Physical activity and its associated factors in patients with neck or shoulder complaints: a cross-sectional study

Masterthesis

Physiotherapy Science
Program in Clinical Health Sciences
Utrecht University

Name student	HA (Henk) van der Hoek
Student number	6412203
Date	June 24, 2021
Internship supervisor 1	Corelien Kloek, PhD
Internship supervisor 2	Mark van Tilburg, MSc
Lecturer/supervisor Utrecht University	Merel Timmer, PhD
Internship institute	Academische Werkplaats Fysiotherapie Hogeschool Utrecht lectoraat Innovatie van Beweegzorg Utrecht, the Netherlands

Abstract

Background: Neck and shoulder complaints are becoming more prevalent. Insufficient physical activity (PA) increases the risk of neck and shoulder complaints. Measuring PA has become much easier, but little is known about how this outcome is related to other factors in this patient group. Exploring which demographic or health-related factors are associated with PA in patients with neck or shoulder complaints will expand the body of knowledge on this topic.

Objective: The objective is to explore the association between demographic or health-related factors and PA in patients with neck and shoulder complaints. PA is primarily operationalized as daily minutes of moderate or vigorous PA (MVPA) and secondary as other relevant elements of PA behavior: ten-minutes bouts of MVPA, minutes of light PA, and minutes of sedentary PA.

Methods: In this cross-sectional study, data from 80 adults with non-specific neck or shoulder complaints in primary care physiotherapy were included. Data were analyzed using multivariate linear regression analysis with backward stepwise selection. Potential explanatory variables included risk of persisting disabling pain, region-specific pain and disability, quality of life, time of complaints, age, and Body Mass Index (BMI).

Results: Mean daily MVPA was 34.2 minutes (IQR=27.1), 41.3% had <30 minutes MVPA per day. Quality of life (physical component) (β=0.886 [95%CI 0.256 to 1.516], p=0.006), BMI (β=-1.240 [95%CI -2.418 to -0.061], p=0.040) and (compared to medium-risk) low-risk of persistent disabling pain (β=-10.014 [95%CI -19.893 to -0.135], p=0.047) were significantly associated with minutes of MVPA. Compared to medium-risk, high-risk of persistent disabling pain (β=84.193 [95%CI 0.716 to 167.669], p=0.048) was significantly associated with minutes of sedentary PA. Quality of life (physical component) (β=0.081 [95%CI 0.028 to 0.134], p=0.003) and BMI (β=-0.134 [95%CI -0.230 to -0.037], p=0.007) were significantly associated with ten-minutes bouts of MVPA.

Conclusion and key findings: patients with a higher BMI and a low risk of persistent disabling pain (reference medium-risk) were less physically active on MVPA. In contrast, patients with a better quality of life (physical component) were more active. The risk of persistent disabling pain and disability yielded uncertain results; studies with larger sample sizes of this subgroup are recommended.

Keywords:

Physical activity, exercise, sedentary behavior, shoulder pain, neck pain.

1. Introduction

Pain and disability in the neck and shoulder are becoming more prevalent[1-3]. Neck and shoulder pain account for 44% of all musculoskeletal complaints[4]. The prevalence of neck pain and shoulder pain in Dutch adults is 27.7 and 48.0 per 1000 patient-years, respectively[5]. Neck and shoulder complaints are caused by multiple factors, like psychosocial, physical, and individual factors (e.g., age, gender, personality type, previous complaints)[6]. Often, these complaints cannot be attributed to a specific pathology[7,8].

Sufficient physical activity (PA) can play a role in preventing the onset of musculoskeletal complaints, while sedentary PA is a risk factor[9-12]. PA includes all activities, regardless of intensity, at any time of the day or night. Sufficient PA is defined as adults meeting at least 150-300 minutes of moderate-intensity physical activity, or 75-150 minutes of vigorous-intensity physical activity per week, or any equivalent combination of the two[13]. More physical activity is better, although the relative benefits tend to diminish at higher physical activity levels[13]. In 2019, the proportion of Dutch adults adhering to PA guidelines was 48%[14,15]. Adults should limit the amount of time spent being sedentary[13]. Traditionally guidelines recommended aerobic activity in bouts of at least ten minutes. The World Health Organization (WHO) recommendations for health were changed only recently, and bouts of any duration now count towards the recommendation[13]. PA guidelines mainly focus on moderate to vigorous physical activity (MVPA)[14,16], but research shows that the composition of several dimensions of PA (e.g., number and duration of bouts, intensity) might be equally or more relevant in determining activity status[17]. Light-intensity PA also appears to be beneficially associated with significant health outcomes after adjustment for MVPA in the adult population[18]. Activity trackers such as smartphones and smartwatches make it easy to record PA in its full dimensions. Therefore, it is essential to create a large body of knowledge about PA in all its dimensions to interpret these recordings correctly. Little is known about how this outcome is related to other factors (e.g., demographic and health-related factors) in this patient group.

In the general population, mental[19,20], physical[21,22], and subjective health outcomes[23] are positively associated with PA. Higher age[24], longer duration of complaints[25], and symptoms of anxiety or depression[26] are negatively associated with MVPA. In contrast, a better health-related quality of life[26,27], higher self-efficacy[28], and higher personal control over illness[29] have a positive relationship with MVPA. An increased risk of numerous health problems is associated with sedentary behavior[30,31], and the development of musculoskeletal complaints is associated with prolonged sitting periods[32]. The body of knowledge on this topic is expanded by exploring which demographic or health-related factors are associated with PA in patients with neck or shoulder complaints. The neck and shoulder have a very complex relationship with biomechanically unique properties. The neck and shoulder are closely linked to the neural, vascular, and respiratory structures. Complaints in this part of the body have specific risk factors such as static postures, precise movements of the upper limbs, and psychosocial factors(33,34). Therefore, it is interesting whether demographic or health-related factors demonstrate different associations with PA within this patient category compared to the general literature of both healthy individuals or patients with musculoskeletal complaints. It could be an impetus for further research into PA in connection with complaints and influencing factors. Because PA is a modifiable amount, it can contribute to the prevention and treatment of healthy individuals and patients.

The primary aim of this study is to explore which demographic and health-related factors are associated with minutes of MVPA in patients with neck and/or shoulder complaints. The secondary aim of this study is to explore which demographic and health-related factors are associated with the number of bouts of at least ten minutes of MVPA, minutes of light PA, and minutes of sedentary behavior.

2. METHODS

2.1 Participants and procedures

The strobe guidelines were used to ensure the reporting of this cross-sectional study(35). Data were selected from patients enrolled in a trial in which stratified care integrated with eHealth was compared with usual physiotherapy(36). For this trial, potentially participating Dutch primary care physiotherapy practices throughout the Netherlands were contacted. Any primary care physiotherapist who treated at least four patients with neck or shoulder complaints each month was eligible to participate. Physiotherapists invited all their patients with non-specific neck or shoulder complaints to participate in the study. Researchers included patients who met the inclusion criteria, and eligible patients between January 2020 until June 2021 were included in the present study.

The inclusion criteria for the main study(36,37) were patients (i) over 18 years of age with (ii) adequate mastery of the Dutch language. In addition, patients had to suffer from (iii) subacromial complaints, biceps tendinosis, shoulder instability, or non-specific musculoskeletal complaints of the neck or shoulder, not caused by acute trauma, e.g., fracture or rupture. The present study used one additional inclusion criterium: the validity of data was determined at a minimum of 6 hours accelerometer-wear per day over at least three days(38-40) (Figure 1). Patients were excluded if a specific pathology caused the neck or shoulder complaints, e.g., frozen shoulder, vertebral fracture, tendon rupture, Parkinson's disease, hernia nucleus pulposus, cervical stenosis), except for subacromial impingement, biceps tendinosis, and shoulder instability(36).

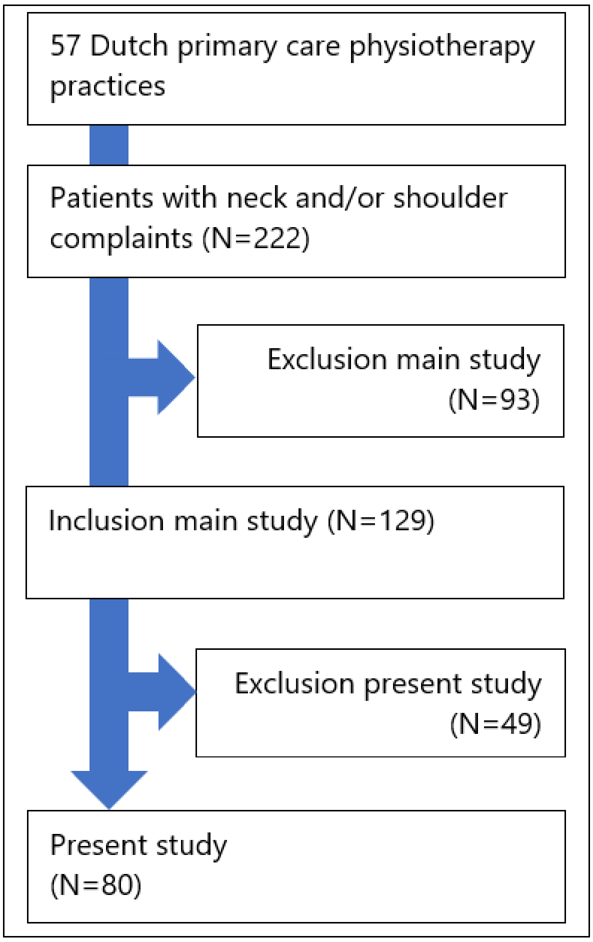

Figure 1 Flowchart of participants through the study

No adequate sample size calculation for association studies was available. Therefore, based on empirical investigations, a widely adopted rule of thumb was used. This rule requires ten outcome events per independent variable(41). To include up to eight independent variables in the multivariate linear regression, at least eighty patients were needed.

2.2 Variables

PA was the primary dependent variable in this study. The level of PA can be divided into sedentary, e.g., sitting or lying down (<1.50 Metabolic Equivalent of Task, MET), light (≥1.5 MET), and moderate (≥3.0 MET) to vigorous PA (≥ 6.0 MET)(42). PA was measured with an Actigraph accelerometer (GT3X or GT3X+), worn on the waist(36). The Actigraph accelerometer summarizes body accelerations over a specified time, and it is a reliable tool for measuring PA in adults(40,43). With Actilife-software(44), cut-off points of Freedson(45) were used to determine sedentary behavior (0-99 counts/min), light PA (100-1951 counts/min), and MVPA (≥1952 counts/min). For the primary analysis, MVPA was operationalized as average minutes per day. For the secondary analysis, the average number of bouts of at least ten minutes of MVPA per day, the average minutes of light PA per day, and the average minutes of sedentary PA per day were calculated. In order to include continuous PA in the current study, MVPA was arbitrarily chosen in bouts of at least ten minutes. Each bout of MVPA was analyzed, and every full ten-minute time span of MVPA was counted as a ten-minutes bout. Thus, a longer single bout of MVPA could yield multiple ten-minutes bouts.

The following factors were selected as independent variables[24-27,29,46-50] to explore the association with PA: Demographic factors, including age and body mass index. Health-related factors, including risk at persistent disabling pain, regional-specific pain and disability, quality of life (both physical and mental components), and duration of complaints.

The risk of developing persistent disabling pain and disability was assessed with the Dutch version of the Keele STarT MSK tool[51]. This validated prognostic questionnaire with a 0-12 range was used to stratify patients into prognostic subgroups with respectively low (0-4), medium (5-8), and high risk (9-12) of persistent pain and disability[51]. Data were analyzed as a categorical variable.

Regional-specific pain and disability were assessed with the Neck Pain and Disability Scale[52,53] (NPDS) or the Shoulder Pain and Disability Index[54] (SPADI). In patients with both neck and shoulder complaints, the dominant region was assessed. In regression analyses, only the sum scores were used (continuous scale, 0-100). Both questionnaires are reliable measurements[52-54], and a higher score indicates more pain or disability.

Health-related quality of life was assessed using the Mental and Physical Component Summary Scores (MCS, PCS) of the RAND-36 Health Survey. Both component summary scores have a range from 0-100 and were analyzed as a continuous variable. Based on the Dutch population reference[55,56], a score above 50 meant a more favorable health state than the Dutch reference population[57,58]. The RAND-36 Health Survey is a reliable questionnaire[57,58].

Age and duration of complaints were assessed with a self-administrated questionnaire. Body mass index (BMI)[59,60] was calculated by dividing body weight in kilograms by body height squared in meters (kg/m^2). Age and BMI were analyzed as continuous data. Duration of complaints [61,62] (<three months, ≥ three months) was analyzed as a dichotomous variable because no continuous scale data were available.

2.3 Statistical analysis

All data were analyzed using SPSS Statistics for Windows (version 25.0, IBM Corp. Armonk, NY, USA). Under the missing (completely) at random assumption, missing values of independent variables (if less than 10%) will be assigned using multivariate imputation by chained equations[63]. Assumptions of normality and checks for linear relationships between PA and the independent variables were checked. Histograms, normality Q-Q plots, boxplots, and scatterplots were made. Shapiro-Wilk test p-values, skewness, and kurtosis z-values were calculated. Checks of normality of residuals, the absence of multicollinearity[64] (Variance Inflation Factor<5), and homoscedasticity were performed.

To explore individual general associations between all independent and all dependent variables, univariate analyses were performed. Subsequently, all independent and dependent variables were analyzed. After the assumptions for linear regression were checked, linear multivariate regression analyses with stepwise backward selection were performed. Variables were removed if the p-value was >0.1. The multivariate regression analyses were performed with and without the outliers of more than three standard deviations from the mean to check significant differences. Beta-coefficients, p-values, and 95% confidence intervals (95%CI) were estimated. Finally, the adjusted R^2-value was calculated to assess the overall performance of the model.

3. Results

3.1 Explanatory variables

In total, 222 participants were identified as potential patients for the main study by the participating physiotherapy practices. Based on the exclusion criteria of the main study, the researchers excluded 93 participants. Of the remaining 129, only 80 participants had sufficient accelerometer data and were included in the present study (figure 1). The data were complete for all participants, and there was no need for imputation. Assumptions for regression were checked. Table 1 shows the characteristics of the participants. The sample had a median age of 45.6, a median BMI of 24.6, and comprised predominantly female participants (65.0%). Duration of complaints (< 3 months=52.5%, ≥3months=47.5%) and location of pain (shoulder=52.5%, neck=47.5%) were somewhat evenly distributed. Regional-specific pain and disability (SPADI or NPDS) showed an average level of complaints of 36.0. Most patients (58.8%) had a low risk of persistent chronic pain, whereas 33.7% and 7.5% had a medium or high risk, respectively. The median scores on MCS and PCS of the RAND-36 were 49.7 and 45.5.

3.2 Dependent variables

Many participants wore their accelerometer all five days (90.0%) with a median of 13.7 hours per day. Overall, the median of minutes of MVPA per day was 34.2 (4.2% of total measurement time). The median of minutes of light PA per day was 260.6 (32.0% of total measurement time), and the median of minutes of sedentary behavior was 519.7 (63.8%). The median of bouts of MVPA of at least ten minutes per day was 1.0. 58.8% of patients met guidelines for sufficient physical activity (MVPA≥30 minutes). The Pearson Correlation coefficient between minutes of MVPA and bouts of ten minutes of MVPA was strong ($r=0.77$, $p<0.000$).

Table 1 Demographic and health-related factors and accelerometer data in the sample

Characteristics	N	%	Mean	SD	Median	IQR
Age (yrs)	80				45.6	24.7
Quality of life, physical component (points)	80				45.5	8.7
Quality of life, mental component (points)	80				49.7	5.3
Body Mass Index (kg/m^2)	80				24.6	4.1
Sex female	52	65.0				
Duration of physical complaints						
<3 months	42	52.5				
≥ 3 months	38	47.5				
Risk at persisting disabling pain						
Low (0-4 points)	47	58.8				
Medium (5-8 points)	27	33.7				
High (9-12 points)	6	7.5				
Region-specific pain and disability (points)						
SPADI + NPDS	80		36.0	18.5		
SPADI	42	52.5	38.9	22.0		
NPDS	38	47.5	33.3	14.4		
Total hours wear time per day (hours)					13.7	1.9
Total monitor-wear (days)						
Three days	3	3.7				
Four days	5	6.3				
Five days	72	90.0				
MVPA (minutes per day)	80				34.2	27.1
MVPA < 30 minutes per day	47	58.8				
MVPA ≥ 30 minutes per day	33	41.2				
Light PA (minutes per day)	80				260.6	123.6
Sedentary PA (minutes per day)	80				519.7	127.1
Bouts of at least ten minutes of MVPA per day	80				1.0	2.2

N=number of participants, SD=Standard deviation, IQR=Interquartile Range, SPADI=Shoulder Pain and Disability Index, NPDS=Neck Pain And Disability scale, MVPA=Moderate to Vigorous Physical Activity, PA=Physical Activity

3.3 Main results on MVPA

Compared to low risk of persistent disabling pain, in the univariate regression, high risk was significantly negatively associated with minutes of MVPA. BMI also was negatively associated, while quality of life (physical component) had a positive association with minutes of MVPA (Appendix 1).

Table 2 shows the resulting significant coefficients of the multivariate regression analysis. Quality of life (physical component) (β=0.886 [95%CI 0.256 to 1.516], p=0.006), BMI (β=-1.240 [95%CI -2.418 to -0.061], p=0.040) and presence of low risk of persistent disabling pain compared to medium risk (β=-10.014 [95%CI -19.893 to -0.135], p=0.047) were significantly associated with minutes of MVPA. Age, duration of complaints, regional-specific pain, and quality of life (mental component) had no statistical significance. R^2-value was 0.125.

Table 2 Multivariable regression of demographic or health-related factors on MVPA

	Multivariate regression on MVPA				
	Adjusted R^2	(unadjusted) β	95.0% CI for β		p-value
	0.125				
Body Mass Index		-1.240	-2.418	-0.061	0.040
Medium-risk persistent pain/disability		reference			
Low-risk-persistent pain/disability		-10.014	-19.893	-0.135	0.047
Quality of life, physical component		0.886	0.256	1.516	0.006

MVPA=Moderate to Vigorous Physical Activity, β=Unstandardized regressions coefficient, CI=Confidence Interval.

3.4 Results on secondary dependent variables.

In univariate regression analyses, none of the explanatory variables were significantly associated with light or sedentary PA. BMI was significantly negatively associated with ten-minutes bouts of MVPA, while quality of life (physical component) was significantly positively associated with ten-minutes bouts (Appendix 2).

Multivariate regression analysis revealed no association between the independent variables and light PA. High-risk of persistent disabling pain was significantly associated with minutes of sedentary PA, compared to medium-risk (β=84.193 [95%CI 0.716 to 167.669], p=0.048). Age (β=0.024 [95%CI 0.001 to 0.047], p=0.037), physical component of quality of life (β=0.081 [95%CI 0.028 to 0.134], =0.003), regional specific pain and disability (β=0.022 [95%CI 0.001 to 0.044], p=0.045) and BMI
(β=-0.134 [95%CI -0.230 to -0.037], p=0.007) were significantly associated with the number of bouts of MVPA of at least ten minutes (Table 3). R^2-values of secondary regression analyses varied between 0.000 and 0.125.

Table 3 Multivariate regression of demographic or health-related factors on secondary dependent variables

	Multivariate regression on secondary dependent variables				
	Adjusted R^2	β	95% CI		p-value
Average daily minutes of light PA					
	0.000				
-		-	-	-	-
Average daily minutes of sedentary PA					
	0.037				
Medium-risk		reference			
High-risk		84.193	0.716	167.669	0.048
Average daily 10' bouts MVPA					
	0.150				
BMI		-0.134	-0.230	-0.037	0.007
Age		0.024	0.001	0.047	0.037
Quality of life, physical component		0.081	0.028	0.134	0.003
Regional pain (SPADI/NPDS)		0.022	0.001	0.044	0.045

β=Unstandardized regressions coefficient, 95% CI=95% Confidence Interval, MVPA=Moderate to Vigorous Physical Activity, PA=Physical Activity, BMI=Body Mass Index, SPADI=Shoulder Pain And Disability Index, NPDS=Neck Pain Disability Scale

4. Discussion

The primary aim of this cross-sectional study was to investigate which demographic and health-related factors were associated with daily minutes of MVPA in patients with neck and/or shoulder complaints. BMI and a low risk of persistent disabling pain (reference medium-risk) were negatively associated with MVPA. In contrast, quality of life (physical component) was positively associated with MVPA. The explained variance was low.

The secondary aim of this study was to investigate similar associations with average minutes of light or sedentary PA and bouts of at least ten minutes of MVPA. A high risk of persistent disabling pain (reference medium-risk) was positively associated with sedentary PA minutes. No significant explanatory variables were found for light PA. BMI was negatively associated with ten-minutes bouts of MVPA. Age, regional-specific pain, and quality of life (physical component) were positively associated with ten-minutes bouts of MVPA.

One of the remarkable findings of this study was that patients with a higher BMI had both fewer minutes of MVPA and fewer ten-minutes bouts of MVPA. This is consistent with the literature; an inverse association was found between PA and BMI[65]. In the literature, no data were found on the percentage of overweight in neck and shoulder complaints. The number of overweight and obese people is increasing. In 2020, 50% of all Dutch people were overweight (BMI>25), of which 13.9% were obese (BMI>30)[66]. It is expected that by 2024 59% of all Dutch people will be overweight or obese[67]. Because BMI and PA are negatively associated, one would expect that more people will be less physically active in the future. Therefore, the percentage of patients with insufficient activity is expected to increase in patients with neck or shoulder complaints. Since many physical activities such as walking, jogging, and cycling mainly stress the lower extremities, adequate ways for neck and shoulder patients to be physically active such as walking[68] or Nordic walking[69] are available.

In the present study, quality of life (physical component score) was positively associated with MVPA and ten-minutes bouts of MVPA, consistent with the literature[26,27]. Previous studies demonstrated a negative association of age[24], BMI[70], level of complaints[71], and duration of complaints[25] with PA. In this study, age and level of pain and disability are significantly positively associated with ten-minutes bouts of MVPA. However, the β-values are close to zero and therefore not clinically relevant. Level and duration of complaints were not significant explanatory variables in any of the analyses. Perhaps, the sample size may have been inadequate to demonstrate significance. Both quality of life and BMI have associations with PA that are consistent with the expectation. The number of minutes with MVPA did not deviate much from the national average. Since no strongly deviating findings from the general literature were found, this leads to whether the findings in the present study differ significantly from disability and pain in other body regions. In the literature, no comparable studies to the present study were found for other body regions. Based on the foregoing, a continuation of specific research within the population of neck and shoulder complaints into factors associated with PA does not appear to be a priority.

The association between the risk of chronicity and MVPA in this study was ambiguous. This study provided some first indications that people with a higher risk of chronicity seem less active. Patients with high risk had significantly more sedentary PA minutes (compared to medium risk). However, patients with low risk of persistent disabling pain had less MVPA compared to patients with medium risk, which is remarkable. As in some other studies, only a small percentage of patients was assigned to the high-risk group[72,73]. The small number of participants with high risk does not allow firm conclusions. The STarT MSK tool has been recently developed. In this tool, “high risk” is defined as the combination of physical and psychosocial indicators for bad outcomes with high values of psychosocial factors[74]. Less favorable psychosocial factors appear to be associated with less MVPA and more sedentary behavior, consistent with the literature[75]. Because chronic complaints are associated with higher medical costs[76] and possible incapacity for work[77], the above results seem to encourage further research with a larger sample size or a specific selection of participants from this high-risk group.

The mean number of minutes of MVPA in this sample was 34.2 minutes per day. However, 41.3% of all patients did not meet the recommendations of 30 minutes of MVPA per day. In 2019, 52% of all Dutch people were insufficiently physically active[13]. Despite a better score than the national average, it is alarming that a significant proportion of the sample does not even meet the minimum requirements. In daily practice, it therefore, seems a great necessity for healthcare workers to promote sufficient PA actively. On average, the sample scored only one bout of at least ten minutes of MVPA per day. There is extensive scientific evidence that ten-minutes bouts of MVPA provide health benefits[78-80]. Nevertheless, recent studies have also shown the utility of shorter bouts[13,81,82]. Whether this research also applies to musculoskeletal complaints is doubtful because most research focuses on all-cause mortality, diabetes and cardiovascular disease. Hypothetically, it would be better to have more extended periods of MVPA. However, a relatively small amount of physical activity (i.e., 2 hours per week) could lower the risk of chronic pain in the lower back and neck/shoulders[83]. As long as there is a lack of knowledge about minimum lengths of bouts, it will remain challenging to analyze bouts of MVPA in health science. Therefore, determining opportunities for improvement for the present sample is complex.

A strength of this study is that, to our knowledge, this is the first study to explore the associations of demographic and health-related factors with PA in a population of neck and shoulder patients. Whether this specific target group differs from musculoskeletal complaints in other body regions is unknown. Differences could arise in lower extremity complaints because lower extremity complaints could hypothetically impair people's ability to be physically active more heavily. Another strength of this study is that PA is operationalized as several dimensions of activity, i.e., average daily minutes of MVPA, ten-minutes bouts of MVPA, and average daily minutes of light or sedentary PA per day. In daily practice, it is nowadays recommended to measure PA in multiple dimensions[17] as it provides a broader picture of PA in general. Demonstrating the positive association between high risk and sedentary PA minutes was one benefit of exploring PA in multiple dimensions.
The data was collected by 57 primary care practices across the country, thus decreasing selection bias. All data was complete, and information was collected utilizing automated web-based questionnaires, which contributed to an objective data collection, avoiding interpretation bias. The sample appears to reasonably represent the population, increasing the external validity of this study. However, it was remarkable that both mental and physical component scores of the quality of life questionnaire were less favorable than the general Dutch population[57,58].

This study has some limitations. The present study was purely intended as an initial exploration of possible associations. Using an existing database prevents a free choice of variables that would seem logical from a priori hypotheses and literature research. Possible follow-up research could explore other demographic and health-related factors like smoking[84], work status, environmental factors, parenting, and living situations[85]. In this study, ten-minutes bouts of MVPA were chosen as a dependent variable to contrast individual minutes of MVPA. The choice for this cut-off point is controversial. Various bouts are used in the literature for which the optimal cut-off point cannot be specified[82]. It may be possible that the results of this study would have minor differences if, for example, a five-minute bout had been chosen, but this cut-off point would also have been arbitrary. In addition, the data was collected when the Dutch population had to comply with the Corona restrictions. The government advised people to work at home. Besides, fitness centers and sports clubs were temporarily closed. These restrictions may have resulted in variance in the PA or amounts of bouts of at least ten minutes of MVPA in the study population[86]. The number of adults with adequate PA decreased during the pandemic[86], and therefore PA might be recorded in a deviated way compared to everyday daily life. On the other hand, wearing an accelerometer may have made patients more aware of their activity, perhaps leading to more PA[87].

5. Conclusion

This study demonstrates that in patients with neck and shoulder complaints, patients with a higher BMI and a low risk of persistent disabling pain (reference medium risk) were less physically active on MVPA. In contrast, patients with a better quality of life (physical component) were more active on MVPA. The risk of persistent disabling pain and disability yielded uncertain results; studies with larger sample sizes of this subgroup are recommended.

6. Conflict of interest

The author declares that there are no actual or potential competing financial interests. Funding is not applicable.

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Appendix 1

Univariate regression of demographic or health-related factors on MVPA

	MVPA			
Independent variables	*β*	*95% CI*		*p*
Age	e			
Gender	e			
Body Mass Index	-1.438	-2.645	-0.231	0.020
Duration of complaints	e			
Region-specific pain and disability	e			
Risk of persisting disabling pain				
Low	reference			
Medium	e			
High	-17.474	-33.954	-0.995	0.038
Quality of life; physical component score	0.643	0.094	1.192	0.022
Quality of life; mental component score	e			

MVPA=Moderate to Vigorous Physical Activity, β=Unstandardized regressions coefficient, 95% CI=Confidence Interval, "e "indicates a P-value > .05

Appendix 2

Univariate regression of demographic or health-related factors on secondary dependent variables

		β	*95% CI*		*p*
			Lower bound	*Upper bound*	
	Explanatory variable				
10' bouts MVPA	Body Mass Index	-0.126	-.219	-0.032	0.009
	Quality of life (physical component score)	0.049	0.006	0.092	0.026
Light PA	-	-	-	-	-
Sedentary PA	-	-	-	-	-

MVPA=Moderate to Vigorous Physical Activity, PA=Physical Activity, β=Unstandardized regressions coefficient, 95% CI=95% Confidence Interval