Sickness Presenteeism Among Health Care Workers and the Effect of BMI, Cardiorespiratory Fitness, and Muscle Strength

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Objectives: The primary objective of this study was to assess the relationship between sickness presenteeism and body mass index (BMI), cardiorespiratory fitness (CRF), and maximal voluntary contraction (MVC). **Methods:** Female health care workers ($n = 139$) were analyzed cross-sectional as well as longitudinal after 3 and 12-month follow-up. Sickness presenteeism was assessed as a summed score using validated questions from three questionnaires: Health and Work Performance Questionnaire, Work Ability Index, and Quantity and Quality Method. CRF was assessed by a maximal cycling test and MVC from four muscle groups. **Results:** Significant relationships were found between sickness presenteeism and BMI as well as MVC both cross-sectional and as changes over 3 months. Participants with BMI more than 30 kg/m^2 had significantly higher sickness presenteeism than those with BMI less than 25 kg/m^2. **Conclusions:** This study suggests that actions that decrease BMI and increase MVC decrease the amount of sickness presenteeism.

Keywords: maximal voluntary contraction, on-the-job performance, physical activity, productivity, randomized controlled trial, VO_2max

Growing evidence has been presented regarding the increase in lifestyle diseases among the population in the developed countries causing immense expenses for the health care systems for prevention and treatment.[1] Studies have also shown substantial costs for companies due to poor health among employees and, therefore, this issue is relevant to address also for employers.[2] Costs due to poor health among employees relate to increased sickness presenteeism (decreased on-the-job performance) as well as absenteeism (habitual absence from work) leading to loss of work productivity.[2]

Overweight, physical inactivity, and low functional capacity in terms of cardiorespiratory fitness (CRF) and muscle strength have been evidenced as risk factors for poor health,[3–5] as well as causes of health-related costs.[6] Furthermore, impaired health of the employees, due to overweight, lack of physical fitness, and musculoskeletal pain, may be associated with sickness presenteeism[2,7,8] and absenteeism from work.[7–9] Sickness presenteeism seems especially relevant to examine, as previous studies indicate that the related economic cost exceeds those caused by absenteeism.[2,10,11] However, compared with absenteeism, the awareness of sickness presenteeism is low, it is difficult to quantify, and as yet inadequately examined.

Physical exercise training may affect overweight, physical fitness, and musculoskeletal pain, and thereby decrease sickness presenteeism. However, only a limited number of seven studies have examined the relationship between sickness presenteeism and physical exercise training and these showed ambiguous results. Hence, four studies found that physical exercise training could decrease sickness presenteeism,[7,12–14] while three studies[15–17] found no effect.

Regarding the relationship between sickness presenteeism and body mass index (BMI), 17 studies[7,18–33] have been identified. However, only three of these studies examined the effects of change over time,[23,31,32] as the remaining part merely included a cross-sectional relationship. The results of the cross-sectional studies indicate that obesity (BMI >30 kg/m^2) and possibly also overweight (BMI >25 kg/m^2) relate to higher sickness presenteeism. In respect to the examination of the effects of change over time, knowledge seems inconclusive. Morgan et al[32] found a significant decrease in sickness presenteeism through significant weight loss among employees. Bilger et al[31] found some evidence that sickness presenteeism decreased, however, not significantly. Finally, Pelletier et al[23] found no decrease in sickness presenteeism for participants, who reduced their BMI and achieved a normal BMI. However, the reduction of the BMI was not statistically significant for the study population following the intervention.

Research on the relationship between sickness presenteeism and the physiological variables CRF and maximal voluntary contraction (MVC) is limited. Only two studies examining the relationship between sickness presenteeism and CRF[7,29] have been identified. These studies found conflicting results. One study,[29] including sedentary computer workers, found no relationship between sickness presenteeism and CRF. Results from the second study,[7] including a varied population, indicated that a higher level of CRF was associated with a higher quantity of work being performed, but not with the quality of work. No previous studies regarding the relationship between sickness presenteeism and MVC have been identified.

The aim of this study is to examine the relationship between sickness presenteeism and the physiological variables: BMI, CRF, and MVC in a cross-sectional sample of health care workers, and in terms of changes in the same physiological variables over time.

METHODS

Study Design

FINALE-Health is a cluster, randomized, single-blinded controlled trial conducted from May 2009 to the end of June 2010.[34] The study consisted of 12 months intervention and included cross-sectional tests at baseline, after 3 months, and after 12 months. The intervention effects on health-related outcomes after 3 months[34] and after 12 months[35] have previously been reported, as well as the effect on sickness presenteeism and absenteeism.[36] However, the interrelations of the variables have not previously been analysed. The present study presents exploratory analysis of the relationship between sickness presenteeism and the variables: BMI, CRF, and MVC cross-sectional, as well as the responsiveness of sickness presenteeism to changes in BMI, CRF, and MVC after 3 and 12 months. The project was ethically approved by The Central Denmark Region Committees on Biomedical Research Ethics

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(M-20090050), and qualified for registration in the International Standard Randomized Controlled Trial Number Registry (NCT01015716).

Recruitment and Randomization

The present study mainly includes health care workers (87.7 %), with the remaining part being occupational therapists, physiotherapists, and administration personnel. A detailed description of recruitment and randomization of participants has previously been published.[34] In short, the recruitment of participants was based on the complete payroll of employees in a care area in Randers municipality. Of 202 invited employees, 158 attended one of three introductory meetings and filled out screening questionnaires. One hundred thirty-nine female employees consented to participate in the project, they were physically tested the following week, and randomized to control or intervention group.

Intervention

The intervention lasted 12 months and consisted of two parts.[34] The first part (0–3 months) included advice on dietary change, calorie counting, weight loss targets, cognitive behavioral training, strengthening exercises, and initiating leisure time physical activity. The second part (3–12 months) focused on weight loss maintenance through further intervention with physical exercise and cognitive behavioral training. The intervention group consisted of 75 participants, who were divided into seven training teams.[34] The intervention and the three elements, including diet, physical exercise training, and cognitive behavioral training, have been previously described in detail.[34,35] The control group consisted of 64 participants, who were offered a monthly 2-hour lecture concerning health-related topics.

Of note is that this secondary analysis was performed disregarding the different treatments in the intervention and control group, as the present study was not aimed at the effects of the intervention. These have been reported in previous articles based on the FINALE-Health study.[34–36] This method was chosen, as changes in physiological variables are not necessarily caused by the study intervention alone. Other campaigns or lifestyle changes might have affected them likewise, meaning that changes may also be observed in the control group and not all participants allocated to the intervention group did comply with the intervention.

Data Collection

Anthropometry and physical capacity were measured for all participants cross-sectional, after 3 and 12 months. A questionnaire was completed 1 week before each test session. The questionnaire consisted of 140 questions and included standardized and validated scales.[37]

Collection of anthropometrical data and physical capacity measures have previously been described in detail.[34] In short, *body weight* and *height* were measured. *CRF* was estimated through an algorithm using measures from a maximal cycle exercise test.[38] *Maximal oxygen consumption (VO_2max)* was calculated as l O_2/min and *Relative VO_2max* was calculated as VO_2max ml/min/kg. *MVC* was measured as isometric maximal voluntary strength obtained with a reproducible standardized setup.[39,40] Measures of force were conducted in shoulder elevation, arm abduction, back flexion, and extension, and measured using a Bofors dynamometer. *Shoulder elevation* and *arm abduction* were measured with the participant seated erect in a chair with legs hanging freely, arms hanging along the side, and the head facing straight forward. In shoulder elevation, the distance from the pressure points to sternoclavicular joint was measured as the moment arm.[41] In arm abduction, the participant had a 90-degree flexion in the elbows and the distance from the pressure points to the lateral epicondyles of the humerus was measured as the moment arm.[41] In *back flexion* and *extension*, the participant was standing upright, facing or backing the beam, and support plate at the spina iliaca anterior superior, measuring back flexion or extension, respectively. The dynamometer was fixed to pull horizontally with a belt positioned at the vertical level of m. deltoid insertion on the humerus. The distance from the belt to a line through the crista iliaca and lumbal columna (L4–L5 level) was measured as the moment arm.[42] For shoulder elevation and arm abduction, the average of left and right side measures are given, thus providing four specific MVCs. *MVC total* was calculated as the sum of the six forces measured in the left and right side of both shoulder elevation and arm abduction as well as in back flexion and extension.

In accordance with the definition in the review of Schultz and Edington,[2] sickness presenteeism is defined as decreased on-the-job performance. Thus, in the present article, sickness presenteeism is analyzed as on-the-job performance. It should be noted that sickness presenteeism and on-the-job performance are inversely connected, that is, the higher on-the-job performance, the lower is the sickness presenteeism.

Sickness presenteeism was assessed as self-reported on-the-job performance, using questions in regard to productivity, work ability, and quantity and quality of work. Productivity was rated on an 11-step scale with the question: ''How would you rate your overall productivity the last month?''. The rating went from 0 (the worst a worker in the same job could do) to 10 (the best a worker in the same job could do). This question is a single item in the World Health Organization Health and Work Performance Questionnaire (HPQ).[43] Work ability was rated using the question: ''How is your current work ability compared to your lifetime best?''. An 11-step scale from 0 to 10 was used, with 0 being unable to work and 10 being the person's best work ability. This question is one of the items in the validated Work Ability Index (WAI)[44] and found to have similar validity as the whole index,[45] thus being a robust indicator of on-the-job performance.[46] Quantity and quality of work, which are indicators of on-the-job performance,[7,47] was measured using two subquestions from Quantity and Quality method: ''The impact of health problems in the last month'' on respectively: ''How much work actually performed during regular hours'' and ''the quality of work performed''.[7] A five-step scale from 1 to 5 was used, with 1 being health problems impacted to a great extent, and 5 being health problems did not impact at all. The answers from the two subquestions were summarized for analyses resulting in a maximum score of 10. A combined sum score of on-the-job performance containing the three questions on productivity, work ability, and quantity and quality of work was used for analyses. The sum score of all three questions ranged from 2 to 30 and was termed on-the-job performance. This is a comprehensive measure of on-the-job performance that enabled the assessment of the performance to include more predictors in a single score.

Statistics

All analyses were conducted using data on completers for respective measures in the outcome of interest. Thus, the number of individuals varied for each analysis. Results with P value less than 0.05 were considered statistically significant. Analyses were conducted using STATA IC13. Research question 1 was analyzed using partial correlations controlling for age on cross-sectional data and therefore represents a cross-sectional view of the relationship. Furthermore, one-way analysis of variance with Tukey HSD post-hoc testing was conducted in order to make comparisons of the sum score of performance across BMI categories. Participants were divided into three groups according to BMI categories of normal weight (BMI $<25\,kg/m^2$), overweight (BMI $25–30\,kg/m^2$), and obese (BMI $>30\,kg/m^2$). Research question 2 was analyzed by examining the delta values of variables from cross-sectional to 3 and

12 months, respectively, and therefore represents the relationship of changes. Partial correlations controlling for age were used.

RESULTS

In total, 202 employees (eight males, 194 females) working with health care in Randers municipality were invited to participate. Among these, 158 employees returned screening questionnaires and attended one of three introductory meetings. Subsequently, 144 employees (five males, 139 females) consented to participate in the study, and a cross-sectional test was performed with these participants. For the analysis of the present study, the five males were excluded resulting in 139 female participants in the analyzed group. After 3 months of intervention, 125 participants remained accessible for follow-up, and after 12 months, 111 participants remained accessible. A flowchart is presented in Fig. 1.

Table 1 presents the cross-sectional characteristics of the study population. As there were some missing data for most variables, the n-values for the different measurements are presented in the results.

Cross-Sectional Relationship

Table 2 presents the cross-sectional relationship between on-the-job performance and the physical capacities, also including the six specific MVC variables. A significant relationship was found between higher on-the-job performance and lower BMI ($P = 0.024$) as well as higher MVC total ($P = 0.023$). No significant relationship between performance and CRF (neither for VO_2max nor relative VO_2max) was found. In respect to specific MVC variables, a significant positive relationship was found between higher performance and higher back flexion MVC ($P = 0.035$) as well as higher back extension MVC ($P = 0.016$). No significant relationship was found between performance and shoulder elevation MVC or arm abduction MVC.

Furthermore, one-way analysis of variance was conducted in order to examine the differences in means of on-the-job performance, across groups of participants divided into the three BMI categories. These analyses found that participants with BMI more than 30 kg/m^2 had lower mean performance than those with BMI less than 25 and BMI 25 to 30 kg/m^2. However, the difference was

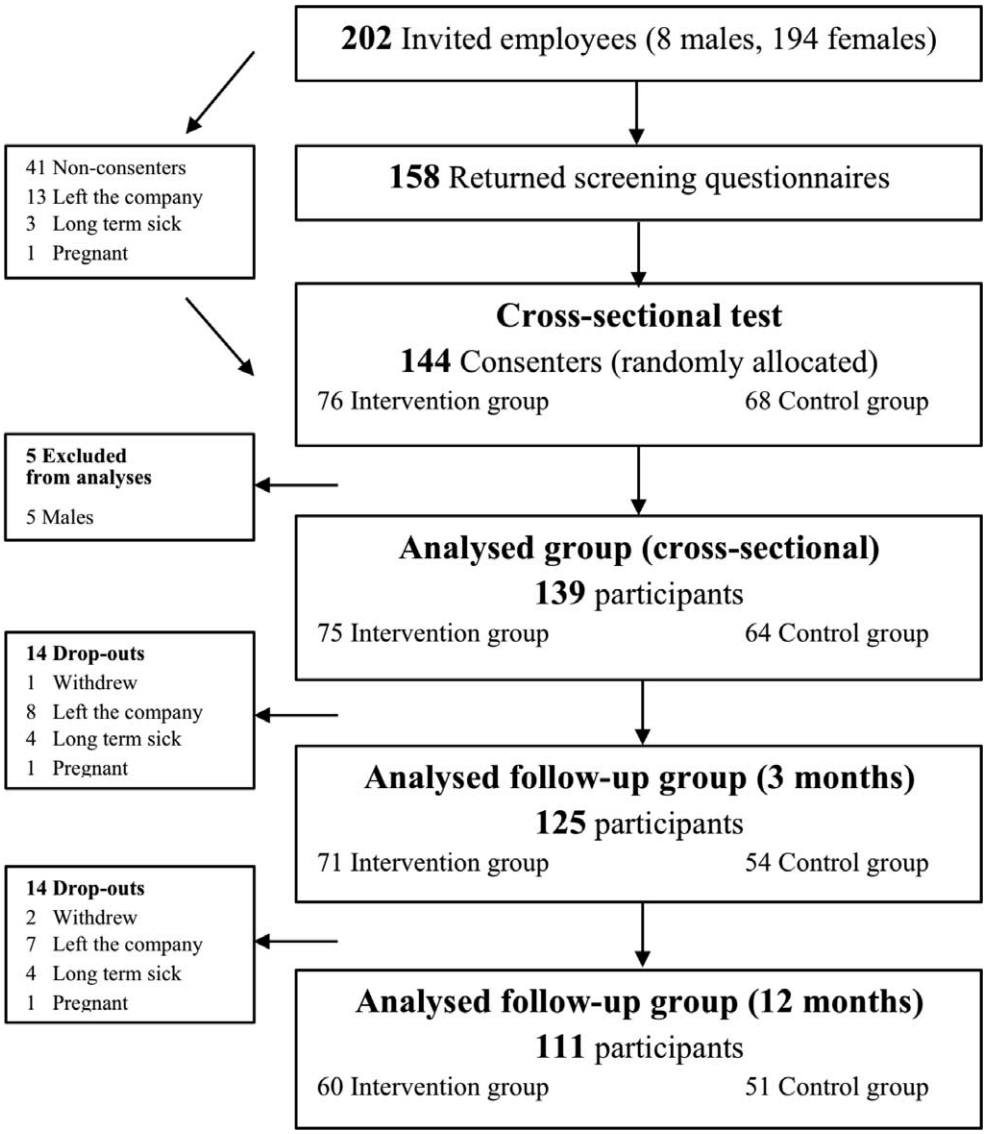

FIGURE 1. Flow of participants.

TABLE 1. Cross-Sectional Characteristics of the Analyzed Group

		n	Analyzed group
Education (health care worker)	*n* (%)	139	122 (87.8)
Age (years)	Mean (SD)	139	45.4 (9.5)
Job seniority (months)	Mean (SD)	115	165.9 (114.3)
Height (cm)	Mean (SD)	132	165.5 (6.1)
Weight (kg)	Mean (SD)	132	77.4 (17.0)
Productivity (0–10 score)	Mean (SD)	117	8.4 (1.4)
Work ability (0–10 score)	Mean (SD)	115	8.4 (1.7)
Quantity and quality (1–10 score)	Mean (SD)	112	8.9 (1.9)
On-the-job performance (2–30 score)	Mean (SD)	108	25.7 (4.1)
BMI (kg/m^2)	Mean (SD)	132	28.2 (5.9)
VO_2max (l O_2/min)	Mean (SD)	88	2.1 (0.4)
Relative VO_2max (ml O_2/kg/min)	Mean (SD)	88	29.2 (6.9)
MVC total (Nm)	Mean (SD)	65	433.3 (103.5)
Back flexion (Nm)	Mean (SD)	73	121.5 (37.6)
Back extension (Nm)	Mean (SD)	72	113.3 (36.9)
Shoulder elevation (Nm)	Mean (SD)	69	126.4 (41.9)
Arm abduction (Nm)	Mean (SD)	69	66.0 (22.9)

n is the number of participants with data available. BMI, body mass index; MVC, maximal voluntary contraction.

only statistical significant with respect to the group of participants with BMI less than 25 kg/m^2 ($P = 0.043$). No significant difference was found between participants with BMI less than 25 and those with BMI 25 to 30 kg/m^2.

Relationship of Changes

Table 3 presents the relationship of the changes from cross-sectional to 3 months, between on-the-job performance and the four physiological capacities as well as the four specific MVC variables. A significant relationship was found between increased performance and lowered BMI ($P = 0.004$) and increased MVC total ($P = 0.046$). No significant relationship was found between changes in performance and VO_2max or relative VO_2max. In respect to specific MVC variables, a significant relationship was found between increased performance and increased back flexion MVC ($P = 0.005$) and back extension MVC ($P = 0.013$). No significant relationship was found between performance and shoulder elevation MVC or arm abduction MVC.

TABLE 2. The Cross-Sectional Relationship Between On-The-Job Performance and the Four Physiological Capacities as Well as the Four Specific MVC Variables

	On-the-job performance		
	N	***r* value**	***P***
BMI (kg/m^2)	*106*	−0.221	0.024*
VO_2max (l O_2/min)	*75*	0.116	0.324
Relative VO_2max (ml O_2/kg/min)	*75*	0.117	0.322
MVC total (Nm)	*54*	0.312	0.023*
Back flexion (Nm)	*60*	0.275	0.035*
Back extension (Nm)	*59*	0.315	0.016**
Shoulder elevation (Nm)	*57*	0.199	0.142
Arm abduction (Nm)	*58*	0.125	0.353

BMI, body mass index.
*$P < 0.05$, **$P < 0.02$.

TABLE 3. The Relationship of Changes Cross-Sectional to 3 Months Between On-The-Job Performance and the Four Physiological Capacities as Well as the Four Specific MVC Variables

	On-the-job performance		
	n	***r* value**	***P***
BMI (kg/m^2)	*78*	−0.326	0.004**
VO_2max (l O_2/min)	*45*	0.099	0.522
Relative VO_2max (ml O_2/kg/min)	*45*	0.231	0.131
MVC total (Nm)	*30*	0.373	0.046*
Back flexion (Nm)	*38*	0.456	0.005**
Back extension (Nm)	*37*	0.411	0.013**
Shoulder elevation (Nm)	*34*	−0.057	0.755
Arm abduction (Nm)	*34*	0.191	0.286

BMI, body mass index.
*$P < 0.05$, **$P < 0.02$.

The relationship of changes from 3 months to 12 months, between on-the-job performance, and the four physiological capacities as well as the four specific MVC variables showed no significant relationships.

DISCUSSION

The present study is the first to examine the relationship between sickness presenteeism and MVC. Results demonstrated a significant relationship between MVC and on-the-job performance, that is, lower sickness presenteeism related to higher MVC cross-sectionally, and decreased sickness presenteeism related to increased MVC over a 3-month period. Furthermore, a significant relationship was found between sickness presenteeism and BMI, both cross-sectionally as well as in changes over a 3-month period. Also, the cross-sectional analysis showed that the group of participants with BMI more than 30 kg/m^2 had significantly higher sickness presenteeism than the group with BMI less than 25 kg/m^2. The present study was also the first to examine the relationship between sickness presenteeism and CRF in terms of absolute and relative VO_2max. However, no relationship between sickness presenteeism and CRF was found, neither for absolute nor relative VO_2max.

A possible explanation for the positive findings in the present study compared with others not supporting such relationships might be that different populations due to specific job demands may require different types of physical exercise training, to have effects on relevant physiological outcome variables. Thus, it seems that the relationship between sickness presenteeism and physical exercise training might be complex. The present study within the FINALE-Health project focused on the relationship between sickness presenteeism and the specific physiological variables: BMI, CRF, and MVC that are modifiable by appropriate job-specific physical exercise training. This approach also enables, in addition to the cross-sectional analysis, a prospective examination regarding the effect of a change in these specific physiological variables on sickness presenteeism. A positive relationship between sickness presenteeism and physiological variables potentially induced a positive cost–benefit of workplace health promotion that included physical exercise training.

Muscle Strength

The present study found a significant linear relationship between sickness presenteeism and muscle strength, which indicated that higher muscle strength is associated with lower sickness presenteeism. When analyzing with respect to specific muscle groups, significance was found only for back flexion and extension. Thus, results indicate that the strength of these muscle groups is of

greater importance in respect to sickness presenteeism among health care workers than the strength of shoulder elevation and abduction.

The cross-sectional results were reflected in the results from the prospective analysis that correspondingly showed a significant relationship between decreased sickness presenteeism and increased muscle strength, and likewise for the specific muscle groups, only the change over time in back flexion and extension strength were significant.

A possible explanation for the relationship between sickness presenteeism and muscle strength could be that health care workers conduct a physically demanding job.[37,48] Thus, muscle strength is important in order to endure the heavy physical tasks throughout the day. The fact that musculoskeletal pain has been found to increase sickness presenteeism[8] might also be of importance in regard to muscle strength. Muscle strength is considered to have the potential to prevent musculoskeletal pain from physically heavy work,[49] and in continuation hereof, workers with low muscle strength are more susceptible to musculoskeletal symptoms from heavy work.[50] Thus, higher muscle strength potentially decrease sickness presenteeism through a lower amount of musculoskeletal pain. The seemingly greater importance of back flexion and back extension strength might also be due to associations with musculoskeletal pain. Lower back pain, which is associated with a lack of core strength, has a very high occurrence, as 49% to 70% of the Danish population experiences pain at some point in life.[51] Furthermore, a systematic review by Amick et al[52] states that health care workers face a high risk of musculoskeletal disorders and pain, in particular lower back pain. This is supported by a Danish study,[53] which found that among 4000 nursing aides, the prevalence of having more than 90 days of lower back pain during a year was 15%. Thus, lower back pain appears to be an issue, especially in the population of health care workers. The specific work demands of health care workers are characterized by movements with heavy lifts using core muscles, rather than heavy lifts using shoulders and arms. Therefore, it seems plausible that the core stability, comprised by the back flexion and extension strength, is of great importance in this population and this is supported by the findings in the present study. Also, cross-sectional characteristics showed that the strength of the present population was above the average strength of Danish females. Nonetheless, muscle strength must be considered an important physiological capacity to focus on among health care workers, and interventions should aim at increasing muscle strength, even though it is above average.

Cardiorespiratory Fitness

The present study found no significant relationship between sickness presenteeism and CRF. Two studies have previously examined the cross-sectional relationship between sickness presenteeism and CRF,[7,29] but no studies before this have examined this relationship over time.

Bernaards et al assessed sickness presenteeism with the HPQ questionnaire,[29] and in accordance with the present study, Bernaards et al found no relationship between sickness presenteeism and CRF. Pronk et al[7] used a test version of the HPQ, including questions on quantity and quality of work and rating of overall perceived job performance to assess sickness presenteeism. Results from Pronk et al indicated that a higher level of CRF was associated with a higher quantity of work being performed, but not with the quality of work. No relationship between CRF and overall job performance was found. In the present study, the same variable of overall job performance is referred to as productivity (F96) through the question from the HPQ questionnaire. This single question is used in the HPQ to measure absolute sickness presenteeism.[54] This question was also used in studies by Bernaards et al and Pronk et al, however, referred to as absolute productivity and overall job performance, respectively. When results from the present study were analyzed using only this specific question and CRF, still no statistical significance was found.

Thus, results indicate that for the population of female health care workers, BMI and muscle strength are of greater importance than CRF, in relation to sickness presenteeism. A possible explanation might be that the work of health care workers is characterized by short-term heavy workload, rather than prolonged workload demanding endurance.

BMI

The present study found a significant linear relationship between sickness presenteeism and BMI, indicating that the higher the BMI, the more sickness presenteeism increases. Furthermore, subsequent analysis using one-way analysis of variance with post-hoc testing found that the group of participants with BMI more than 30 kg/m^2 had significantly higher sickness presenteeism than the group with BMI less than 25 kg/m^2 ($P = 0.043$). Fifteen previous studies have examined the cross-sectional relationship between sickness presenteeism and BMI or overweight. The majority of these studies examined the relationship with BMI stratified into categories, such as the results from the one-way analysis of variance in the present study. However, a study by Cash et al[21] also reported results on the linear trends assessing sickness presenteeism through self-rated work limitations using the WLQ short form questionnaire, which is considered a valid measure.[55] Cash et al found that higher BMI was associated with increased sickness presenteeism: however, the tendency was only significant for females ($P = 0.04$). Thus, the results correspond with results from the present study, wherein only females were analyzed.

The present study found a significant relationship between decreased sickness presenteeism and lowered BMI following 3 months of intervention. Similarly, Morgan et al found a significant decrease in sickness presenteeism ($P = 0.01$), as employees significantly decreased their body weight.[32] In contrast, assessing sickness presenteeism using the SPS-6 questionnaire, Bilger et al[31] found no significantly decreased sickness presenteeism despite participants lowered their body weight significantly. A third study by Pelletier et al[23] assessed sickness presenteeism with the WPAI Scoring (Work productivity loss, Presenteeism, Absenteeism, activity Impairment)[56] and found no decrease in sickness presenteeism for participants, who reduced their BMI ($P = 0.397$). Thus, previous studies attain uncertain results, regarding whether or not weight reduction or lowered BMI decreases sickness presenteeism. In relation to the results of the present study, differences in methods and study populations may explain difference in results. Firstly, sickness presenteeism is not a well defined variable. Secondly, only one[23] of the previous studies examined the direct relationship between sickness presenteeism and BMI, while others studied[31,32] weight and weight loss. Thirdly, the study populations differs, one study[32] only included men, and two studies[23,31] did not stratify for gender. None of the previous studies reported on females or health care workers.

In spite of the heterogeneity of previous studies, the relationship between sickness presenteeism and BMI in the present study more or less corresponds to previous studies on other populations.[18–29,33] High BMI is associated with health risk factors such as hypertension, heart disease, respiratory diseases, type 2 diabetes, and disability,[57] as well as depression and reduced quality of life.[58] BMI is biomechanically associated with musculoskeletal pain, as higher weight will increase the mechanical load on joints.[59,60] Furthermore, according to McDonald et al,[8] musculoskeletal pain is associated with sickness presenteeism. Thus, a lowered BMI, which potentially lowers the amount of musculoskeletal pain, might decrease sickness presenteeism. In addition, an explanation might be found in respect to higher self-esteem. A study by Friedman et al[61] examined the relationship between BMI and self-esteem

measured by the Rosenberg Self-Esteem Scale. Friedman et al found that BMI and the degree of obesity were significantly associated with self-esteem. In continuation hereof, Baumeister et al[62] argues that studies have indicated a correlation between higher self-esteem and higher job performance, which is supported by Pierce and Gardner.[63] Hence, it is possible that lower BMI might relate to higher performance, and thus lower sickness presenteeism, through higher self-esteem.

The relationship between BMI and sickness presenteeism was present for both the cross-sectional data and data from changes over 3 months. This increases the probability of a causal relationship between sickness presenteeism and muscle strength and BMI. This relationship was, on the contrary, not maintained at 12 months follow-up. A plausible reason could be that weight loss and increased muscle strength actually provides a better functionality. This can be measured in productivity, but after 12 months, it is possible that the participants no longer recall the newfound functionality and thus no longer can detect it in the self-assessed productivity.

Strengths and Limitations

A limitation in the study is that the target group only consisted of females and primarily health care workers. Therefore, the generalizability of the study is limited and cannot be extrapolated to males and only to a few other occupations with similarities in work demands.

On the contrary, this can also be considered as a strength, as the population is homogenous in respect to social class, gender, and work conditions, which could also affect the associations and would normally need to be controlled for. The chosen sum score may provide a strong measure of sickness presenteeism incorporating three different dimensions all being important and contributing to the concept of sickness presenteeism.

With regard to CRF of the present study, this was estimated through a maximal bicycle exercise test, whereas Bernaards et al[29] estimated this by means of a walking test, and Pronk et al[7] with self-reported measures. Thus, the present study had a more accurate objective measure than previous studies.[38] The present study included an intervention, as well as cross-sectional data and provides data from follow-up after 3 months and 12 months. This enabled comparisons of the relationship through time, and to our knowledge, it is the only study, which has included two follow-up periods. It is considered a strength in the present study that it allows a cross-sectional association as well as a prospective evaluation of the effect of a change in BMI. The chosen population secures a wide range of BMI changes to be studied, partly as a natural change in BMI over time and partly as an intervention effect on BMI.

In conclusion, the present study demonstrated a significant relationship between higher sickness presenteeism and lower muscle strength and higher BMI cross-sectional. In changes over a period of 3 months, a significant relationship was found between decreased sickness presenteeism and increased muscle strength and lowered BMI.

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