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Physical activity of workers with and without chronic diseases

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ABSTRACT

Objective. To contribute to the development of measures that increase physical activity (PA) levels in workers with and without chronic diseases, insight into workers' PA level is needed. Therefore, this study examined the association between the number of chronic diseases and PA in a Dutch working population.

Methods. Data of 131,032 workers from the Dutch Public Health Monitor 2012 were used in this cross-sectional study conducted in 2015 in the Netherlands. PA was operationalized as adherence (yes/no) to three PA guidelines. One of these was the American College of Sports Medicine (ACSM) guideline (≥3 days/week, ≥20 min/day of vigorous-intensity activities). Also, the amount of moderate- and vigorous-intensity PA in min/week for those who were physically active for >0 min/week was calculated. Associations between chronic diseases (0, 1, ≥2 chronic diseases) and PA were examined using logistic regression and Generalized Estimating Equations stratified for age (19–54 years/55–64 years).

Results. Workers aged 19–54 years with one (OR = 0.90 (99% CI = 0.84–0.95)) and multiple chronic diseases (OR = 0.76 (99% CI = 0.69–0.83)) had lower odds of adhering to the ACSM-guideline than workers without chronic diseases. Similar patterns were found for older workers. Younger workers with one (B = 24.44 (99% CI = 8.59–40.30)) and multiple chronic diseases (B = 49.11 (99% CI = 26.61–71.61)) had a higher amount of moderate PA than workers without chronic diseases.

Conclusion. Workers with chronic diseases adhered less often to the ACSM-guideline, but among workers aged 19–54 years who were physically active for >0 min/week, those with chronic diseases spent more time in moderate-intensity PA than those without chronic diseases.

Introduction

The beneficial effects of physical activity (PA) are well known. People with sufficient levels of PA are at decreased risk for the development of several chronic diseases (Physical Activity Guidelines Advisory Committee, 2008a; World Health Organization, 2010). Furthermore, PA is associated with work-related outcomes such as reducing absenteeism and improving work performance (Lahti et al., 2010, 2012; Pronk et al., 2004; Proper et al., 2006). Research has also shown that people with chronic diseases benefit from sufficient levels of PA (Physical Activity Guidelines Advisory Committee, 2008a). A physically active lifestyle can reduce pain and contribute to an improved physiological, emotional and social functioning in everyday life for chronically ill people (Bossen et al., 2014; Martin, 2013; van der Ploeg et al., 2004). In turn, this could result in improved quality of life and ability to function independently, and decreased use of health care and medication (Bossen et al., 2014; Barile et al., 2012). Despite these benefits, PA levels in the general adult population, including those with chronic diseases and disabilities, are low (de Hollander et al., 2015; Carroll et al., 2014). More specifically, just above 50% of the general adult population without chronic diseases and 31%–52% of the population with chronic diseases and disabilities is sufficiently active according to PA recommendations (i.e. performing ≥5 days/week of ≥30 min/day or ≥150 min/week of at least moderate-intensity activities) (de Hollander et al., 2015; Carroll et al., 2014).

The risk of developing a chronic disease increases with age (Slingerland et al., 2007). As society is aging and the statutory age of retirement is rising, an increasing number of chronically ill people are stimulated to take an active part in the workforce (Boot et al., 2011). Considering the health benefits of PA and because workers with chronic diseases may be more prone to productivity loss, engaging in PA to maintain and improve health is especially relevant for this group (Bergh et al., 2007; Roskes et al., 2005). To contribute to the development of effective measures that increase PA levels in all workers, i.e. both with and without chronic diseases, insight into the level of PA among these worker groups is needed. This insight is important to tailor future policy measures and workplace PA programs to target specific

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poor PA behaviors of workers with and without chronic diseases. To this end, detailed aspects of their PA levels should be examined, taking into account differences in duration and intensity of PA. So far, such comprehensive knowledge about the PA level of workers with and without chronic diseases is still lacking; PA levels have often been operationalized without adequate distinctions in duration and intensity. In addition, previous studies concerning PA in people with chronic diseases have focused on the general population and not specifically on the working population.

Therefore, the aim of this study was to examine the association between the number of chronic diseases and PA levels in a working population aged 19–64 years.

Methods

Study population and design

In this cross-sectional study (conducted in 2015), data were used from the Dutch Public Health Monitor of the Community Health Services, Statistics Netherlands and the National Institute for Public Health and the Environment 2012. Data from the Dutch Public Health Monitor 2012 were available through an online application at the national Health Monitor office (http://www.ggdghorkennisnet.nl/loket-monitors-gezondheid). A random sample of participants was extracted from the Municipal Personal Records Database. Participants of the Dutch Public Health Monitor 2012 received a questionnaire with questions about demographic factors and (determinants of) health via the Internet or by mail, and few were filled out verbally. As an Institutional Review Board (IRB) approval is only needed when the daily life of participants is influenced or when participants are required to perform specific actions, an IRB approval was not warranted. This was confirmed by the Medical Ethical Committee of the VU University Amsterdam. Of the people approached to complete the questionnaire, approximately 50% responded (n = 387,195) (Gezondheidsmonitor (Public Health Monitor)). For the present study, a selection of the working population was made, defined as those aged 19–64 years with a paid job for ≥12 h/week. In total, 131,032 workers with complete data on the relevant variables were used for analyses (Fig. 1).

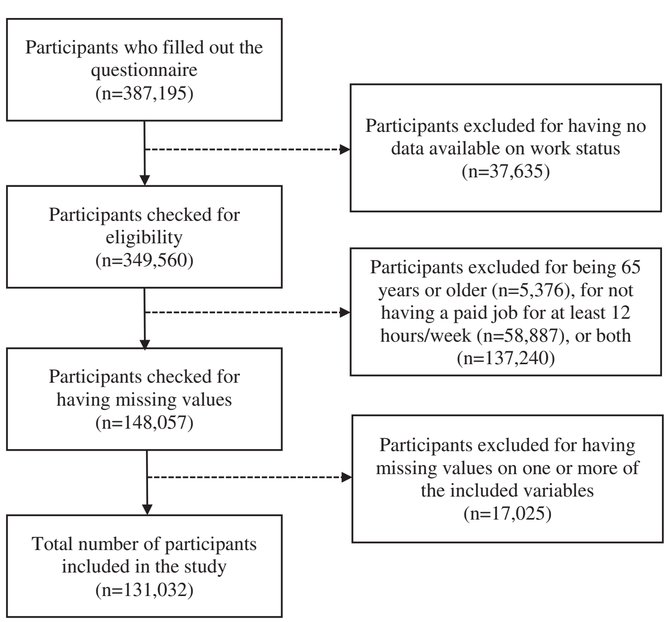

Fig. 1. Flow diagram of study participants (The Netherlands 2015).

Measures

Physical activity

PA was measured with the validated Short QUestionnaire to ASses Health enhancing physical activity (SQUASH) (de Hollander et al., 2012; Wendel-Vos et al., 2003). In SQUASH, participants are asked to report the number of days per week and the average amount of time per day they engage in leisure time activities, household activities, activity at work and school and commuting activities. Based on the compendium of Ainsworth, every activity receives a MET-value (Ainsworth et al., 2011). Light-intensity activities are operationalized as activities with a MET-value of <4.0 for people aged 18–54 years and a MET-value of <3.0 for people aged ≥55 years. Moderate-intensity activities are operationalized as activities with a MET-value of 4.0–6.4 for people aged 18–54 years and a MET-value of 3.0–4.9 for people aged ≥55 years. Vigorous-intensity activities are operationalized as activities with a MET-value of ≥6.5 for people aged 18–54 years and a MET-value of ≥5.0 for people aged ≥55 years (Kemper et al., 2000). Subsequently, the amount of time a person engages in respectively light-, moderate-, vigorous-intensity activities can be calculated. Based on the frequency and intensity of PA, the following dichotomous PA variables were created (adhere to guideline/do not adhere to guideline):

- *Dutch PA guideline* (*NNGB*): ≥5 days/week and ≥30 min/day of at least moderate-intensity activities (yes/no). The NNGB is aimed at maintaining a good health over the long-term (Kemper et al., 2000; Haskell et al., 2007).
- *American College of Sports Medicine* (*ACSM*) *guideline*: ≥3 days/week and ≥20 min/day of vigorous-intensity activities (yes/no). The ACSM-guideline is aimed at maintaining physical fitness (e.g. strength, endurance) (Kemper et al., 2000; Haskell et al., 2007).
- *Combined guideline*: NNGB and/or ACSM-guideline (yes/no). Participants adhere to the combined guideline when they adhere to one or both of the other two guidelines.

Besides examining differences in adherence to PA guidelines in the total study population, the duration of PA was also examined for workers who were doing at least some physical activity (here defined as >0 min/week). To this end, for those who were physically active (>0 min/week), two variables for the duration of PA (in min/week) were created for the amount of moderate- and vigorous-intensity activities, respectively in min/week.

Chronic diseases

Chronic diseases were assessed by asking participants to indicate whether they had or have had chronic diseases (yes/no) from the following list: 1) Diabetes; 2) Cardiovascular diseases (i.e. stroke, cerebral hemorrhage, cerebral infarction; myocardial infarction; other severe heart conditions; vasoconstriction of vessels in abdomen or legs); 3) Cancer; 4) Migraine; 5) Asthma or COPD; 6) Skin disorders (i.e. psoriasis; chronic eczema); 7) Bowel disorders (i.e. severe or persistent bowel disorder for ≥3 months); 8) Musculoskeletal disorders (i.e. joint degeneration of hips or knees; chronic joint inflammation; severe or persistent back disorder, disorder of neck or shoulder, disorder of elbow, wrist or hand). For myocardial infarction, stroke, cerebral hemorrhage and cerebral infarction, participants were asked whether they have ever had these diseases. For diabetes, the time-frame of the question was currently ("Do you have diabetes?"). For all other diseases, participants were asked whether they currently have or have had that disease in the last 12 months. Participants could report having no, one or more diseases. Those who reported having multiple diseases within one disease category as specified above were considered as having one chronic disease. For example, in case of having psoriasis and chronic eczema and no other diseases, the participant was classified as having one chronic disease (i.e. skin disorder).

Covariates

Socio-demographic factors were gender, age, marital status, ethnicity (Western ethnic origin/non-Western ethnic origin), highest level of education completed and standardized household income based on national income data from the Dutch population. Lifestyle factors of interest were alcohol use (no alcohol use (0 glass/week); light alcohol use (0–3 glasses/week for males and 0–2 glasses/week for females); moderate alcohol use (4–21 glasses/week for males and 3–14 glasses/week for females); heavy alcohol use (>21 glasses/week for males and >14 glasses/week for females)) and current smoking (yes/no). Body Mass Index (BMI) was determined based on self-reported height and weight and categorized as underweight (BMI < 18.5 kg/m^2), healthy weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25–29.9 kg/m^2) and obese (BMI ≥ 30 kg/m^2). Motor disability (no disability; mild disability; moderate or severe disability) was assessed with three questions about the extent to which participants experience limitations during activities related to motor abilities (e.g. "Can you walk 400 meters without resting?") (McWhinnie, 1981). Answers were given on a 4-point Likert scale: yes, without difficulty; yes, with some difficulty; yes, with much difficulty; no, I cannot do this.

Statistical analysis

As we conducted a complete case analysis, data had to be available on PA, chronic diseases and all covariates. The participants who were excluded due to missing data reported more often the presence of multiple chronic diseases and they adhered less often to the ACSM-guideline ($p < 0.01$). In addition, among the physically active participants, the mean amount of moderate and vigorous PA in min/week was higher for excluded participants ($p < 0.01$).

Descriptive analyses (percentages and means (SD)) were performed to describe the characteristics of the study population.

To determine the level of PA of workers with no, one or multiple chronic diseases, descriptive statistics were used to determine percentages of adherence to the PA guidelines and to determine means (99%-CI) of the amount of moderate and vigorous PA in min/week for these three worker populations. Unadjusted logistic regression models were used to assess differences in adherence to the PA guidelines by number of chronic diseases. Unadjusted Generalized Estimating Equations (GEE) models with robust standard errors were used to assess differences in the amount of moderate and vigorous PA (in min/week) by number of chronic diseases. The values of the amount of moderate and vigorous PA followed a positively skewed distribution and thereby violated the assumption of normality. Therefore, GEE models with robust standard errors were used instead of linear regression models.

To examine the association between chronic diseases and PA levels, logistic regression and GEE were used. All covariates were checked for possible confounding and effect modification. Relevant confounding was assumed when a change of greater than 10% was observed in at least one of the regression coefficients of the variable number of chronic diseases after adding the potential confounder to the crude models. Analyses revealed that all potential confounders were relevant confounders. Two regression models were carried out for each of the five PA measures: Model 1: adjusted for socio-demographic factors; Model 2: adjusted for socio-demographic factors, lifestyle factors, and motor disabilities. Effect modification was examined for gender, education, BMI and motor disabilities by adding the interaction term of the potential effect modifier and chronic diseases to the regression models. Analyses revealed no significant effect modifiers.

Because the definition of moderate- and vigorous-intensity activities is different for adults younger and older than 55 years, age stratified analyses were performed (19–54 years/55–64 years). Due to our large sample size, $p < 0.01$ was considered statistically significant. All analyses were carried out in 2015 using IBM SPSS Statistics, version 22.0 (New York: IBM Corp).

Results

Table 1 presents the characteristics of the study population stratified for age (19–54 years/55–64 years). Of the workers aged 19–54 years and 55–64 years, 53.5% and 42.4% respectively were female and 41.8% and 34.5% respectively were higher educated. Of the older workers, 34.3% reported having one chronic disease and 17.2% reported having multiple chronic diseases. For younger workers, these percentages were 29.2% and 12.8% respectively.

Table 2 shows the unadjusted level of PA by number of chronic diseases of workers aged 19–54 years and 55–64 years. The percentage of workers aged 55–64 years that adhered to the NNGB was lower for workers with two or more chronic diseases (76.8%) compared to workers without chronic diseases in the same age group (79.8%) ($p < 0.01$). Furthermore, adherence to the ACSM-guideline was lower for younger and older workers with one chronic disease (9.9% and 51.9% respectively) and multiple chronic diseases (7.1% and 47.3% respectively) compared to workers without chronic diseases (12.6% and 54.2% respectively) ($p < 0.01$).

Among those who were moderately physically active for >0 min/week, the mean amount of moderate PA in min/week was higher for workers aged 19–54 years with one chronic disease (858.0 min/week) and multiple chronic diseases (897.0 min/week) compared to those without chronic diseases (835.9 min/week) ($p < 0.01$). On the contrary, among

Table 1
Characteristics of the study population (The Netherlands 2015).

	Workers 19–54 years (n = 103,395) *% or mean (SD); median*	Workers 55–64 years (n = 27,637) *% or mean (SD); median*
Adherence to NNGB (% yes)	52.7	79.1
Adherence to ACSM-guideline (% yes)	11.1	52.2
Adherence to combined guideline (% yes)	54.8	82.1
Amount of moderate PA[a] (min/week)	850.1 (890.2); 480.0	930.7 (934.1); 575.0
Amount of vigorous PA[b] (min/week)	190.5 (213.9); 120.0	363.9 (392.5); 240.0
Number of chronic diseases		
0	57.9	48.5
1	29.2	34.3
≥2	12.8	17.2
Gender (% female)	53.5	42.4
Age		
19–39 years	45.1	–
40–54 years	54.9	–
55–64 years	–	100
Marital status		
Married, living together	76.2	82.4
Single, never been married	18.0	5.1
Divorced	5.4	9.0
Widow, widower	0.5	3.5
Education (% high)	41.8	34.5
Standardized household income (% higher, >31,000 Euros)	31.2	48.6
Alcohol use (% heavy)	7.1	11.8
Smoking (% yes)	22.8	19.7
Overweight (% BMI ≥ 25 kg/m^2)	43.4	57.1
Motor disability (% moderate or severe disability)	1.9	3.3

ACSM-guideline, American College of Sports Medicine guideline; BMI, Body Mass Index; COPD, Chronic Obstructive Pulmonary Disease; NNGB, Dutch PA guideline; PA, physical activity; SD, standard deviation.

[a] Only participants with >0 min/week of moderate PA were included (n = 98,558 for workers aged 19–54 years and n = 26,635 for workers aged 55–64 years).

[b] Only participants with >0 min/week of vigorous PA were included (n = 37,074 for workers aged 19–54 years and n = 22,125 for workers aged 55–64 years).

Table 2
Level of physical activity by number of chronic diseases (The Netherlands 2015).

		Adherence to NNGB (% Yes)		Adherence to ACSM-guideline (% Yes)		Adherence to combined guideline (% Yes)		Amount of moderate PA (minutes (>0)/week) (mean (99%-CI))		Amount of vigorous PA (minutes (>0)/week) (mean (99%-CI))	
		19–54 years (*n* = 103,395)	55–64 years (*n* = 27,637)	19–54 years (*n* = 103,395)	55–64 years (*n* = 27,637)	19–54 years (*n* = 103,395)	55–64 years (*n* = 27,637)	19–54 years (*n* = 98,559)	55–64 years (*n* = 26,635)	19–54 years (*n* = 37,074)	55–64 years (*n* = 22,125)
Number of chronic diseases	0 (ref)	52.9	79.8	12.6	54.2	55.3	82.8	835.9 (826.3–845.4)	910.8 (889.9–931.7)	196.3 (192.6–199.9)	372.1 (362.4–381.9)
	1	52.6	79.3	9.9*	51.9*	54.4	82.4	858.0 (844.5–871.5)*	946.6 (921.2–972.0)*	181.4 (176.2–186.6)*	358.8 (347.3–370.3)
	≥2	51.8	76.8*	7.1*	47.3*	53.1*	79.5*	897.0 (876.3–917.6)*	955.3 (919.0–991.6)*	176.8 (166.9–186.7)*	349.4 (332.5–366.2)*

ACSM-guideline, American College of Sports Medicine guideline; CI, confidence interval; NNGB, Dutch PA guideline; PA, physical activity; Ref, reference group.
*$p < 0.01$ (statistical significance compared to reference group (no chronic diseases)).

those who were vigorously physically active for >0 min/week, the mean amount of vigorous PA in min/week was lower for younger workers with one chronic disease (181.4 min/week) and multiple chronic diseases (176.4 min/week) compared to those without chronic diseases (196.3 min/week) ($p < 0.01$). Similar patterns were found for workers aged 55–64 years.

From Table 3, it can be seen that after adjustment for all confounders, having one or multiple chronic diseases was not associated with adherence to the NNGB and the combined guideline. However, workers aged 19–54 years and 55–64 years with multiple chronic diseases had lower odds of adhering to the ACSM-guideline compared to those without chronic diseases (OR = 0.76 (99%-CI = 0.69–0.83) and OR = 0.88 (99%-CI = 0.80–0.97), respectively). It further appeared that among 19–54-year-old workers who were moderately active (>0 min/week), the number of chronic diseases was positively associated with the amount of moderate PA in min/week. Workers with one (B = 24.44 (99%-CI = 8.59–40.30) and multiple chronic diseases (B = 49.11 (99%-CI = 26.61–71.61)) spent more time in moderate PA compared to those without chronic diseases. No significant associations were found for the amount of vigorous PA in min/week, after full adjustment.

Table 3
Odds ratios and regression coefficients of physical activity levels by number of chronic diseases (The Netherlands 2015).

		19–54 years	55–64 years
		OR (99%-CI)	OR (99%-CI)
Adherence to NNGB			
Model 1	0 chronic disease	1.00	1.00
	1 chronic disease	0.96 (0.93–1.00)*	0.97 (0.89–1.06)
	≥2 chronic diseases	0.91 (0.87–0.96)*	0.84 (0.76–0.93)*
Model 2	0 chronic disease	1.00	1.00
	1 chronic disease	1.00 (0.96–1.04)	1.05 (0.96–1.14)
	≥2 chronic diseases	1.01 (0.96–1.06)	1.00 (0.90–1.12)
Adherence to ACSM-guideline			
Model 1	0 chronic disease	1.00	1.00
	1 chronic disease	0.84 (0.79–0.89)*	0.92 (0.86–0.99)*
	≥2 chronic diseases	0.64 (0.58–0.70)*	0.78 (0.71–0.85)*
Model 2	0 chronic disease	1.00	1.00
	1 chronic disease	0.90 (0.84–0.95)*	0.97 (0.91–1.05)
	≥2 chronic diseases	0.76 (0.69–0.83)*	0.88 (0.80–0.97)*
Adherence to combined guideline			
Model 1	0 chronic disease	1.00	1.00
	1 chronic disease	0.95 (0.92–0.99)*	0.97 (0.89–1.07)
	≥2 chronic diseases	0.89 (0.85–0.93)*	0.81 (0.73–0.91)*
Model 2	0 chronic disease	1.00	1.00
	1 chronic disease	0.99 (0.95–1.03)	1.05 (0.96–1.16)
	≥2 chronic diseases	0.99 (0.94–1.05)	0.98 (0.87–1.10)
		19–54 years	55–64 years
		B (99%-CI)	B (99%-CI)
Minutes/week of moderate-intensity activities			
Model 1	0 chronic disease	0.0	0.0
	1 chronic disease	18.5 (3.0–34.0)*	11.4 (−20.0–42.7)
	≥2 chronic diseases	34.9 (13.3–56.5)*	−6.5 (−46.6–33.6)
Model 2	0 chronic disease	0.0	0.0
	1 chronic disease	24.4 (8.6–40.3)*	18.3 (−13.7–50.3)
	≥2 chronic diseases	49.1 (26.6–71.6)*	9.1 (−32.8–50.9)
Minutes/week of vigorous-intensity activities			
Model 1	0 chronic disease	0.0	0.0
	1 chronic disease	−7.5 (−13.7–−1.2)*	−14.8 (−29.8–0.3)
	≥2 chronic diseases	−8.4 (−18.8–2.1)	−26.0 (−45.4–−6.6)*
Model 2	0 chronic disease	0.0	0.0
	1 chronic disease	−6.3 (−12.6–−0.04)	−8.7 (−23.8–6.4)
	≥2 chronic diseases	−5.5 (−16.0–5.0)	−13.7 (−33.2–5.9)

ACSM-guideline, American College of Sports Medicine guideline; B, Regression coefficient; CI, confidence interval; NNGB, Dutch physical activity guideline; OR, odds ratio.
Model 1: adjusted for socio-demographic factors (gender, age, marital status, ethnicity, education, standardized household income); Model 2: Model 1 + adjusted for lifestyle factors (alcohol use, smoking, BMI) and motor disabilities (fully adjusted model).
*$p < 0.01$ (significance level).

Discussion

Our main finding is that, after adjustment for confounders, workers with chronic diseases adhered less often to the ACSM-guideline compared to those without chronic diseases. Among those who performed moderate activities (>0 min/week), chronically ill workers aged 19–54 years had higher levels of moderate PA compared to workers without chronic diseases.

Our findings on adherence to the ACSM-guideline by the number of chronic diseases are in line with previous studies showing lower PA levels in persons with chronic diseases. In a study among the Canadian general population, adults with chronic diseases were less physically active during leisure-time than those without chronic physical conditions (Kaptein and Badley, 2012). Moreover, in a literature review, Durstine et al. (2013) reported that chronically ill people are less likely to be physically active and that the presence of comorbidities is likely to further deteriorate physical abilities and the ability to perform PA (Durstine et al., 2013). Similarly, in our study, the odds of adhering to the ACSM-guideline were lower for workers with one chronic disease compared to those without chronic diseases, and these odds declined even further in workers with multiple chronic diseases. Low levels of PA of workers with chronic diseases may be explained by the experienced disability (e.g. fatigue, pain, activity limitations) caused by the chronic disease and by fear that PA will have negative consequences for health (Jaarsma et al., 2014). Although we took into account the presence of motor disabilities, other underlying physiological processes may be present that restrict chronically ill workers to engage in PA, and especially vigorous PA as this requires more physiological effort.

Of the workers who were moderately physically active for more than 0 min/week, those with one or more chronic diseases had a higher amount of moderate PA compared to workers without chronic disease. This finding may be explained by the promotion of PA, especially moderate intensity PA, in chronically ill people by health care providers. For example, in a national sample of over 8000 New Zealanders, the odds of receiving PA advice from a health professional were higher for people with one chronic disease (OR = 4.3 (95% CI = 3.5–5.3)) and for people with multiple chronic diseases (OR = 7.6 (95% CI = 5.9–9.8)) compared to people without chronic diseases (Croteau et al., 2006). In addition, vigorous PA may be too challenging for chronically ill people and this group may perceive moderate PA as more beneficial and safe (Physical Activity Guidelines Advisory Committee, 2008a).

As previous studies on the association between chronic diseases and PA mostly used one overall measure for PA, results cannot be compared easily. Cimarras-Otal et al. (2014) found a negative association between the number of chronic diseases and the MET-hours/week in a sample of 22,190 individuals, but only for people younger than 24 years and older than 74 years (Cimarras-Otal et al., 2014). In a Canadian study among 17,000 adults aged 18–69 years, Hudon et al. (2008) concluded that there was no association between the number of chronic diseases and the number of PA sessions (Hudon et al., 2008). Taken together, these studies did not find strong, overall associations between chronic diseases and PA. In our study, after full adjustment, we did not find associations between the number of chronic diseases and adherence to the NNGB whereas strong associations between the number chronic diseases and adherence to the ACSM-guideline were observed. Furthermore, the number of chronic diseases was not associated with the amount of vigorous PA, but was positively associated with the amount of moderate PA in younger workers. By taking moderate and vigorous PA measures together in an overall measure, such associations could not have been detected. Our findings thereby emphasize the importance of taking into account the difference between moderate and vigorous PA instead of using an overall measure of PA.

Limitations and strengths

In the interpretation of the findings, several limitations should be noted. The cross-sectional design of this study implies that no causal or prognostic inferences can be made. The current study cannot answer the question whether the presence of chronic diseases leads to lower PA levels or vice versa. To do so, a longitudinal study design is needed. However, a longitudinal design would not have been necessary with respect to the first purpose of this study, as cross-sectional data are suitable for comparing PA levels in workers with and without chronic diseases.

A second limitation lies in the fact that this study makes use of self-reported data. The bias related to self-reported data on chronic diseases is probably limited, as several studies have suggested that self-report of chronic diseases is fairly to largely accurate for most chronic diseases (Haapanen et al., 1997; Hansen et al., 2014; Simpson et al., 2004). Although the SQUASH-questionnaire has been found to be a fairly reliable and reasonably valid questionnaire to measure PA (de Hollander et al., 2012; Wendel-Vos et al., 2003), there may still have been bias in terms of over- and underestimation of PA by participants (Godino et al., 2014; Ronda et al., 2001; van Sluijs et al., 2007; Watkinson et al., 2010). However, we believe the impact on the study findings to be small, because there is no reason to assume that over- and underestimation of PA in workers with and without chronic diseases would be different.

We decided to conduct a complete case analysis to compare the same study population in the crude and adjusted regression models. Compared to the included participants, the excluded participants in our study reported more often the presence of chronic diseases and adhered less often to the ACSM-guideline, and, if they were physically active, they did more minutes/week of moderate and vigorous PA. As these findings are in line with the main findings of our study and because of the large (variation within the) study sample, we believe the exclusion of participants with missing data to have only limited impact on our study conclusions.

As the recruitment of the study population was done in the general adult population, our study population may not be fully representative of the Dutch working population, including the different occupational groups and sectors. However, because data were derived from a large national Dutch sample, our study population of over 130,000 people is representative for the general Dutch adult population. Furthermore, due to the large sample, there was adequate statistical power. Another major strength is that we used both moderate and vigorous PA measures in our analyses to gain a better insight into the association between chronic diseases and PA.

Conclusions

In a Dutch working population, workers with chronic diseases adhered less often to the ACSM-guideline, but among workers who were physically active for >0 min/week, those with chronic diseases spent more time in moderate-intensity PA than those without chronic diseases. These findings imply that there is room for improvement in the PA level of chronically ill workers. In promoting PA in workers, policy makers and health promoters should pay special attention to workers with chronic diseases and their needs and experienced disability. Research is needed to examine barriers to (vigorous) PA in chronically ill workers and to examine how these barriers can be effectively reduced. More specifically, it is necessary to examine if and how people with chronic diseases can be enabled to engage in vigorous PA, taking into account the recommendation that people with chronic diseases should do activity according to their abilities (Physical Activity Guidelines Advisory Committee, 2008b). Besides the health benefits of moderate PA, engaging in vigorous-intense activities may have additional benefits for workers as previous studies have found associations between vigorous PA and reduced sick leave (Lahti et al., 2010, 2012; Proper et al., 2006). Health care providers can play an important role in increasing (vigorous) PA participation rates in chronically ill people, because they can assist in developing PA plans that fit the needs of people with chronic diseases. Furthermore, as most workers spend a considerable part of their waking time at one place, i.e. the workplace, focusing on workplace initiatives to promote PA in workers with and without chronic diseases is considered an efficient way to increase PA levels (Conn et al., 2009).

Conflict of interest

The authors declare that there are no conflicts of interest.

Transparency document

The Transparency document associated with this article can be found, in the online version.

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