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Leisure-time physical activity and absenteeism

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Regular physical activity has a significant impact on health. There is scientific evidence for prescription of exercise in the treatment of at least 26 different chronic non-communicable diseases. Furthermore, it has an indirect role in the preservation of work capacity. The aim of this study was to review the published results of research on the relationship between leisure-time PA and absenteeism due to sickness. Medline database was searched using the keywords "leisure-time physical activity AND (sick leave OR sickness absence OR absenteeism)". Fifteen studies were included in the final analysis. A negative correlation between leisure-time PA and absenteeism due to sickness in working population was determined in 11 studies. The results support the inclusion of PA promotion in the programmes intended to reduce absenteeism prevalence, the latter being an important public health issue.

KEY WORDS: *exercise; productivity; recreation; sick leave; workplace*

Regular physical activity (PA) has a significant impact on health, especially on the enhancement of functional abilities and prevention of various non-communicable diseases (1, 2). There is scientific evidence for the prescription of exercise in the treatment of at least 26 different chronic non-communicable diseases, including psychological conditions and diseases, neurological, metabolic, cardiovascular, musculoskeletal, pulmonary diseases, and cancers (3).

The importance of PA for health is therefore indisputable. Regular PA and balanced caloric intake are a prerequisite for weight maintenance (4). Physical activity is necessary for the improvement of cardiovascular and muscular fitness, which can be accomplished through aerobic activities and muscular strength and power exercises (5). It improves mental health and has an impact on different health risk factors like obesity, increased cholesterol, and arterial pressure (6). Various studies have pointed to a need for 2.5 hours per week of moderate intensity PA for achieving health benefits and it was shown that regular PA during adulthood may extend life expectancy by 1.3-3.7 years, depending on the gender and level of PA (7, 8).

Despite its well-known positive effects on health, many people do not participate in PA (9). There are many reasons for this, such as lack of time, dissatisfaction and discomfort while exercising (10). Physical inactivity or an insufficient level of PA is a risk factor for, as well as a cause of a significant number of chronic non-communicable diseases (11), many of which are responsible for absenteeism due to sickness.

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In terms of indirect influence of physical inactivity on productivity, it was estimated that in 2013 globally $13.7 billion in productivity losses were attributable to deaths related to inactivity, and that physical inactivity was related to 13.4 million disability-adjusted life-years (DALYs) (12).

Previous studies have shown a relationship between leisure-time PA and absenteeism – it has been determined that vigorous PA significantly reduces absenteeism due to sickness (13). It has also been shown that musculoskeletal and cardiovascular diseases - diseases in which PA has a significant preventive role - are among the main causes of absenteeism, permanent disability, and early retirement (14).

Regular PA has a positive impact on work productivity – studies indicate that cardiovascular fitness and moderate to vigorous PA are related to high work engagement, while obesity and sedentary lifestyle are related to presenteeism (15). As the number of sedentary jobs is ever increasing, a progressive development of inactive lifestyle among employees can be expected, leading to reduced physical fitness and increased risk of development of non-communicable chronic diseases. Reduced productivity, increased health care costs, and a decreased quality of life are possible related consequences.

Absenteeism is omnipresent and is more than just a medical issue. Therefore, preventive precautionary measures are necessary to reduce its prevalence. To explore the potential of leisure-time PA as a preventive measure in reducing the prevalence of sick leave, the purpose of the study was to review the published results of the research on the relationship between leisure-time PA and absenteeism due to sickness.

METHODS

The MEDLINE database was searched to retrieve published results of the studies on the relationship between leisure-time PA and absenteeism. The following keywords were used: "leisure-time physical activity AND (sick leave OR sickness absence OR absenteeism)". The search was limited to the studies that included adult participants (Humans, Adult: 19+ years). The examined articles were published in English language. The initial search yielded 89 articles. After the inspection of the titles and abstracts, 74 articles were excluded for not corresponding to the research question. Fifteen studies with the primary aim to determine the relationship between leisure-time PA and absenteeism due to sickness were included in the final analysis.

RESULTS

The characteristics of the studies included in the analysis are described in Table 1 (research aim and design, participants, measured variables (leisure-time PA and absenteeism due to sickness), results) (16-30).

Four out of 15 studies included in this review were from Denmark (18, 19, 21, 26), three studies were from Finland (17, 20, 24), two studies were from the Netherlands (23, 25), and the remaining six studies were from Belgium (16), Brasil (22), Norway (27), Singapore (28), the United States (29), and Sweden (30). Nine studies were prospective (17-21, 25-27, 29), five were retrospective (16, 23, 24, 28, 30), and one was cross-sectional (22). The participants in all studies were employees aged 19 or more, with the reported mean age between 40-48 in eight studies (16-21, 23, 28), although in the study by Wong et al. (28) the male participants were somewhat older (mean age (95% CI), 41.0 (40.2-41.8) years) than female participants (35.8 (34.9-36.8) years). Besides the females in the mentioned study, the participants in other four studies (22, 24, 25, 29) were on average somewhat younger, with the mean age between 36 and 38 years. In the remaining three studies only age range was indicated – 18-69 years (26), <25->64 years (27), and 50-59 years (30). In 11 studies, both male and female participants were included, in three studies all participants were women (17-19), and in one study all participants were men (24). In 12 studies, the level of leisure-time PA was determined only via a questionnaire (16-20, 22-23, 25-29), one study used both questionnaire and telephone interview methods (21), and in one study the level of leisure-time activity was determined only by interview (30). Three studies reported participants" general PA level across different domains (16, 22, 30). One study included commuting in questions regarding leisure-time PA (20) and one study included separate questions on leisure-time PA and sports (23). Some of the studies measured additional variables along with PA, such as systolic blood pressure, anthropometric measurements, and maximal oxygen uptake by exercise test (30), blood glucose, cholesterol, blood triglycerides (28), etc. In one of the studies, fitness components were determined instead of the level of PA (24). Because of the expected coherence between fitness components and the PA level, results of this study were finally included in the analysis.

Regarding the participants occupations and the level of occupational physical activity across studies, the participants were: secondary school teachers, out of which 22 % physical education teachers (16); female kitchen workers (17); health care workers in eldercare sector (18, 19), nurses" aides (27); banking corporation employees (23); military personnel with both physical and office work (24); law enforcement officers (29); employed in different job groups according to occupational physical workload, ranging from two groups (workers and salaried employees (30), three [blue-collar jobs, white-collar jobs, and caring professions) (25), assembly-line workers, office workers, executives (22)], four (managers and professionals, semi-professionals, routine non-manual, and manual workers) (20) to five or six job groups (21, 26, 28). All studies that included participants from different job groups reported taking into account occupational workload as a confounder.

Most studies reported on the participants" general health. In three studies, only healthy participants were included, i.e., participants with chronic or more severe medical conditions were excluded from analysis (18, 28, 29). The participants were asked about their diseases or long-term health conditions in four studies (17, 21, 22, 27), so the self-reported morbidity was accounted for. In further five studies the participants provided estimation of their general health, either by SF-36 questionnaire (16, 20), or a general question on their health, with several answer categories (23, 25, 26). In one study, the presence of hypertension was acknowledged (30), and in one study the participants were physically examined by medical doctors and were reported to be in "good physical condition" (24). One study examined participants with low back pain (19).

Absence days were examined via a questionnaire (16, 17, 22, 27, 28) or from the official records found in other studies. One study investigated the predictors of absenteeism due to musculoskeletal pain (17), while none of other studies specified the reasons for sick leave.

A negative relationship between leisure-time PA and absenteeism due to sickness among working population was determined in most of the analysed studies (16, 18-22, 25, 27-30). One of the studies has shown that leisure-time PA reduces the impact of overweight and obesity on absenteeism (23). The study by Kyröläinen et al. (24) found that lower levels of muscular and cardiovascular fitness were positively correlated with the duration of sickness absence. Christensen et al. (26) have not determined a relationship between leisure-time PA and long-term sickness absence. Haukka et al. (17) found a trend of increased risk

Table 1 *Characteristics of the studies investigating the relationship between physical activity (PA) and absenteeism*

Study	Research aim and design	Participants	Measured variables		Results
			Leisure-time PA	Absenteeism due to illness	
Bogaert et al., 2014 (Belgium)	Aim: To investigate effects of both demographic and work-related factors on mental, physical and work-related health. To examine the relationship between different types of PA and mental, physical and work-related health. Design: a self-reported restrospective study	1066 participants, Flemish secondary school teachers, online research (68 % women, mean age 40.3±9.7 years; range 21-61 years); Physical education (PE) teachers (22 %); 41 % reported active transport to school. Reasons for sick leave not presented.	International Physical Activity Questionnaire, IPAQ	Question about absenteeism in the last 12 months. **Other variables: Job satisfaction, occupational stress:** Psychosocial Aspects at Work (PAW) questionnaire **Physical and mental health:** Short-form 36 Health Survey (SF-36)	**Higher level of PA in leisure time** related to significant positive self-assessment of mental health (β=3.31; P<0.01), physical health (β=3.64; P<0.01) and job satisfaction (β=0.36; P<0.1), **furthermore negatively related to absenteeism (β=-2.29, P<0.05)** No associations between the total amount of PA and health outcomes. No significant associations between active transport or domestic PA and participants' physical, mental, or work-related health.
Haukka et al., 2014 (Finland) (17)	Aim: To explore predictors of absenteeism due to musculoskeletal pain in a period of 2 years (assessment at the beginning of the research and after 3,6,9,12,15,18,21, and 24 months). Design: a self-reported longitudinal study	386 female kitchen workers from kindergartens, schools, nursing homes, homes for the elderly (mean age 46.0±8.7 years). High prevalence of musculoskeletal pain (only 13 % pain-free), chronic diseases (23 % of participants had a musculoskeletal disease, 32 % some other somatic disease), depressive symptoms (46 % during the previous month).	**PA in leisure time** estimated by a single question: "During the past 12 months, how many times a week did you exercise at ≥20 minutes per session, to the extent to cause perspiration?" **Other predictors:** age, musculoskeletal pain and musculoskeletal and somatic diseases; depressive symptoms [Depression Scale (DEPS)], physical workload ("physical strenuousness of seven main work tasks during the previous week" – two categories defined: low and high physical workload); psychosocial workload; body mass index (BMI); smoking	**Absenteeism because of musculoskeletal pain:** absenteeism due to pain – 7-item questionnaire covering the period of last 3 months	Three models (three groups) of absence trajectories due to musculoskeletal pain have been established in the observed period: a) no absence; b) intermediate – stable prevalence of absence (18-29 % during the follow-up); c) high and growing prevalence of absence (52-83 %). There was no statistically significant effect of PA on absenteeism. Due to age, there was increased trend of risk related to low level of PA (OR=1.64), but with no statistical significance.
Quist et al., 2014 (Denmark) (18)	Aim: To examine prospective relationship between lifestyle factors (smoking, BMI and leisure-time PA) and the risk of long-term sickness absence (LTSA) within 12 months. Design: a longitudinal study with objective (register-based) measurement of sickness absence	7401 female health care workers in the eldercare sector; [(mean age 45.2 (24-60) years (2.5-97.5 percentile)], range 24-60 years). All participants healthy at baseline (not receiving sickness benefits). Reasons for sick leave not presented.	Lifestyle factors: smoking, BMI and **leisure time PA** (assessed with a single question with four response categories: "Which description most precisely covers your pattern of physical activity at leisure time during the last 12 months?")	**Long-term sickness absence (LTSA):** Employer register – Danish Register for Evaluation of Marginalization (DREAM) (national register of social transfer payments)	LTSA was significantly related to all three observed factors (smoking, BMI values and PA). Higher levels of PA were related to lower risk of LTSA (a dose-response relationship, trend test P=0.01). Adjustment for confounders (age, years employed in health care, occupational type, physical workload, psychosocial work environment, and previous LTSA) did not affect the significant associations between the lifestyle risk-factors and LTSA.

Study	Research aim and design	Participants	Measured variables		Results
			Leisure-time PA	Absenteeism due to illness	
Holtermann et al., 2014 (Denmark) (19)	Aim: To explore if leisure-time PA is a predictor of long-term sickness absence (LTSA) among health care workers with different level of low back pain (LBP). Design: a prospective cohort study with objective (register-based) measurement of sickness absence	8655 female health care workers in eldercare sector (2761 without LBP; 3942 with acute LBP; 1952 with chronic LBP); mean age across groups - from 41.4±11.5 to 47.0±9.5 years	**PA –** single question with four response options: "Which description most precisely covers your pattern of physical activity during leisure time? **Other variables:** back pain (Standardized Nordic questionnaire for the analysis of musculoskeletal symptoms), age, smoking, BMI, total years of service, Copenhagen Psychosocial Questionnaire (COPSOQ), working conditions	**Long-term sickness absence (LTSA):** data from the Danish register DREAM; monitoring within 12 months	High level of leisure time PA significantly decreases risk of LTSA among healthcare workers: a) with no LBP [hazard ratio (HR): 95% (CI) 0.47:0.23-0.97 for low *vs*. very high activity]; b) with acute LBP (0.43:0.23-0.84 for low *vs*. very high activity). Decreased risk among healthcare workers with chronic LBP (1.15:0.55-2.44) was not found.
Lahti et al., 2012 (Finland) (20)	Aim: To investigate the relationship between changes in leisure-time PA and subsequent sickness absence (mean follow-up 2.8 years). Design: a prospective cohort study with objective (register-based) measurement of sickness absence	8960 participants, employees of the City of Helsinki, at baseline (80 % women), age: 40-60 years, participants included in the final, present analysis 4182 (83 % women), mean age 48 years. Four occupational groups: "managers (managerial and administrative work) and professionals (e.g. teachers and doctors), semi-professionals (e.g. nurses and foremen), routine non-manual (e.g., childminders and assistant maids), and manual workers (e.g. transport and cleaning work)". Reasons for sick leave not presented.	**Leisure-time PA:** Questions on average weekly hours of leisure-time PA within the previous 12 months in four intensity categories. PA level expressed as MET-hours per week (3 groups: inactive (<14 MET-hours/week), moderate (at least 14 MET-hours/week moderate activity), and vigorous activity (at least 14 MET-hours/week including vigorous activity). **Other variables:** age, gender, socioeconomic status, smoking, BMI and assessment of physical functioning (SF-36)	**Number of periods of absence during the follow-up** (from employer register): for short period of absence (1 to 3 days) and for longer, medically certified absence periods (more than 3 days)	Inactive participants who increased PA to vigorous activity had significantly lower risk of short-term absence (RR (95% CI)=0.80 (0.65-0.97) and long-term absence [(0.63 (0.49-0.83)] compared to inactive participants. Significantly lower risk of absence among participants who enhanced PA from moderate to vigorous category [0.71 (0.61-0.83)]. The lowest risk of short sickness absence was found among participants who performed vigorous PA (RR=0.70, 95 % CI 0.61-0.80; adjusted for age and gender). Associations in longer sickness absences, similar to those in shorter absences, but stronger. Covariates had only a minimal effect on determined associations.

Study	Research aim and design	Participants	Measured variables		Results
			Leisure-time PA	Absenteeism due to illness	
Holtermann et al., 2012 (Denmark) (21)	Aim: To examine if leisure-time PA and occupational PA provide the same or similar effect on long-term sickness absence (LTSA) within 2 years monitoring. Design: a prospective cohort study with objective (register-based) measurement of sickness absence	7144 various employees (52 % women); mean age [mean ± SD (years)]: 42.0±10.8 and 41.7±10.6 for females and males with low level of PA, respectively; 39.2±11.1 and 38.9±11.1 for females and males with high level of PA, respectively). Five job classes: executive managers; middle managers; white-collar workers; skilled blue-collar workers; semiskilled or unskilled workers. Reasons for sick leave not presented.	**Occupational and leisure-time PA:** single questions with four response options (for leisure-time PA: "Which description most precisely covers your pattern of physical activity in leisure time?"). Three PA groups: low, moderate and high. **Other variables:** age, gender, smoking, alcohol, chronic diseases, BMI, psychosocial factors [Copenhagen Psychosocial Questionnaire (COPSOQ)], social class; occupational PA (low, moderate, and high)	**Long-term sickness absence (LTSA):** receiving compensation for ≥3 weeks in a 2-year period; data obtained from register DREAM	Reduced risk of LTSA among employees with moderate [HR (CI) 0.85 (0.72-1.01)] and high [0.77 (0.62-0.95)] level of leisure-time PA compared to employees with low leisure-time PA. Increased risk for LTSA among employees with moderate [1.59 (1.35-1.88) and high (1.84 (1.55-2.18)] levels of occupational PA compared to employees with low occupational PA.
Fonseca et al., 2010 (Brasil) (22)	Aim: To explore relationship between PA, absenteeism, presenteeism, health care utilization and morbidity among employees. Design: a self-reported cross-sectional study	620 General Motors employees (11 % women, mean age 38.5±10.15 years). Job categories: "hourly employees (assembly-line workers and related work areas), salaried employees (office, administrative, and technical employees), and executives (managers and directors)". Reasons for sick leave not presented.	**PA: Baecke Questionnaire -** occupational PA; leisure-time sport and exercise; leisure-time PA (sports excluded) – giving 3 scores, when summed, provide the habitual physical activity (HPA) score. **Other variables:** age, gender, race, schooling, job category, work shift, smoking, self-reported morbidity, alcohol intake, BMI	**Health care utilization, absenteeism and presenteeism:** the World Health Organization's Health and Work Performance Questionnaire (HPQ) – categories - participants who reported: a) health care use and hospitalization in the past 12 months – positive for health care utilization; b) absence from work because of health-related problems in the past 12 months – positive for absenteeism; c) low-work performance or presenteeism in the past 12 months	Leisure-time PA showed significantly negative correlation with **absenteeism** (OR (95% CI) 0.76 (0.58-1.00), *P*=0.053) and **health care utilisation** (0.76 (0.57-1.02), *P*=0.067). Occupational PA was positively correlated with absenteeism [1.63 (1.31-2.02)] and health care utilization [1.25 (0.99-1.58), *P*=0.061]. Reported morbidity was correlated with occupational TA [1.3 (1.06-1.61)] and leisure-time sports [0.67 (0.54-0.82)]. There was a significant association between absenteeism and age, education level, race, tobacco, and referred morbidity, but not with habitual physical activity.

Study	Research aim and design	Participants	Measured variables		Results
			Leisure-time PA	Absenteeism due to illness	
van Strien and Koenders, 2010 (the Netherlands) (23)	Aim: To assess the effects of PA, sports and restrained eating on the relationship between overweight and absenteeism. Design: a retrospective study with objective (register-based) measurement of sickness absence	3030 banking corporation employees (40.6 % women, mean age 42.89±0.43 years); average BMI 25.06 (SD 0.74); 1353 participants with BMI ≥25; 251 participants were obese, BMI ≥30. Reasons for sick leave not presented.	**Health-related lifestyle:** a web-based lifestyle questionnaire, **PA (frequency and duration** – time spent doing PA and Time spent doing sports**),** tobacco use and BMI **Eating behaviour:** The Dutch Eating Behaviour Questionnaire (DEBQ)	**Absenteeism:** employer register – calculation of absenteeism in percentage (number of absence days divided by number of work days)	Absenteeism was more prevalent among women, employees with lower level of education, smokers, poor health condition employees and employees with emotional eating problems as well as higher values of BMI. PA and sports attenuated positive relationship between overweight and/or obesity and absenteeism. Confounders and all moderator variables (general health, PA, sports, and restrained eating) were accounted for.
Kyröläinen et al., 2008 (Finland) (24)*	Aim: To evaluate physical fitness and BMI and their correlation with absence among soldiers. Design: a retrospective study with objective (register-based) measurement of sickness absence	7179 male military personnel (mean age 37, range 18-59 years; average BMI 26.0, BMI range 17-50). Both physical and office work (around 1000 participants with moderate or heavy occupational PA). Reasons for sick leave not presented.	**Cardiorespiratory fitness VO_2max:** 12-min running test and/or progressive cycling test. **Muscular fitness:** push-ups, sit-ups, handgrip strength, squats. Medical examination, determining BMI	**Absenteeism:** data from absence register, three groups based on duration of absence (0, 1-7d , >7 days)	Group of participants with the longest absence (>7 days) had lower level of muscular fitness in 3 out of 4 tests and shorter running distance compared to the group with shorter absence (1-7 days) (P<0.001). High BMI, poor muscular and aerobic fitness were correlated with increased absence.
Bernaards et al., 2006 (the Netherlands) (25)	Aim: To evaluate longitudinal relation (3-year follow-up) between high intensity leisure-time PA and psychological complaints (depression, emotional exhaustion) to provide evidence for the preventive role of PA in the development of psychological complaints. To evaluate longitudinal relation between high intensity leisure-time PA and poor general health as well as sickness absence due to psychological complaints. Design: a prospective cohort study with objective (register-based) measurement of sickness absence	1747 employees from 34 companies (blue-collar jobs, white-collar jobs and caring professions; mean age for the population (presented elsewhere) 36 years, 18-59 years). Reasons for sick leave not presented.	**Strenuous PA:** a single question, six response options: "How often within the past four months did you participate in strenuous sports activities or strenuous physical activities that lasted long enough to become sweaty?" **Depression** – the Center for Epidemiological Studies Depression (CES-D) questionnaire. **Emotional exhaustion** – MBI-NL (Maslach Burnout Inventory) **General health** – self-reported based on a single question, four response categories: "How would you rate your health in general?". **Sedentary job** – question about sitting during the largest part of the working day	**Absence -** from employer data; long-term absence (≥22 days), medium to long-term absence (≥8 days), all absence (≥3 days)	High intensity PA (1-2 times per week) was significantly related to a reduced risk of depression and emotional exhaustion among workers with a sedentary job, whereas PA at a higher frequency (≥3 times per week) was not. Vigorous leisure-time PA (1-2 times per week) was associated with a lower risk of long term absence (>21 days), while PA at a higher frequency was not.

Study	Research aim and design	Participants	Measured variables		Results
			Leisure-time PA	Absenteeism due to illness	
Christensen et al., 2007 (Denmark) (26)	Aim: To examine the impact of health behaviours (smoking, alcohol consumption, leisure-time PA, BMI) on the risk of long term sickness absence (LTSA), within 18-month period. Design: a prospective cohort study with objective (register-based) measurement of sickness absence	5020 employees, 18-69 years (48.6 % women). Five job classes: executive managers; middle managers; white-collar workers; skilled blue-collar workers; semiskilled or unskilled workers. Reasons for sick leave not presented.	**Leisure-time PA:** single question with response options: <2 h per week; 2-4 h per week; >4 h per week or strenuous; or >4 h per week and strenuous. **Other variables:** smoking, alcohol consumption, socioeconomic status, physical work environment exposures, psychosocial questionnaire, BMI	**Long term sickness absence (LTSA):** defined as receiving compensation for 8 weeks within 18-month period; data form register (DREAM)	Leisure-time PA and alcohol consumption were not associated with long term sickness absence.
Eriksen and Bruusgaard, 2002 (Norway) (27)	Aim: To explain the relationship between leisure-time PA and occurrence of long-term absence; 15-month follow-up. Design: a self-reported longitudinal study	5563 nurses' aides (96.1 % women; 98.2 % in age range <25 to >64 years). Reasons for sick leave not presented.	**Leisure-time PA:** a single question: "During the previous 3 months, what kind of physical exercise have you been doing regularly in the leisure time? By the word regularly, we mean 20 minutes or more at least once a week." Checklist with optional responses regarding the type of PA was provided. **Other variables:** demographic data, smoking; work factors and health complaints (musculoskeletal pain, sleeping disorders, affective symptoms). "General Nordic Questionnaire for Psychological and Social factors at Work (QPSNordic)"	**Absence questionnaire:** sickness absenteeism >14 consecutive days or >8 consecutive weeks in the past 12 months. Outcome measures – 1-year cumulative incidence of absence >14 days, and 1-year cumulative incidence of absence >8 weeks	Fast walks [OR (95% CI), 0.78 (0.63-0.98)], aerobics or gymnastics [0.71 (0.49-1.02)], and other leisure-time activities [0.81 (0.66-1.00)], for ≥20 min at least once a week were predictors of lower occurrence of long-term absence (>14 days). Regularly physically active participants were younger, had less health problems, were less often smokers or passive smokers during childhood.
Wong et al., 1998 (Singapore) (28)	Aim: To investigate leisure-time PA among workers and its relation to sociodemographic characteristics and lifestyle habits and determine impact of PA on stress and cardiovascular risk factors (cholesterol, triglycerides and blood glucose) before planning a physical fitness program. Design: a self-reported retrospective study	613 participants (38.8 % women; mean age (95 % CI): women [35.8 (34.9-36.8)], men [41.0 (40.2-41.8)]. Job groups: lecturers (females 47.1 %; males 66.7 %), managers, technicians, clerks, telephone operators, attendants. Participants with chronic conditions (e.g. hypertension, diabetes, asthma) were excluded from the analysis. Reasons for sick leave not presented.	**Leisure-time PA:** questionnaire about frequency and duration of PA (20 min duration and of enough intensity to cause sweating and heavy breathing) during the past year (brisk walking, jogging, swimming, cycling, aerobic and other activities) **Other variables:** dietary habits questionnaire, self-reporting stress, blood pressure measurements; blood samples: glucose, cholesterol and triglycerides	**Number of days of absenteeism during the past 6 months:** self-reported questionnaire	**Impact of low-intensity PA on stress and absenteeism:** a higher percentage of women who did not exercise reported sick leave (61.1 %) compared to women who exercised at least 3 times per week (40.9 %). The relationship was observed even after stratification by age. Higher percentage of women who did not exercise (39.4 %) reported higher levels of stress compared to women who exercised regularly (18.2 %).

Study	Research aim and design	Participants	Measured variables		Results
			Leisure-time PA	Absenteeism due to illness	
Steinhardt et al., 1991 (Texas, US) (29)	Aim: To explore the relationship between the level of PA and cardiovascular fitness and absenteeism and medical care claims during 1 year period. Design: a prospective cohort study with objective (register-based) measurement of sickness absence	734 law enforcement officers (10.9 % women; age range 21-60 years); mean age±SD (years): 38.2±7.4 for sedentary and 36.1±7.6 for regularly active participants. Reasons for sick leave not presented.	**Leisure-time PA:** self-reported – three categories (1=little or no PA; 2=occasional PA; 3=regular PA at least three times per week). **Physical fitness assessment:** cardiovascular fitness (Bruce protocol maximal treadmill exercise test), body composition, muscular strength, muscular endurance and flexibility.	**Absenteeism and medical care claims:** data from the Personnel Office – absenteeism was reported as the total number of days of absence from duty for the year (specific reasons not coded; work-related injuries not included, absence due to care for sick children or pregnancy leaves included)	Sedentary participants were significantly more (P<0.05) absent compared to active officers. Higher fitness level was related to reduced absenteeism in males, but not in females. The number of medical care claims was lesser in more active and fit male participants, but not significantly different than in the less active and less fit ones.
Andersson et al., 1986 (Sweden) (30)	Aim: To investigate the relationship between healthy habits and sickness absence in older industrial employees. Design: a retrospective study with objective (register-based) measurement of sickness absence	1313 employees, age 50-59 years (two categories: a) workers (N=545, 6 % women); b) salaried employees (N=768, 10 % women). Reasons for sick leave not presented.	**PA:** interview (physical activity at work, during transport, PA before the age of 20, current exercise habits). **Other variables:** sex, age, systolic blood pressure, height and weight, anthropometric measurements, bicycle ergometer exercise test for assessment of cardiovascular fitness, overweight, education. Level of responsibility.	**Absenteeism days:** according to personnel records (worker and salaried employee category)	Low level of PA or inactivity among salaried employees was related to significant increase of absenteeism. Low level leisure-time PA was the risk factor most strongly related to high rate of absenteeism. Participants who were not regularly active were either over- or underweight.

**In the study, fitness components were determined instead of the level of PA*

of absenteeism with lower levels of PA (OR=1.64) but the results were not statistically significant.

DISCUSSION

In the analysis of the published results of research on the relationship between leisure-time PA and absenteeism, the results of most studies have shown a significant negative relationship between PA and absenteeism occurrence and duration. Some of the studies observed the PA impact on various health conditions, such as mental health, depression (25), overweight (23), and musculoskeletal pain (17).

Moderate PA and sports, in line with the existing studies, have a preventive impact on absenteeism among overweight and obese individuals (23). Poor muscular fitness and endurance, as well as high BMI are risk factors for reduced work productivity causing absenteeism and additional costs for the employer (24). Physical fitness testing of employees might be a useful method for enhancing awareness of individual levels of physical fitness.

It has been shown that participating in vigorous PA reduces the duration of absenteeism (31). By enhancing the proportion of muscular tissue and insulin action, as well as reducing visceral fat tissue, PA contributes in prevention of various diseases such as obesity, which can cause increased morbidity and early retirement (3). Steinhardt et al. (29) showed that a moderate level of cardiovascular fitness was related to reduced absenteeism, underpinning the public health message on benefits of PA and cardiovascular fitness and emphasising the need to promote active lifestyle programmes.

One of the possible benefits of regular PA with regard to reduction of absenteeism is its impact on mental health. The relationship between vigorous PA (1-2 times per week) and reduced risk of long-term absenteeism occurrence (>22 days) indicates a preventive role of vigorous PA on long-term absenteeism occurrence, mental symptoms and poor general health among the working population (25). In addition, employees with sedentary jobs may gain more benefits of PA compared to people with non-sedentary jobs (25). Other studies have shown a negative impact of prolonged sitting on physical health, mental health, and higher depression incidence (23, 32). Psychological issues, such as losing the feeling of satisfaction, job burnout, anxiety, and depression are important causes of absenteeism and working disability (33). Thereby, PA may play an important role due to its preventive and therapeutic impact on the occurrence of psychological symptoms.

Musculoskeletal and mental health issues, especially depression, are dominant medical causes of absenteeism due to sickness (34). Low level of PA increases the risk of absenteeism due to musculoskeletal pain (17). A significant independent role that multifocal disease and musculoskeletal pain, as well as depressive symptoms, smoking and overweight or obesity have in predicting the occurrence of absenteeism due to musculoskeletal pain was also shown (17). Therefore, early screening and special attention to these factors are important to prevent negative consequences on work ability and absenteeism.

The studies analysed in this review emphasise that unhealthy lifestyles among female health care workers (BMI >25; <18 kg m^{-2}, smoking and reduced PA) are related to a high risk of absenteeism due to sickness (18). Subsequently, regular leisure-time PA may be related to a reduced risk of medical staff absenteeism (27). To secure healthy working environment and to decrease the risk of absenteeism, promoting healthy lifestyle programmes should be encouraged and planned in order to reduce risk behaviours among workers.

Despite the negative relationship between leisure-time PA and absenteeism confirmed in the majority of the analysed studies, the conclusions should be taken with caution for several reasons. First, what limits the conclusions is the fact that the examined studies differed in the selection of participants and applied methodology. The other obvious limitation inherent to the studies on PA is that self-reported levels of PA collected via questionnaire may be overestimated or underestimated (16-23, 25-29), and during the interview, the participants may give socially desirable answers.

Also, when considering the impact of leisure-time PA on sickness absence, we have to bear in mind different potential confounders. Only one study presented reasons for sick leave (17). We might assume that participants in other studies could have had some already existing diseases or health conditions that might have influenced the frequency and duration of their sick leave. However, most of the studies reported on the general health state of their participants and took it into account as a potential confounder. A reversed causation should also not be overlooked – persons with diseases could be less prone to engage in leisure-time PA. The already mentioned study by Haukka et al. (17) found a trend of increased risk of sick leave with lower levels of PA, although the relationship was not statistically significant. We might argue that the general health of the participants might have influenced this result – the participants reported a high prevalence of musculoskeletal pain (87 %), other somatic diseases (32 %), and depressive symptoms (46 %) (17).

PA is a complex behaviour, difficult to measure, as people can be active in different domains of their everyday life. Beside investigating leisure-time PA, some studies also reported on PA across other domains, such as commuting, which could have also added up to the influence of leisure-time PA on sickness absence (16, 20, 22, 23, 30), while other studies did not report on general PA level.

Occupational level of PA could have also influenced the frequency of sickness absence, since the studies included participants employed in different job groups. All the studies that included participants employed at workplaces that differed in the level of occupational PA reported taking into account this confounding factor. The results of the studies

with participants from similar job groups were congruent, except for the study by Christensen et al. (26), in which no relationship between leisure-time PA and long term sickness absence was found.

Also, the studies included participants of different age groups, but all studies accounted for age as a confounder. Although study design differed, most of the studies were prospective (17-21, 25-27, 29).

Four prospective studies showed a dose-response relationship between leisure-time PA and risk of absenteeism (18, 20, 21, 25). Three of them included employees in different job groups, of both sexes (20, 21, 25). Vigorous-intensity PA was associated with the lowest risk of absenteeism in the study by Lahti et al. (20) and higher level of leisure-time PA (in terms of intensity) was associated with a lower risk of long-term absenteeism in the study by Holtermann et al. (21). Bernaards et al. (25) also found a negative relationship between vigorous leisure-time PA and risk of long-term absenteeism (>21 days), but the relationship depended on the frequency of PA—the relationship was significant if strenuous PA was performed 1-2 times per week, whereas higher frequency of weekly PA was not associated with a lowered risk of absenteeism. This result is somewhat congruent with the one of Heuch et al. (35), who found a decreased risk of chronic low back pain with increasing leisure-time PA level, but not in the group of participants who performed strenuous PA ≥3 hours per week.

Also, fast walks and/or combination with other activities at least 20 min at least once weekly were associated with a lower risk of sickness absence lasting more than 14 days in the study by Eriksen and Bruusgaard (27).

In the study by Holtermann et al. (19), high leisure-time PA was associated with reduced sick leave in participants with no low back pain, or non-chronic low back pain, but not in participants with persistent low back pain. It seems the effect of leisure-time PA was attenuated or absent in the studies in which participants had some pre-existing health problems (17, 19).

Expectedly, reported pre-existing morbidity was positively related with absenteeism in several studies, as well as lower education levels and smoking (22, 23). Several studies reported higher absenteeism in women (16, 21, 23, 26, 28, 29). Also, Eriksen and Bruusgaard (27) reported that regularly active participants were younger, apparently healthier, and less often smokers, while in the study by Andersson et al. (30) less active participants were either over- or underweight.

Our search identified no randomised controlled trials, which are obviously required to provide stronger evidence on the influence of leisure-time PA on sickness absence. Proper et al. (36) systematically reviewed controlled trials of worksite PA interventions on absenteeism, and found limited evidence for their effectiveness, mostly due to the lack of quality randomised controlled trials. The main shortcomings of the studies analysed in the mentioned review, which should be taken into account in future PA intervention studies, were inadequate descriptions of the inclusion criteria and randomisation, dropouts, and compliance with the interventions (36). Although the evidence based on our analysis is inconclusive due to the aforementioned limitations, the results of several analysed prospective studies suggest that vigorous-intensity PA performed 1-2 times per week seemed to be most associated with a decreased risk of absenteeism, while people with pre-existing diseases, women, employees with lower education level and smokers are the subgroups which the interventions should be targeting.

In conclusion, most of the analysed studies indicate that regular leisure-time PA may be related to a reduced risk of absenteeism due to sickness. Because of a low level of leisure-time PA among adults and the fact that absenteeism due to sickness is a very important public health, social and economic issue, intervention programmes are necessary for promoting and maintaining regular PA.

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Tjelesna aktivnost u slobodno vrijeme i absentizam

Redovita tjelesna aktivnost (TA) ima značajan utjecaj na zdravlje, što potkrepljuju i znanstveni dokazi o učinkovitosti propisivanja tjelovježbe u liječenju barem 26 različitih kroničnih nezaraznih bolesti. Povrh toga, tjelovježba igra neizravnu ulogu u očuvanju radne sposobnosti. Cilj ovoga rada bio je pregledati objavljene rezultate istraživanja odnosa između TA u slobodno vrijeme i absentizma zbog bolesti. Pretražena je Medline baza podataka korištenjem ključnih riječi *leisure-time physical activity I* (*sick leave* ILI *sickness absence* ILI *absenteeism*). U završnu analizu uključeni su rezultati petnaest istraživanja, a u njih 11 utvrđena je negativna korelacija između rekreativne TA i absentizma zbog bolesti u radnoj populaciji. Rezultati idu u prilog uključivanju promicanja TA kao dijela programa smanjenja prevalencije absentizma koji je važan čimbenik javnoga zdravlja.

KLJUČNE RIJEČI**:** *bolovanje; produktivnost; radno mjesto; rekreacija; tjelovježba*