper, 2018). For example, Lee et al. (2012) reported that physical inactivity contributes to 6% of cardiovascular morbidities, and 7% of type 2 diabetes and further confirms that 6-10% of NCDs and some cancer risks could be eliminated by adequate physical activity. Apart from the personal health benefits and reducing health care costs, it also helps at social and economic levels where sustainable transportation practices such as cycling and walking help decline greenhouse gas emissions (Bjørnarå et al., 2017). Furthermore, sports and recreational activities could promote PA among populations and are also helpful in community development, tourism, and social involvement, such as in humanitarian programs.

Physical activity is described and incorporated in the Sustainable Development Agenda 2030, where many of these goals can be achieved through adequate awareness, involvement, and

policies on PA. Health and socio-economic benefits of PA contribute directly to Sustainable development goals (SDG), e.g. Good health and wellbeing - SDG 3, Ending all forms of malnutrition-SDG 2, Tackling social and health disparities in SDG 4 (Quality education), creating equal opportunities to engage in health-promoting PA in SDG 5 (Gender equality), and SGD 10 (Reduce inequalities).

Furthermore, communities who are physically active also fulfil the goals related to economic aspects such as SDG8 (Decent work and economic growth), SDG9 (Industry, innovation, and infrastructure), and SDG 11 (Sustainable cities and communities). Moreover, through active transportation means reducing carbon footprint, SDG12 (Responsible production and consumption), via reducing greenhouse gas emissions by cycling or walking, SDG 13 (Climate Action), SDG 15 (Life on land) as explained by Winters et al. (2017). Indirectly, in some instances, sports and leisure activities contribute in SDG like SGD 16 (Peace, justice and strong institution) and Partnerships – SDG 17 (WHO, 2018).

Sedentary behavior (SB) or sitting or idle times are important when describing health-promoting physical activity. WHO guidelines on physical activity and sedentary behavior (2020) recommend the time durations of SB according to age and clinical conditions. Increasing sedentary behavior has resulted in physical inactivity and technological advancement has contributed largely to this increased SB (WHO,2020). Even though SB is not considered in the present study it is important to understand that it is still debated in research regarding the demarcation of SB and Adequate PA as there can be instances where one would have adequate amount of PA while being sedentary during the rest of the day (van der Ploeg & Hillsdon, 2017) but SB is not explored in this study (the reasons are further discussed in Strengths and limitations).

2.1.1 Health-promoting Physical Activity

Evidence-based health-promoting physical activity guidelines were recommended by the WHO (2018) on physical activity and sedentary behavior. These guidelines are further developed to serve specific age groups taking intensity, frequency, and duration into account (WHO, 2020). Furthermore, these guidelines are advised to be incorporated in policies and national guidelines of countries to increase PA among the population. The recommended amount of health-promoting physical activity varies depending on factors like age, current fitness level, and specific health conditions and goals. Guidelines are provided by health organizations, such as the World Health Organization (WHO, 2020) or the National guidelines from health authorities of respective countries. This study focuses on Swedish adults; hence adult age group recommendations of the WHO are considered as the guide to demarcate health-promoting PA. The WHO PA guideline (WHO, 2020) has recommendations for various age groups from 5 years to 65 years and older. These guidelines are also based on various conditions such as pregnancy, post-partum, chronic illnesses, and disabilities (WHO, 2020). The age group focused on the present study is 18-64 years old, which includes those in the

country's workforce. Even though the recommendations are similar to adult age groups of 18-64 years and 65 years and above, the elderly population differs from the 18-64 years age group due to retirement from work, chronic illnesses, and various other disabilities occurring due to aging. Occupation is a demographic variable of interest in this study hence the group of 65 years and older is not included in the present study.

The WHO recommends that all adults perform regular PA, which is beneficial for health. The recommendation for the adult age group (18-64 years) is to do at least 150 -300 minutes of moderate-intensity aerobic physical activity or 75-150 minutes of vigorous-intensity aerobic PA, or 75-150 minutes of moderate & vigorous physical activity per week. WHO also recommends more than 300 minutes of moderate-intensity PA, and more than 150 minutes of vigorous-intensity PA per week could generate additional health benefits.

Moderate-intensity aerobic exercises include brisk walking, leisure cycling, dancing, hiking, rollerblading, and pushing a lawn mower. Vigorous intensities are running, swimming, gymnastics, skipping, martial arts, and sports like football, rugby, hockey, etc. (NHS, UK 2021).

2.2 The Covid-19 Pandemic and Physical Activity

The Covid-19 pandemic, declared in March 2020, became a global public health emergency that not only caused respiratory health-related morbidities and mortality but many other health and socio-economic related catastrophes. Many countries followed strict measures and imposed lockdowns, leading to social isolation. Under these circumstances, lifestyles changed drastically, where physical activity, sedentary behavior, diet, smoking, and alcohol consumption are among them (Brancaccio et al., 2021; Ipsen et al., 2021).

The pandemic accelerated the adoption of remote working and studying, supporting the public health measures that were taken to reduce personal interactions and disease spread (Bloom, 2020). Remote working brought many advantages to workers along with reduced exposure to the virus but also flexible time frames and management of both work and personal responsibilities, and improved work-life balance (Ipsen et al., 2021; Uresha, 2020), but some studies have shown the reduction of active travel and social interactions due to lack of office environment, reduced PA and increased of mental health-related disorders (Blom et al., 2020; Brusaca et al., 2021; Coskun et al., 2022; Kooshari et al., 2021).

The study by Elvén et al. (2022) explored PA variations in three intensity levels, mild, moderate and vigorous, and the total PA level in metabolic equivalent minutes (METs) and examined the changes in PA and SB during pandemic and before pandemic in general population from the survey data that is also used in this study (further explained in Methods section). In addition, the study by Elvén et al. (2022) also explored the association of demographic and behavioral determinants and PA levels. The results revealed an overall reduction of PA levels where 51% reported a reduction during pandemic with men having increased SB during pandemic.

Remote working during the Covid-19 pandemic brought many novel challenges, as the disease itself brought physical complications that reduced physical activeness. Nevertheless, studies have shown a significant reduction in PA during the Covid-19 pandemic (Brito et al., 2021; Brancaccio et al., 2021; Elvéns et al., 2022; Feter et al., 2022; Matthews et al., 2022; Sañudo et al., 2020). Furthermore, since the experience of remote working during the pandemic has prompted new avenues towards future workstations, many organizations have allowed employees to continue remote working.

2.3 Theoretical Framework - The Social Ecological Model

Theories and models that express psychological, individual and societal impressions have been prominently seen in research and policies related to PA. Some theories focus on individual behavior (Bandura, 1986; Dishman, 1991), while some focus on social and environmental predictors (Sallis et al., 2015). Theoretical and empirical data shows that identifying predictors of PA projects is a more important research concern and beneficial at an individual and community level rather than finding causal effects (Bauman et al., 2002; Cochrane & Davey, 2008; Zhang & Solmon, 2013).

Similar approaches have been seen before the initial Social Ecological Models in Ecological system theory (EST) in psychology, which was developed by Urie Bronfenbrenner (1994), The EST explains that different factors interact to influence human behavior. The ecological system theory and the social-ecological model (SEM) bear similar approaches as both identify the multiple levels of influence on behavior but differ in focus. The EST focuses more on individuals' development and behavior components, emphasising nested systems that influence an individual's life. In contrast, SEM gives a broader aspect of social and environmental factors that influence behavior. In public health, individual factors, as well as social and environmental factors, are important in creating health-promoting behaviours (Dishman, 1991; Whitehead & Dahlgren, 2006). Emphasis on policies, cultural norms, and healthy and secure vicinities is needed to generate sustainable health-promoting behaviours (UN, 2015), and Social Ecological Model gives more ground for future developments.

The social ecological model has been recognized and applied in investigations of health issues and health promotion (Mcleroy et al., 1988). Ecological models project the nature of human interactions with the individual's physical and social environments and policy levels (Rhodes et al., 2019; Sallis et al., 2015). Such broader scope in recognizing policy influences and community and organizational influences on health behavior is the key feature distinguishing ecological models from behavioural theories and models (Sallis et al., 2015). Healthy behaviours will easily endorse when environmental and policy support is given to healthy living conditions from the community.

The social-ecological approach accentuates that physical activity is a behavior with individual (Intrapersonal) behavioural factors and interpersonal, Organizational, environmental and policy-level factors that interplay. The present study aims to investigate the Individual domain

where demographic factors are recognized to be predicting PA behavior (Sallis et al., 2015). The SEM allows understanding the complex interplay of multiple factors influencing PA not only on the influence of behavior but across many contexts like work, living environment, transportation, and leisure time (Sallis et al., 2006).

Even though many theories can help explain how demographic factors influence physical activity, the social-ecological model suggests multiple complex levels that can influence PA behavior; in contrast, other theories are more suggestive of behavioural factors and belief behind the PA behavior, the social-ecological model holds more ground when exploring demographic factors that are discussed in this study hence chose the social-ecological model (Rhodes et al., 2019).

Based on the Social ecological model by McLeroy et al. (1998), modified by Sallis et al. (2006), demographic factors in the individual domain of the social-ecological model are explored in this research (Figure 1). The SEM conceptualizes physical activity and focuses on multiple factors that influence PA. Therefore, demographic factors explored in this study are a micro component in the individual domain of SEM (Figure 1).

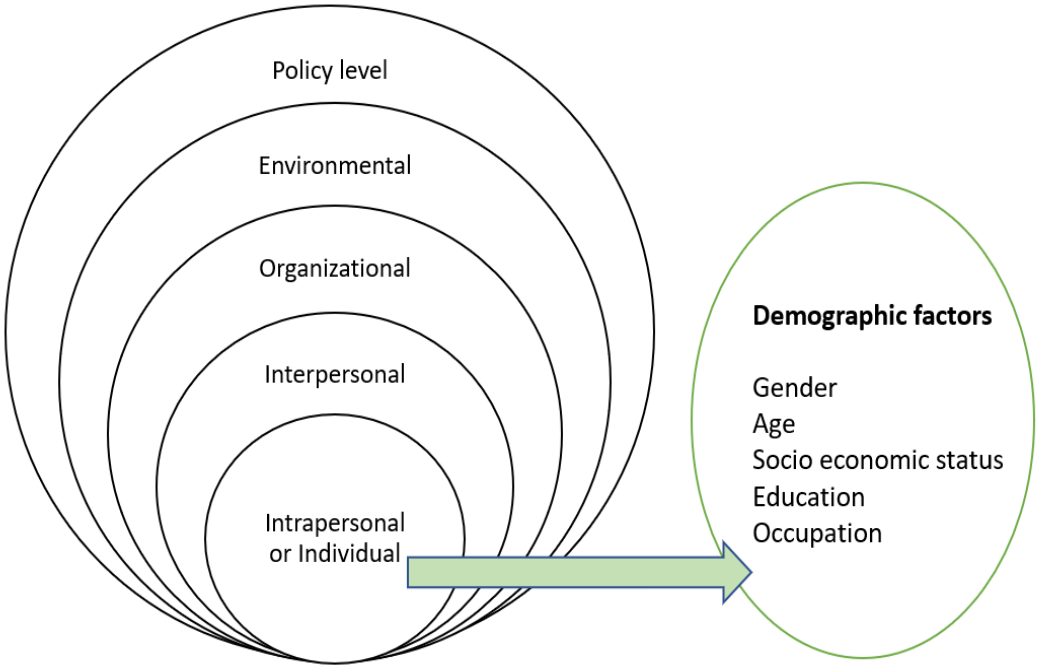

Figure 1. Social-ecological Model of five domains of PA. Illustrated from the model, adapted from Sallis et al. (2006).

2.4 Relevance of the Topic to Public Health Sciences

Physical activity is considered a beneficial and a sustainable lifestyle habit in public health contexts. Public health science aims to prevent disease, promote healthy living, and prolong life (WHO, 1998). According to the latest WHO data, insufficient physical activity is seen among more than a quarter of adults (WHO., 2022a). This rising physical inactivity has affected the health sector, socio-economic development, environment and quality of life. The non-communicable diseases have taken their toll, where 70% of deaths worldwide results from NCDs (WHO, 2022b). PA plays a significant role in managing and preventing obesity. Obesity it a leading cause to many systemic illnesses including NCDs. Research evidence has shown that regular PA reduces health risks linked with overweight and obesity (Blair & Brodney, 1999; WHO, 2018) Among many risk factors which are often linked with socio-economic status, physical inactivity and sedentary behavior are modifiable risk factors. NCDs significantly impact a country's economy due to expenditure on healthcare-related investigations and lifelong treatment as well as loss of productivity workforce due to premature mortality and morbidity (Bjørnaråa et al., 2017; Lee et al., 2012; Leon, 1997; WHO, 2022b). Empirical data shows that NCD prevention and control are achieved by addressing the modifiable risk factors (Rodgers et al.,2004). Prevention efforts include individual and community-level lifestyle modifications via interventions that address the modifiable risk factors and societal-level intervention on policy and guidelines. Existing research indicates that regular, adequate PA reduces the risks of developing NCDs and improves mental health and overall well-being (Leon, 1997; Maurice et al., 2018).

2.5 Problem Formulation

Health-promoting physical activity is considered a health benefit. Nevertheless, physical activity itself is a behavior influenced by many factors (Bauman et al., 2012; Sallis et al., 2006). Most of these factors are modifiable (Bauman et al., 2012). According to the social-ecological model (Sallis et al., 2006), many factors support PA. Exploring these demographic factors can provide insight and variations of health-promoting PA in the population and among subgroups (Bauman et al., 2012; Cochrane & Davey, 2008; Sallis et al., 2006). Demographic factors such as Gender, Age, occupation and education can influence an individual's awareness, access to resources, and opportunities for health-promoting PA (Lee & Park., 2021). Understanding these associations is necessary to establish health-promoting PA in the population. As explained in 2.1.1, health-promoting physical activity has numerous health-promoting benefits. (WHO, 2018).

Furthermore, exploring such entities and generating new knowledge will create opportunities for future research in developing interventions on health-promoting PA to develop policies to

increase health-promoting PA and reduce PA-related health disparities in the population. The Covid-19 pandemic is a global phenomenon that changed many lifestyle habits, including PA and related consequences. Remote working, which was encouraged and adhered to during Covid-19 pandemic as a protective measure, is a sustained practice that is continued even after the travel bans were withdrawn. Therefore, identifying demographic factors associated with health-promoting PA could help identify the PA-related health risks during the Covid-19 and provide knowledge and understanding of the subgroups (Hallal et al., 2012). Interventions and physical activity-promoting programs are effective when tailored to the population groups according to demographic characteristics and societal and cultural context (Schwarzer, 2008).

Even though Previous research based on socio-ecological models has shown that demographic factors such as Gender, Age, Occupation, and education level are associated with physical activity (Bauman, 2012; Cochrane & Davey, 2008; Solmon, 2015), there are significant societal and individual transformations, since the Covid-19 pandemic. Hence understanding the association between these factors and physical activity by observing and analysing population data during peaks of the Covid-19 pandemic would help identify the barriers and develop necessary interventions and policies to promote physical activity among the relevant identified subpopulations as the world have not yet fully recovered of the consequences and societal changes due to the Covid-19 pandemic.

3 AIM

The aim of the study was to determine the prevalence of health-promoting physical activity and explore the demographic factors associated with health-promoting physical activity in Swedish adults during the covid- 19 pandemic.

3.1 Research Questions

1. What was the prevalence of health-promoting physical activity, according to WHO guidelines, among Swedish adults during the Covid-19 pandemic?

2. Was health-promoting physical activity (according to WHO guidelines) associated with demographic factors in the adult Swedish population during the Covid-19 pandemic?

3. Did demographic factors predict health-promoting physical activity among Swedish adults during the Covid-19 pandemic?

4 METHOD

4.1 Methodological Approach

Quantitative studies collect and analyze numerical data using statistical and computational methodologies (Creswell, 2009). The Present study uses quantitative methodologies to explore the association of demographic factors and physical activity, and predictors of health-promoting PA during the Covid-19 pandemic. For this, the quantitative methodology is relevant and appropriate and social-ecological model is chosen as the theoretical guide (Sallis et al., 2015).

4.2 Study design

Study design is a cross-sectional population-based study using the data collected from the population at a specific point in time. The data on exposure and outcome variables are gathered simultaneously. (Creswell, 2009).

4.3 Sample and Data collection

The present study used data collected by a self-reported online questionnaire in December 2020, by participants gathered via survey management service for the research by Elvén et al. (2022). This was when Sweden experienced the second wave of the Covid-19 pandemic. The questionnaire included questions on demographic data, health status, remote working or studying percentage for a month, during pandemic and previous year when there was no Covid-19 pandemic. The International Physical Activity Questionnaire Short-Form (IPAQ-SF) was used to formulate the questions on PA levels and SB data during pandemic and before pandemic. Even though IPAQ-SF is used as a standardized self-reported measure of PA in populations the review by Lee et al. (2011) showed that correlation between the IPAQ-SF measures and objective measures of PA in large major studies were low, but the IPAQ-SF is largely used as a comparable measure.

The questionnaire also collected data on capability, motivation and opportunity for PA but not included in the present study. The questionnaire was sent to a Stratified sample of 2000 participants, based on sex gender and region of living where 1035 (51.7%) responded. Covid-19 confirmed cases peaked during this time in Sweden and various measures were taken to reduce the disease spread. Remote working and studying, social isolation and distance was encouraged during this time. (Elvén et al., 2022). The questionnaire was in Swedish Language, and sentences were individually translated to English with the use of a translator application

available through Google Services (did not upload documents but translated words and phrases when it was not clear) and clarified with students who are native Swedish speakers and the supervisor during initial preparations.

4.3.1 Main Sample

The main sample consists of participants residing in Sweden aged 18-79 years who filled the questionnaire mentioned above. Therefore, the main sample was 1035.

4.3.2 Analytical Sample

The analytical sample was extracted from the main sample with the criteria that suit the present study, focusing on health-promoting PA. WHO guideline on PA recommendation for adults aged 18-64 is the guide to demarcate the health-promoting PA (WHO, 2020) as Age 65 is the retirement age in Sweden. Regarding adults in the working age groups 18-64 years appears as logical and ideal for the study purpose. WHO guidelines for PA gives clear guidance demarcated for 18-64 years. The present study aims to analyze association of occupation, hence, the participants between the age 18-64 years representing the working adults, was chosen from the main sample which reduced sample size to 776.

4.4 Measures

4.4.1 Health-Promoting Physical Activity

In the present study health-promoting PA is the outcome variable of interest. Data on PA was collected with the International Physical activity questionnaire short form (IPAQ- SF) format, where the participants were given questions to assess the PA in three intensity levels which were, mild, moderate and vigorous. The questions focused on two different time zones: “before the pandemic” and “during pandemic”. Data analyzed for this study is the reported data on “during pandemic” time frame. The questions used for the present study is shown in (Appendix A) and the questions that were directed to the participants on the Moderate and Vigorous PA, are used in the present study. The Swedish Questions and the English translation are given in Appendix C. Mild intensity PA was measured with activities such as walking, moderate intensity as leisure cycling and gardening while vigorous intensity with aerobics and running. Participants reported the duration of PA, which was asked in minutes, hours, on a week and a day during pandemic. This study used, the moderate intensity PA minutes per week and Strenuous intensity PA minutes per week. Even though IPAQ-SF gives a common protocol to analyse PA levels in METs, individual energy consumption levels in accordance with WHO PA guideline can be identified through initial measurements in minutes (Karolinska Institute, 2015)

Health-promoting PA (HPPA) was defined with the WHO criteria for adults aged 18-64 years in four conditions below.

1. 150–300 minutes of moderate-intensity aerobic physical activity per week

2. at least 75–150 minutes of vigorous-intensity aerobic physical activity per week

3. 75-150 minutes of an equivalent combination of moderate- and vigorous-intensity activity throughout the week

4. Engaging in either one or more of the three previously mentioned PA is considered as HPPA. Based on the three previous levels, fourth condition was created.

The PA levels below the lower value of the above-mentioned range of PA time in minutes per week, were considered as none or inadequate PA, while values above the lower value of the range was considered as health-promoting PA (HPPA). Even though IPAQ-SF Questionnaire (Karolinska Institute 2015) allows to calculate PA intensity in Metabolic equivalent minutes (METs), the WHO guideline on health-promoting physical activity is explained in minutes; hence the reported minutes per week was taken as the variables for three PA conditions, Moderate-intensity PA (MIPA), Vigorous-intensity PA (VIPA) and combined moderate and vigorous PA (MVPA).

4.4.2 Gender

Gender was asked through the questionnaire and recorded as a categorical variable. There were three categories, “Male”, “Female” and “other”. No participant chose the category “other”; hence not used during the analysis.

4.4.3 Age

Age was collected as a numeric answer and ranged from 18- 79 in the main sample. Three categories from the primary data set were used as they share common characteristics. Yong adults (18-29 years), Middle-aged adults (30- 49 years) and older adults (50- 64) years of age. Age 64-79 years group was not used in this analysis as they are not included in the WHO PA guide for adults (WHO, 2020)

4.4.4 Education

Education level was answerable in four different options, which were Compulsory school (up to nine years), Senior high school, University and none mentioned. As there were an extremely small number of participants in the non-mentioned group, this was combined with the compulsory school for smooth analyzing and interpretive purposes.

4.4.5 Occupation

The occupation was questioned in the survey with seven options, these were translated and compared with the primary study by Elvén et al., 2022. Of these seven categories, some had very few observations, therefore similar categories were combined for analyzing purposes. E.g., Parental leave, Sick leave, retired persons, and job seekers in one category as they did not work). Five categories were made from these seven categories: Students/others, Manual workers, non-Manual workers, and self-employed. Leave/job seekers. Ten participants chose the option "others", and this group was combined with the students' group which had the lowest number of participants (87) compared to other groups. This new group was called students/others in the present study.

4.4.6 Remote Working/Studying

Remote working or studying was recorded in percentages. The questionnaire asked the participants to write the percentage they worked from home or studied from home during a month, during the Covid-19 pandemic.

"1. What percentage have you worked from home / studied at a distance in the past month? (0-100%) _____% or I have not worked / studied in the last month.

Then these percentages of working from home for a month during the Covid-19 pandemic were further grouped according to the among of remote working or studying as in Fukushima et al. (2021) for smooth analysis and comparing purposes (0%-24%, 25- 49 %, 50- 74%, 75-100%).

4.5 Methods of Analysis

The analysis was conducted with IBM SPSS statistics (version 28; IBM SPSS, Armonk, NY, USA). Screened the data for any missing values, outliers and normality and found that the "during pandemic remote working/ studying" variable had missing values (272) and outliers. Descriptive statistical analysis was performed for the sociodemographic data of the main and analytical samples. The analytical sample was limited to participants within the age limit of 18-64 years. Frequencies and percentages were analyzed for categorical variables, and central tendencies (mean, median) were analyzed for the continuous variables. Statistical significance was determined at $p < 0.05$ in all the analyses.

For the first research question, Descriptives of each health-promoting PA level were analyzed to explore the prevalence of health-promoting PA. The PA levels were recorded in minutes, and therefore PA variables were dichotomized under two conditions where one group had the adequate level (number of minutes per week) of health-promoting PA (HPPA), and the other had None or Inadequate PA.

1. 150–300 minutes of moderate-intensity aerobic physical activity per week (MIPA)
   HPPA ≥ 150 minutes per week

None or inadequate PA - ≤149 minutes per week

2. at least 75–150 minutes of vigorous-intensity aerobic physical activity per week (VIPA)
HPPA - ≥ 75 minutes per week
None or inadequate PA - ≤74 minutes per week

3. 75-150 minutes of an equivalent combination of moderate- and vigorous-intensity activity throughout the week (MVPA)
HPPA - ≥ 75minutes per week
None or inadequate PA - ≤74 minutes per week

4. All-HPPA - Engaging in either one or more of the three previously mentioned PA levels (VIPA, MIPA, MVPA) HPPA is considered as HPPA in this category. Hence the fourth condition was created. WHO explains that an individual with either of these three PA levels is considered to have health-promoting PA. With this condition intact, a new variable was formed, named "All-HPPA", including all who fulfilled either one or more of the above three conditions.
Analytical samples were then examined to analyze the necessary data on the research questions.

The second research question was to individually identify the association between health-promoting PA (dependent variables) and demographic factors (independent variables). Independent variables in the present study are the demographic variables which are Gender, Age, Education and Occupation. Remote working or working from home was also taken as an independent variable for research question one; therefore, the percentage of working from home during pandemic was taken as a separate variable in the analysis. Finally, analyze each of the independent variables (the demographic factors and remote work/study) and the levels of PA according to WHO criteria on health-promoting PA.

As gender, age groups (age groups were made from the continuous variable), education level, occupation and the remote working/studying variable were categorial, and the dependent variable was dichotomous (health-promoting PA or None/inadequate PA) variable that fits the study condition Chi-Square test for independence was performed. The chi-square test for independence explores the relationship between two categorical variables (Field, 2018; Pallant, 2016). health-promoting PA level variables were dichotomous. Therefore, chi-square analysis explored the association of independent categorical variables with each PA level, moderate-intensity, Vigorous intensity, Moderate & vigorous combined, and the overall health-promoting PA level. The strength of association was analyzed using Cramer's V as explained by Cohen (1992) and guidelines retrieved from the IBM website (IBM, 2023) Effect size (ES) ≤ 0.2 weakly associated, 0.2 < to ≤ 0.6 -moderately associated, ES > 0.6 - strongly associated. Assumptions such as 'minimum expected cell frequency' were not violated (Field, 2018; Pallant, 2016). For effect size, the phi coefficient value was used for a 2x2 table and Cramer's V when there are more than two levels in a categorical variable (Field, 2018).

The third research question explored the predictors of physical activity from the demographic variables analyzed for association independently in the second question. Binary logistic regression analysis was used to determine the predictors of health-promoting PA.

Since the outcome variable “One or more health-promoting PA” is dichotomous as yes or no, binary logistic regression could help explore the predictive ability of the independent variables, which are demographic factors in the present study (Pallant, 2016). Even though the Working/Studying from home variable was analyzed as an independent variable in the research question, it was not further included in the binary logistic analysis due to many missing data revealed in the beginning (35.1%). The independent variables considered in this analysis are Gender, Age groups, educational level and occupation, which are categorical. These factors are chosen based on theoretical and empirical considerations through the social-ecological model (Sallis et al., 2015). Gender was chosen as the first predictor, followed by Age, Occupation level and Education level. A hierarchical regression method was used when adding predictors (Field, 2018). First, multicollinearity was checked as there is a risk of correlating two or more predictor variables (Field, 2018). Checking for high variance inflation factors (VIFs) and variance proportion output suggested no multicollinearity was associated with the predictor variables.

4.6 Ethical considerations

Ethical considerations are an essential aspect of research, which ensures the protection of the study participants' welfare and rights while ensuring the validity and reliability of the research findings by providing professional standards of conduct. Research brings in new knowledge and provides solidity for forecasting that can bring goodness and benefits to humankind (Swedish Research Council, 2017). Vital ethical considerations include informed consent, confidentiality & privacy, protection of participants and data, and legal and regulatory compliance (World Medical Association, 2013). The present study uses secondary data from the research published by Elvén et al. (2022). The researchers have gathered information through the survey management agency via an online questionnaire. Participants were granted their informed written consent, and the data was saved with an anonymous identity. The researchers did not receive any personal identification information that could link to any living person (The Swedish Research Council, 2017). For the present study, relevant questions that linked to variables in the study were received from the initial data set with anonymous identification numbers that protect the privacy and confidentiality of the study participants (Creswell, 2009). Storage of data and use during analysis was guided and followed according to General Data Protection Regulation (GDPR, MDU) by the education institute. Data was stored only in the secure storage, password-protected computer of the researcher with the permission of the primary research group, Elvén et al. (2022). No data was uploaded, stored or shared in digital storage space. Received data will be permanently deleted once the research purposes have been served.

5 RESULTS

5.1 Descriptive of the Main sample and Analytical Sample

Description of the main and analytical samples is given in Table 1. The main sample data was acquired during Covid-19 pandemic and included participants of 18-79 years of age. The analytical sample acquired from the main sample consisted of adults aged 18-64 years (N=776) that fits the WHO PA guideline (WHO, 2020). The mean age of the main sample was 50.6 years and the analytical sample 43.6 years.

Table 1: Descriptive characteristics of the Main sample and analytical sample

Characteristics	**Main Sample n(%)**	**Analytical sample 18-64 years n(%)**
	N= 1035	N= 776
Gender		
Male	523 (50.5)	390 (50.3)
Female	512 (49.5)	386 (49.7)
Occupation		
Students/others	97 (9.4)	93 (12)
Manual Workers	230 (22.2)	225 (29)
non-Manual workers	336 (32.5)	328 (42.3)
Self-employed	63 (6.1)	51(6.6)
Leave/job seekers	309 (29.9)	79 (10.2)
Highest education		
Compulsory school (9 years)	68 (6.6)	38 (4.9)
Senior high school	421 (40.7)	330 (42.5)
University	546 (52.8)	408 (52.6)
Age groups (years)		
18 - 29	171 (16.5)	171 (22)
30 - 49	317 (30.6)	317 (40.9)
50 - 64	288 (27.8)	288 (37.1)
65 -79	259 (25.0)	-
Remote working/studying		
0 -24%	302 (29.2)	225 (29)
25 - 49%	37 (3.6)	29 (3.7)
50 - 74%	55 (5.3)	39 (5)
75 - 100%	292 (28.2)	211 (27.2)
Missing	349 (33.7)	272 (35.1)

5.2 Prevalence of Health-Promoting Physical Activity

Health-promoting PA criteria according to WHO guideline is shown in Table 2. The descriptive analyses revealed nearly 67% of the group did not engage in vigorous intensity HPPA and 62% of the cohort did not have HPPA in moderate intensity. However, nearly 50% had health-promoting PA when Moderate and vigorous intensity PA was combined. Then the cohort was analyzed for having All-HPPA and nearly 55% of the cohort had HPPA according to WHO PA guideline for adults ages 18-64 years of age (WHO, 2020); which answers the first research question, the prevalence of health-promoting activity among Swedish adults 54.9%.

Table 2. Descriptives of health-promoting PA according the WHO guideline (WHO, 2020)

Groups (N=776)	Vigorous Intensity PA n,(%)	Moderate Intensity PA, n(%)	Moderate and vigorous intensity PA , n (%)	All-HPPA n (%)
No or inadequate PA	521 (67.1)	482 (62.1)	379 (48.8)	350 (45.1)
HPPA	255 (32.9)	294 (37.9)	397 (51.2)	426 (54.9)

PA- Physical activity, HPPA- Health-promoting physical activity,

5.3 Associations between Demographic Factors, Remote working/Studying, and Health-Promoting Physical Activity

The second research question explored the association of demographic factors with health-promoting PA during the Covid-19 pandemic in Sweden among the adult population. The analytical sample was explored for the available demographic factors, also included in the social-ecological model (Sallis, 2006). Table 3 shows the results of a chi-square test of independence, where the relationship between dependent and independent variables was analyzed.

A significant associations were revealed between Gender and Moderate intensity PA, ($\chi^2(1, N = 776) = 10.84$, $p < .001$, Cramer's v = 0.118) Moderate and Vigorous Intensity PA ($\chi^2(1, N = 776) = 12.36$, $p < .001$, Cramer's V = 0.126) and All-HPPA. PA levels ($\chi^2(1, N = 776) = 12.91$, $p < .001$, Cramer's V= 0.129). Males reported a higher percentage of HPPA than females in all four WHO (2020) PA variables compared to females. This difference was significant in MIPA, MVPA and All-HPPA but not in VIPA. Cramer's V value indicated a weak association in all four HPPA levels. The association between Vigorous intensity PA and gender was not statistically significant.

Occupation groups revealed significant associations between MIPA ($\chi^2(4, N = 776) = 13.91$, p 0.008, Cramer's V=0.134) and MVPA ($\chi^2(4, N = 776) = 9.846$, p 0.043). Residual analysis showed that the non-Manual workers' group with the lowest HPPA contributed the most to

this significant association. Cramer's V showed that the association was week in all four PA conditions according to WHO PA guidelines (WHO, 2020).
PA levels differed among age groups, where the highest proportions of HPPA were seen in the 18 to 29 age group in MIPA, MVPA and VIPA, HPPA, but this difference was not statistically significant. Cramer's Value showed that the effect size was weak in all four conditions of PA.
Education-level students and self-employed groups had the highest recorded proportions of HPPA in four PA conditions according to WHO PA guidelines (WHO, 2020), but this difference was not statistically significant.
Remote working/studying variables (n= 504) and HPPA groups showed no significant association. Those who worked/studied from home >50% up to 74% had high levels of HPPA in MIPA, MVPA and All-HPPA, but this difference was not statistically significant.

Table 3: Results of the Chi-Square independence test between demographic factors and physical activity variables

	VIPA HPPA	*p*	MIPA HPPA	*p*	MVPA HPPA	*p*	All-HPPA HPPA	*p*
Gender (n=776)		*0.070*		***0.001***		***<0.001***		***<0.001***
Male	140 (35.9%)		170 (43.6%)		224 (57.4%)		239 (61.3%)	
Female	115 (29.8%)		124 (32.1%)		173(44.8%)		187 (48.4%)	
Age Groups (n=776)		*0.394*		*0.572*		*0.900*		*0.787*
18to29	62 (36.3%)		62 (36.3%)		90 (52.6%)		97 (56.7%)	
30to49	106 (33.4%)		116 (36.6%)		160 (50.5%)		175 (55.2%)	
50to64	87 (30.2%)		116 (40.3%)		147 (51.0%)		154 (53.5%)	
Occupation level (n=776)		*0.459*		***0.008***		***0.043***		0.898
Student/others	36 (38.7%)		40 (43.0%)		54 (58.1%)		59 (63.4%)	
Manual Workers	71 (31.6%)		101 (44.9%)		126 (56.0%)		131 (58.2%)	
non-Manual workers	100 (30.5%)		101 (30.8%)		147 (44.8%)		161 (49.1%)	
Self-employed	20 (39.2%)		23 (45.1%)		29 (56.9%)		31 (60.8%)	
Leave/jobseekers	28 (35.4%)		29 (36.7%)		41 (51.9%)		44 (55.7%)	
Education (n=776)		0.626		0.488		0.712		0.062
None/Elementary	10 (26.3%)		14 (36.8%)		20 (52.6%)		20 (52.6%)	
Senior High School	107 (32.4%)		133 (40.3%)		174 (52.7%)		184 (55.8%)	
University /College	138 (33.8%)		147 (36.0%)		203 (49.8%)		222 (54.4%)	
Remote working/ studying (n=504)		*0.108*		*0.479*		*0.058*		*0.079*
0-24%	76 (33.8%)		94 (41.8%)		123 (54.7%)		130 (57.8%)	
25-49%	9 (31.0%)		9 (31.0%)		14(48.3%)		15 (51.7%)	
50-74%	19 (48.7%)		15 (38.5%)		25 (64.1%)		27 (69.2%)	
75-100%	61 (28.9%)		75 (35.5%)		94 (44.5%)		104 (49.3%)	

VIPA- Vigorous Intensity physical activity, MIPA- moderate-intensity PA, MVPA- moderate and vigorous intensity PA, All-HPPA- either one or more of health-promoting physical activity, p= Pearson's chi-square

5.4 Demographic Factors Determining Health-Promoting Physical Activity

The third research question aimed to analyze the factors predicting health-promoting PA during Covid-19 pandemic. The binary logistic regression model with three independent variables was significant ($\chi2(7) = 25.154$, $p<.001$), indicating that the independent variables, Gender, Age groups and Occupation, were able to predict the dependent variable, which is the "All health-promoting PA". Starting with Gender ($\chi2(1) = 12.95$, $p<.001$), adding of age improved the model ($\chi2(3) = 14.28$, $p<.001$).Even though Education levels were added in the initial hierarchical method to choose the most suitable model (Field, 2018), adding Education level did not improve the model; therefore, the model with three predictors was chosen. The overall accuracy of the model was 60.3%.

Table 4 shows the coefficients standard errors and significant levels of the independent variables Gender, Age groups and Occupation levels in the model. Gender and Occupation level were significant predictors of HPPA. In gender, the odds of having HPPA were lower in females (OR = 0.56, 95% CI 0.42- 0.75, p= .003) than in males during Covid-19 pandemic. In the occupation group, the odds of having HPPA were lower in "non-Manual workers" (OR= 0.47, 95% CI, 0.27- 0.81 p=.007) than in the student/others group during the Covid-19 pandemic.

Table 4. Association between demographic factors ~~prediction~~ All health-promoting physical activity analyzed by binary logistic regression.

	B	S.E.	Odds Ratio	95% C.I.for EXP(B)	
				Lower	Upper
Include					
Constant	0.88	0.24	2.42		
Gender					
Male	Reference				
Female	-0.58*	0.15	0.56	0.42	0.75
Age groups					
18- 29	Reference				
30- 49	0.17	0.22	1.183	0.77	1.820
50-64	0.04	0.23	1.039	0.67	1.616
Occupation					
Student and others	Reference				
Manual Workers	-0.31	0.28	0.74	0.43	1.26
non-Manual workers	-0.76**	0.28	0.47	0.27	0.81
Self-employed	-0.35	0.39	0.71	0.33	1.51
Leave/jobseekers	-0.38	0.34	0.69	0.35	1.34

Note R2 = 5.72(Hosmer–Lemeshow), 0.032 (Cox & Snell) 0.043 (Nagelkerke). Model $\chi2$ (2) = 25.15, p = <.001. *p <.001, **p= 0.007. (Abbreviations, HPPA- Health-promoting physical activity, SE – Standard Error, C.I. – Confidence interval).

The model's ability to correctly classify cases into positive and negative categories based on the predicted probability of the outcome variable can be measured by sensitivity and specificity (Field., 2018). Regarding the outcome of the present model (HPPA according to

WHO), the sensitivity (0.60) and specificity (0.59) are similar, which indicates that the model is equally good at correctly identifying cases with the outcome of interest (HPPA) and without the outcome of interest (None or inadequate PA) (see Appendix. , Table 5)

6 DISCUSSION

The study aimed to explore the association of demographic factors with health-promoting PA. The main findings of the present study were that 55% of Swedish adults engaged in HPPA according to WHO guidelines and that Gender and occupation were associated with HPPA. Regarding gender and health-promoting PA, Females had a lower HPPA when compared to males. This difference was significant in moderate-intensity PA, moderate and vigorous-intensity PA, and All-HPPA. Regarding Occupation and health promoting-PA, a significant association was seen in the Moderate intensity PA and Moderate and vigorous combined intensity PA, and the non-Manual workers ' group had the lowest level of HPPA. In addition, health-promoting physical activity was low among females and non-Manual workers compared to males and students/others.

6.1 Result Discussion

Unlike many other countries, Sweden did not have a strict lockdown, social isolation, or follow a containment method for those infected with the Covid-19 virus (Swedish Institute, 2022). The data analyzed here are from the time when Swedish public health concerns were raised, and recommendations encouraged the population to practice remote working/studying and social distancing (Elvén et al., 2022). So, the results are subjected to the timeline where social distance and remote working were recommended and practiced in Sweden. In the analytical sample, about 2/3 of adults did >25% of remote working during a month. The mean age of the analytical sample was 47.3. The distribution of males and females was equal across the sample, where 50.3% were males. In the occupation group, 2/3 of the participants were non-Manual workers; in the education group, half of the participants had a university or higher education.

Health-promoting physical activity prevents the development of NCDs, such as cardiovascular diseases, hypertension, diabetes mellitus, some types of cancers, and obesity (WHO, 2018). According to the WHO fact sheet 2016, 28% of adults had not had health-promoting PA as per WHO guidelines (WHO, 2022b). in comparison, the present study revealed 45.1 % with no or inadequate PA, which is higher than the global values but non-comparable as the worldwide data was acquired before the Covid-19 pandemic. A study that analyzed multinational survey data from 14 countries showed that, compared to pre-restrictions (Covid-19 related) HPPA as per WHO guidelines, declined by 41% in Moderate to Vigorous PA and 42% in Vigorous PA during post-restrictions times (Wilke et al., 2021). In the present study, None or Inadequate

PA in MVPA (48.8%) was closer to what Wilke et al. (2021) reported but higher in VIPA (67.1%).

The evidence shows that the global reduction of HPPA is partly due to high sedentary behavior in workplaces and homes and partly due to the Covid-19 pandemic-related restrictions (WHO, 2022a; WHO, 2022b; Wilke et al., 2021). There is growing evidence on reduced PA levels globally during the Covid-19 Pandemic (Brito et al., 2021; Elvén et al., 2022; Wilke et al., 2021). In the present study, descriptive analysis of Health-promoting PA revealed that about one-third of the sample had engaged with HPPA in VIPA and MIPA, and half of the sample had health-promoting PA in the levels of Vigorous and moderate combined (MVPA) and All-HPPA. However, population-based studies reported overall reduced PA during the Covid-19 pandemic, even in the primary study of the current data set (Elvén et al., 2022), where every second person reduced their total PA level during the Covid-19 pandemic. Even though not restricted to travel, some studies revealed that people restricted themselves to homes for fear of getting infected or of exhaustion due to infection (Pierce et al., 2020). In contrast, a cross-sectional study by Brattlöf et al. (2023) analyzed survey data from 2018 & 2021, which revealed an increase in PA among the Swedish population, but the survey data from 2020 was not included (the present study uses data from 2020).

When demographic factors were analyzed individually with the health-promoting PA levels as intended in the second research question, a significant association was seen in gender and health-promoting PA, specifically on Moderate-intensity PA, Moderate & Vigorous Intensity PA, and All-HPPA conditions. The difference between male and female were seen when nearly 61.3% of males in the group engaged with any of three health-promoting PA levels (All-HPPA), compared to 48.4% in women. Similar results on male and female groups have been seen in research during the Covid-19 pandemic in Saudi Arabia, where gender was associated with the type and level of PA (Alqahtani et al.,2021). Even though there are social and cultural factors hindering PA among females, evidence shows that Females were found to be engaged with low levels of PA (Béghin et al., 2019; Eime et al., 2018; Guthold et al., 2018; McCarthy & Warne, 2022; Matthews et al., 2022). A study on population-based surveys of PA from 168 countries revealed that the highest levels of physical inactivity in the year 2016 were women from high-income Western countries, Latin America, and South Asia (Guthold et al., 2018). In contrast to global evidence, Brattlöf et al. (2023) reported that females engaged with more PA (According to WHO guidelines) than males in 2018 and 2021 in Sweden.

The Covid-19 pandemic resulted in a shift of workplaces to homes which in return provided flexible working hours and was said to have provided work-life balance. Some studies have reported that female employees who remotely worked during the pandemic had low levels of PA than males (Gonzales et al., 2022; Lopez-Bueno et al., 2020) A study in Spain reported specifically on low, moderate to vigorous PA and high sedentary behavior compared to those who did not remotely work (Lopez-Bueno et al., 2020); this may be caused by multiple factors that have been highlighted during the Covid-19 pandemic where remote working conditions applied, such as reduced opportunities for PA during work time, household duties, daily routines, and lack of usual PA related to travel as Sweden is a country with active travel PA

such as walking and cycling to work (Blom et al., 2020). Sweden is a country where the prevalence of reaching recommended PA levels was reported as 67% for males and 65% for females (Sweden PA fact sheet, 2014), which was before the Covid-19 pandemic but in the present study, HPPA was lower in females (48.4%) while males had 61% closer to the prevalence reported in a fact sheet (WHO EU, 2021).

Even though descriptive data revealed that half of the analytical sample had engaged in HPPA in one or more physical activity level (VIPA, MIPA & MVPA) in all three age groups, the differences between age groups were not statistically significant. Swedish fact sheet 2021, which was published with National public survey data of 2020, revealed higher values than the present cohort results, where 72% of 16-29 years, 70% of 30- 44 years and 66% of 45-64 years of the population had sufficient physical activity levels (WHO EU, 2021), also noticed that the age limit of the groups was slightly different to the present study. Research evidence shows that physical activity reduces with ageing (Bauman et al., 2012; Dayi et al., 2017; Lee & Park., 2021), while a study on Swedish population shows elderly between 65-84 years of age were more physically active than younger age groups in 2018 and 2021(Brattlöf et al., 2023). However, the present study findings show no significant association between age and health-promoting physical activity.

Occupation level is associated with health-promoting physical activity in moderate-intensity PA and combined moderate & vigorous-intensity PA levels. When HPPA was observed in each occupation variable category, less than 45% engaged in moderate-intensity HPPA, and one-third engaged with Vigorous intensity HPPA. Even though a study in Saudi Arabia during the Covid-19 showed occupation significantly predicted the recommended HPPA, according to WHO, in MVPA and in the present study, the group which was more likely to meet the recommended HPPA was unemployed (Alqahtani et al., 2022). Blom et al. (2020) explained that workers' PA was reduced during the pandemic due to changes in lifestyle habits, where they reported a 26% reduction during the first wave and 20% in the second wave. The non-Manual workers' category had the lowest recorded HPPA, and the students/others category had the highest HPPA compared to other occupational categories in this variable. A significant association was seen among occupation and health-promoting PA levels in moderate intensity and Moderate and vigorous combined intensity HPPA levels.

Remote working situations, lockdowns, and travel restrictions differed among countries. Even though there were missing values, the sample in the present study was analyzed for the remote working situation and revealed that those who engaged 75-100% of remote working had the lowest HPPA, but this difference was not statistically significant. A study by Fukushima et al. (2021) which analyzed the proportions of remote-working groups, revealed that workers with>50% remote working had significantly prolonged uninterrupted sedentary behavior and reduced PA. Studies conducted on remote studying have also revealed reduced PA and increased SB among student populations observed (López-Valenciano, 2021; Romero-Blanco, 2020). Evidence from recent studies and systematic reviews revealed that remote working has increased since the Covid-19 pandemic and has caused a reduction in PA among remote workers (Argus & Pasuka, 2021; Crane et al.,2023; Kooshari et al., 2021; Ráthonyi et al., 2021;

Wilms et al., 2022). Since remote working is a practice sustained even after the restrictions of the Covid-19 pandemic were lifted, raising awareness and concerns about health risks bound with low PA levels and SB is essential.

Multiple studies have shown that the level of education significantly associates with PA (Bauman et al.,2012; Lee & Park, 2021); these studies indicated that those with high education levels engaged less in HPPA, but the present study did not find any significant association. A cross-sectional study in Sweden on PA revealed that those with high education levels with low occupation levels did adequate PA (according to WHO guidelines, 2020)in 2018 and 2021 (Brattlöf et al., 2023).

The social-ecological model recognizes multiple interacting domains which contribute to physical activity. To analyze the third question, which explored the association of demographic factors and health-promoting PA, a model was utilized with the available secondary data that described some demographic characteristics. Gender, Age, Education level and occupation have been recognized as factors that influence or affect PA by numerous studies (Alqahtani et al., 2021; Cochrane & Davey, 2008; Lee & Park, 2021; Wang et al., 2020). The Study by Alqahtani et al. (2021) and Lee & Park (2021) revealed that males had a significantly higher PA than females, and the present study is in line with these findings concerning males where females engaged less in HPPA. Another observation is that in the present study, the non-Manual workers' group had a reduced likelihood to engage in HPPA; these findings were in line with the existing research findings of individual association of gender and occupation with HPPA (Alqahtani et al., 2021; Eime et al., 2018). Some studies highlighted that unemployed individuals were more likely to meet the WHO recommendation of Moderate and vigorous PA than the employed (Alqahtani et al., 2021; Lee & Park et al., 2021). However, the population in the study by Alqahtani et al. (2021) and Lee & Park (2021) was socio-economically and culturally different from the present study population. The present study used the social-ecological model to understand the complex structure of factors influencing PA. However, the demographic factors analyzed and presented in this study cannot alone define or determine an individual's physical activity. The Covid-19 pandemic was a massive environmental, societal transforming factor that was also subjected to the time frame of this study. However, other individual factors were not explored in this study, such as individuals' motives, self-efficacy, and psychosocial well-being; therefore, future research can be structured to explore more of these domains unexplored through the present study.

6.2 Methods Discussion, Strengths, and Limitations

The present study explored the association between health-promoting physical activity and demographic factors using numerical data via statistical analysis (Creswell, 2009). The sample size is important when considering the reliability and generalizability of the findings. A larger sample size would provide more precise and reliable estimates of the population and can reduce the margin of error. A strength of the present study is the relatively large sample size. Even though the analytical sample of the study was further reduced because cases within the

18-64 age groups were selected, the demographic characteristics and proportions were quite similar to the main sample. The sample was stratified based on age, gender, and region or location in Sweden; therefore, a comparable sample with many population subgroups was acquired during initial sample collection. Stratified sampling helps reduce selection bias (Creswell, 2009). However, weighted analysis was not done to adjust for imbalances in sample characteristics or to account for the representation of different groups in the population, as this method was not included in the quantitative syllabus in the master's course. Data were collected when Sweden experienced the second wave of the Covid-19 pandemic; therefore, the time zone was suitable for the present study. The questionnaire had a repetition of similar questions, which allowed cross-checking of the accuracy of data when comparing the answers given for the same question in different formats, e.g., time spent moderate PA in minutes/ hours/daily and weekly (See appendix A). Therefore, the questionnaire provided adequate answers to gather all conditions that add up to health-promoting physical activity, according to WHO guidelines.

Ethical guidelines ensure the protection of participants, their information, and also the research data. The data analyzed in the present study is from a research group, Elvén et al. (2022), who carried out their research in accordance with the guidelines provided by Helsinki Declaration (World Medical Association, 2013). Furthermore, a survey management service conducted the primary survey, and the identities of the participants always remained anonymous. They were not even revealed to the previous researchers (Elvén et al., 2022), which protected the privacy of the participants. Furthermore, secure storing of research data was carried out throughout the analysis, where no data was shared or stored in any public domain or servers. This is an essential aspect to consider as the privacy of the participants should be intact at all times (World Medical Association, 2013), and the present study was conducted abiding with the ethical guidelines and values; therefore, is a strength for this research.

However, there are some limitations to be acknowledged. The main limitation of the study is the self-reported measurements of PA. As it required to report the physical activity in minutes and hours by the participants, the data would be subjected to recall bias. Even though this study used IPAQ-SF, Colley et al. (2018) have shown that self-reported data had over-reported PA values. The use of an accelerometer is effective and reduces recall bias during different study designs, but it cannot be used in a survey when participants are contacted online.

Another limitation of the cross-sectional study design is the difficulty in establishing the direction and causality of the variables. However, it allows for establishing an association between variables at a single point in time. The present study uses secondary data from a previous study. Therefore, retrieving further information on data was limited during the analysis. There were comparatively high numbers of missing data in the Remote working/studying variable, which limited the inclusion of it in the regression analysis. The question was not specifically on remote working but also studying; therefore, it was difficult to demarcate studying and working. Another difficulty is to demarcate between no respondents (missing data) and respondents who marked 0% for the amount of worked/studied from home.

One of the significant transformations during the Covid-19, globally, was the adoption of 'Working from home'; therefore, being unable to explore this further due to inaccurate data is a limitation in the present study.

Even though sedentary behavior (SB) also closely connects with physical activity, SB was not analyzed or included in this study due to a lack of clarity, as sedentary behavior was recorded as sitting time. However, "sitting time" refers to leisure and occupational sitting, but immobile time is not mentioned clearly (Some may work standing up). Therefore, SB was not included in the study because there was no clear demarcation of occupational or leisure sedentary time.

The social-ecological model (Sallis et al., 2006) is a widely used framework that emphasizes multi-level predictors of PA in five domains: individual, interpersonal, community, environmental and policy. In addition, this model considers the complex interplay between the said domains. However, even though the present study is based on the social-ecological model, due to limited time and availability of secondary data, the present study only explores the demographic factors in the intrapersonal domain of the social-ecological model of PA (Sallis et al., 2015). Furthermore, environmental, societal, and policy-level factors that could influence PA were not explored in the current study; therefore, all the domains of the social-ecological model were not explored.

Another limitation is the lack of data on potential confounders for physical inactivity, such as disability and morbidities. Even though chronic illnesses were questioned, type, disease, or severity were unavailable, along with missing data.

Generalizability – present study explores the prevalence and demographic factors associated with health-promoting PA among Swedish adults aged 18-64 during the Covid-19 pandemic. Previous studies carried out during the Covid-19 pandemic on the said topic showed similar associations as the present study results; therefore, it has a fair chance of generalizability but needs further exploration. Nevertheless, during initial data collection and analysis, Elvén et al., 2021 stated that the main sample had 485 drop out of participants and a relatively high number of participants in the university education group compared to the Swedish population (Elvén et al., 2022); hence present sample might further differ from the general population.

6.3 Public Health Relevance and Further Research

Physical activity is a modifiable factor that could be influenced to create positive health impacts without significant expenditure or resources (Rippe, 2018; WHO, 2018). Encouraging physical activity among adults brings unique benefits improving physical and mental health and overall well-being along with socioeconomic and environmental benefits as explained and included in sustainable development goals (UN, 2015).

Social-ecological models (SEM) depict physical activity's influencing or promoting factors (Sallis et al., 2015). Even though the present study explored a few demographic factors in the individual domain of the SEM, the evidence and information gathered could pave new research

areas in health-promoting physical activity. As the existing research based on SEM explains, the elements in the domains differ due to the diversity of populations, therefore population-based research in public health helps to provide evidence-based guidelines and recommendations unique and appropriate for the studied population and subgroups. Sallis et al. (2006) show that PA differs across communities due to type and settings such as workplace, transportation, schools, and elderly homes; therefore, all the domains of SEM are important to consider so that no disparities exist. Based on this evidence, Guidelines, recommendations, and actions could be planned that improve population health. Research evidence on factors predicting HPPA could be influential in formulating health promotion strategies where determinants and barriers could be identified; for example, this evidence could be used to direct physical activity promotions toward the subgroups without health-promoting PA (Sallis et al., 2020). In the present study, low levels of HPPA were seen among the female gender during the Covid-19 pandemic. Future research could be oriented toward exploring the other domains that could also affect HPPA among females in the population.

As working from home is a sustained practice, further research on the working community could help reduce the health-related risks brought in via physical inactivity. Therefore, new adapted remote working practices and lifestyle habits should be explored further in future research (Ipsen et al., 2021; Ráthonyi et al., 2021). The study revealed significant results in non-Manual workers compared to other occupational groups. Non-manual workers are the workforce that does not engage in any form of physical activity during their work. Hence this is an important aspect to consider as manual work has been replaced by machines with increased technology-based jobs that require more sitting time (Ráthonyi et al., 2021; Tavares, 2017). The economic burden and social impact of physical inactivity are broadly discussed in considerable research (Bjørnarå et al., 2017; Daneshmandi et al., 2016; Lee et al., 2012; Leon, 1997; UN, 2015). The study by Brattlöf et al. (2023) revealed that those born and raised in Sweden had adequate health-promoting PA than those not born in Sweden. Therefore, another important factor to consider in future research as Sweden is a country that has immigrant subgroups. Research oriented on health-promoting physical activity, as the present study, could provide evidence of the potential economic impact of healthcare costs for public health professionals and policymakers; they can provide cost-effective, healthy work-related policies and guidelines (WHO, 2018). Obesity and overweight have been reported to be increasing in Sweden, where the Swedish public agency states that 50% of adults in Sweden are overweight or obese (Public Health Agency, 2018) and Statista (2023) reports 36% of overweight and 16% of obesity among Swedish adults based on survey data. Promoting PA is a dire need to tackle obesity; therefore, identifying populations and subgroups who lack health-promoting physical activity could be ideal in future research. Nevertheless, the research on health-promoting lifestyle habits contributes to surveillance to identify work-related trends and variations among different populations; thus, it helps to evaluate the impact of environmental disasters such as the Covid-19 pandemic and guide the interventions on target populations (Kooshari et al., 2021; Wang et al., 2020).

7 CONCLUSIONS

Health-promoting physical activity was seen among 55% of the study population of adults in Sweden during the Covid-19 pandemic. Demographic factors such as gender and occupation were associated with physical activity. Female gender, compared to males, had lower health-promoting physical activity, and non-Manual workers, compared to other groups, had significantly lower health-promoting physical activity levels during the Covid-19 pandemic. In addition, health-promoting physical activity was lower among females and non-Manual workers compared to males and students/others.

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APPENDICES

Appendix A

Questions used in the present study to create variables, from the Questionnaire by Elvéns et al., 2022.

1. What is your main occupation?
2. What percentage have you worked from home / studied at a distance in the past month? (0-100%) Share:
3. In the last 7 days, how many of these days did you perform work that was very strenuous?
4. How much time did you spend, on average during such a day, on very strenuous physical activity? Number of minutes:
5. How much time did you spend, on average during such a day, on very strenuous physical activity? Number of minutes:
6. In the last 7 days, how many of these days have you done work that is moderately strenuous (not walking)?
7. How much time did you spend, on average during such a day, on moderately strenuous physical activity? Number of hours:
8. How much time do you spend, on average during such a day, on moderately strenuous physical activity? Number of minutes:
9. During a normal week a year ago, how many of these days did you perform work that was moderately strenuous?
10. How much time did you spend, on average during such a day, on moderately strenuous physical activity? Number of hours:
11. How much time did you spend, on average during such a day, on moderately strenuous physical activity? Number of minutes:
12. During the last 7 days, how many days have you walked for at least 10 minutes straight?
13. How much time did you spend, on average, on such a day, on walks? Number of hours:
14. How much time did you spend, on average, on such a day, on walks? Number of minutes:
15. During a normal week a year ago, how many days did you walk for at least 10 minutes straight?
16. How much time did you spend, on average, on such a day, on walks? Number of hours:
17. How much time did you spend, on average, on such a day, on walks? Number of minutes:
18. In the last 7 days, how much time did you spend sitting on such a day? Number of hours:

19. In the last 7 days, how much time did you spend sitting on such a day? Number of minutes:
20. During a normal week a year ago, how much time did you spend sitting on such a day? Number of hours:
21. During a normal week a year ago, how much time did you spend sitting on such a day? Number of minutes:

22. Gender
23. Age
24. Enter your highest completed education:
25. Main occupation:
26. Very strenuous physical activity - Number of minutes per week NOW
27. Moderately strenuous physical activity - Number of minutes per week NOW
28. Walk - Number of minutes per week NOW

Appendix B

Table 5. Classification table of the chosen model.

		None	HPPA (either of the three)	Percentage correct
None		130	220	37.1
HPPA (Either of the three)		88	338	79.3
Overall Percentage				60.6

Appendix C

Physical activity questions from the Questionnaire used in primary study by Elvén et al., 2022.

Fråga 1
Tänk nu på alla de mycket ansträngande aktiviteter du utför.
Mycket ansträngande fysisk aktivitet innefattar aktiviteter som upplevs som mycket arbetsamma
och får dig att andas mycket kraftigare än normalt, såsom tunga lyft, tyngre bygg- och trädgårdsarbete, aerobics, löpning eller cykling i högre tempo. Tänk enbart på de aktiviteter som du
utfört under minst 10 minuter i sträck.
1a) Under de senaste 7 dagarna, hur många av dessa dagar har du utfört arbete som är mycket
ansträngande?
_____dagar
Ingen sådan aktivitet, gå till fråga 1c
1b) Hur mycket tid tillbringade du, i genomsnitt under en sådan dag, på mycket ansträngande
fysisk aktivitet?
_____minuter
Vet ej
1c) Under en normal vecka för ett år sedan, hur många av dessa dagar utförde du arbete som
var mycket ansträngande?
_____dagar
Ingen sådan aktivitet, gå till fråga 2
1d) Hur mycket tid tillbringade du, i genomsnitt under en sådan dag, på mycket ansträngande
fysisk aktivitet?
_____minuter
Vet ej

Fråga 2
Tänk nu på alla de måttligt ansträngande aktiviteter du utför.
Måttligt ansträngande fysisk aktivitet innefattar aktiviteter som upplevs som arbetsamma och får
dig att andas något kraftigare än normalt, såsom cykling, simning, måttligt bygg- och trädgårdsarbete eller annat i måttligt tempo? Inkludera ej promenader. Tänk enbart på de aktiviteter
som du utfört under minst 10 minuter i sträck.

2a) Under de senaste 7 dagarna, hur många av dessa dagar har du utfört arbete som är måttligt
ansträngande (ej promenader)?
_____dagar
Ingen sådan aktivitet, gå till fråga 2c

2b) Hur mycket tid tillbringade du, i genomsnitt under en sådan dag, på måttligt ansträngande
fysisk aktivitet?
_____timmar
_____minuter

Vet ej

2c) Under en normal vecka för ett år sedan, hur många av dessa dagar utförde du arbete som
var måttligt ansträngande?
_____dagar
Ingen sådan aktivitet, gå till fråga 3
2d) Hur mycket tid tillbringade du, i genomsnitt under en sådan dag, på måttligt ansträngande
fysisk aktivitet?
_____timmar
_____minuter
Vet e

Question 1

Now think about all the very strenuous activities you perform.
Very strenuous physical activity includes activities that are perceived as very strenuous
and makes you breathe much harder than normal, such as heavy lifting, heavier build and
gardening, aerobics, running or cycling at a higher pace. Think only of the activities that you
performed for at least 10 minutes in a row.

1a) In the last 7 days, how many of these days have you done work that is a lot grueling?
_____days
No such activity, go to question 1c
1b) How much time did you spend, on average during such a day, on very strenuous work
physical activity?
_____minutes
Do not know
1c) During a normal week a year ago, how many of these days did you perform work that
was very strenuous?
_____days
No such activity, go to question 2
1d) How much time did you spend, on average during such a day, on very strenuous work
physical activity?
_____minutes
Do not know

Question 2

Now think about all the moderately strenuous activities you perform.
Moderately strenuous physical activity includes activities that are perceived as hardworking and sheepish
you to breathe slightly heavier than normal, such as cycling, swimming, moderate build and
gardening or other at a moderate pace? Do not include walks. Think only of those activities

which you performed for at least 10 minutes in a row.

2a) During the last 7 days, how many of these days have you performed work that is moderate
strenuous (not walking)?
_____days

No such activity, go to question 2c
2b) How much time did you spend, on average, on such a day, on moderate exertion physical activity?
_____hours
_____minutes
Do not know

2c) During a normal week a year ago, how many of these days did you perform work like was moderately strenuous?
_____days
No such activity, go to question 3

2d) How much time did you spend, on average, during such a day, on moderate exertion
physical activity?
_____hours
_____minutes
Do not know

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