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ORIGINAL ARTICLE

The relationship between leisure-time physical activity and job satisfaction: A dynamic panel data approach

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Abstract

Objective: Previous research has documented a positive effect of leisure-time physical activity (LTPA) on life satisfaction. The relationship between physical activity and the specific domain of job satisfaction is, however, relatively unknown. This study aims to investigate the effects of different frequency levels of LTPA on self-reported job satisfaction and specifically focuses on the two mechanisms of health and recovery from work stress.

Methods: Using data from the German Socio-Economic Panel (2001-2019), fixed effects and dynamic panel data regression models are estimated to address the problems of unobserved heterogeneity and reverse causality. A mediation and sub-sample analysis shed light on the role of health and work stress.

Results: The results reveal that weekly LTPA has a positive effect on job satisfaction and that health represents a channel yielding those benefits. The effect appears to be moderated by work stress. Further, the analysis reveals the importance of considering unobserved heterogeneity and reverse causality when studying this relationship.

Conclusion: The findings indicate a positive relationship between regular LTPA and job satisfaction and add plausible causal evidence to the limited literature in this context. The findings yield implications for employers and employees.

KEYWORDS

dynamic panel estimator, job satisfaction, physical activity, public health

1 | INTRODUCTION

A vast body of research has revealed that physical activity positively influences an individual's subjective well-being in terms of overall happiness and life satisfaction,[1] with varying impacts of participation frequency and intensity.[2] However, existing studies only considered global measures of life satisfaction, neglecting different domains of an individual's life satisfaction. Van Praag, Frijters, and Ferrer-i-Carbonell[3] distinguish between six different domains: job, financial, housing, health, environment, and leisure. While the effect of physical activity on domains such as health and leisure time satisfaction has been studied already,[4] the role of physical activity in the domain of

job satisfaction has attracted less research attention even though it is one of the most important contributors to overall life satisfaction.[5]

Previous research has shown that job satisfaction determines an individual's productivity at work by, for example, improving job performance[6] or reducing absenteeism among employees.[7] Moreover, existing evidence suggests that job satisfaction has a positive effect on organizational commitment[8] and reduces employee turnover.[9] As a consequence, both employers and employees should be interested in understanding drivers of job satisfaction and identifying mechanisms to improve it.

Similar to general life satisfaction, a job satisfaction measure is considered a proxy for utility from working. Clark and Oswald[10] describe the function of this form of utility as follows:

$$u = u(y, h, i, j) \tag{1}$$

with y defining individuals' income, h the working hours, and i and j different individual and job-specific characteristics. Previous research has investigated the influence of the different determinants of job satisfaction in Equation (1) and has found a positive effect of income y[10] and negative effects of working hours h.[11] Regarding individual i and job-related j characteristics, existing research has identified numerous significant predictors, such as age, gender, education, and marital status as individual determinants[5,11] and company size, tenure, job status, or job autonomy as job-related predictors.[12]

One aspect which is not yet considered in Equation (1) is the importance of non-work domains. These so-called spillover effects occur when aspects of one domain (non-work) transfer to the other (work).[13] While previous research has primarily focused on the interrelationships between family and work,[14] a smaller strain of research has focused on the role of leisure activities and their effect on job satisfaction. For example, Mojza, Sonnentag, and Bornemann[15] found a positive relationship between the time spent on volunteer work activities and job satisfaction.

Accordingly, Equation (1) can be extended to:

$$u = u(y, h, i, j, l) \tag{2}$$

with l describing an individual's leisure time. One leisure activity where positive spillover effects can be expected is physical activity due to mainly two reasons. First, with research indicating that health represents an important determinant of job satisfaction because of its positive effects on productivity and overall well-being,[16] higher levels of physical activity could lead to improvements in job satisfaction through the channel of improved health. Second, existing studies have shown that stress and general exhaustion after work are significant negative predictors of job satisfaction.[17] Research has indicated that physical activity and exercise can help individuals to recover and cope with stress after work by enhancing the process of replenishing depleted resources.[18] Being physically active often charges different resources compared to an individual's work and thus enhances the recovery from work-related resources.

Most of the literature dealing with the relationship between physical activity and job satisfaction has focused on work-related physical activity. While studies were able to demonstrate positive effects of worksite physical activity in terms of health and recovery and coping with stress from work,[19] the literature has produced inconclusive findings regarding the effects on job satisfaction.[20] When it comes to the relationship between leisure-time physical activity (LTPA) and job satisfaction, empirical evidence is limited. Hecht and Boies[21] have found no significant effect. However, their study used only a small cross-sectional sample (n = 108) and did not control for job-related characteristics. Wheatley and Bickerton[22] have examined the effect of numerous leisure activities on several satisfaction domains. They found a positive relationship between LTPA and job satisfaction, but with inconclusive results regarding participation frequency. Likewise, their study omitted individual and job-related control variables and only used cross-sectional data. De-Pedro-Jiménez et al[23] differentiated between the role of occupational and leisure-time physical activity and their impact on job satisfaction. Their results indicated only a positive association between LTPA on women's job satisfaction. However, their study only used a descriptive research design. Some experimental studies have found a positive relationship between LTPA and job satisfaction,[24,25] but these studies are only based on small samples which are not representative.

With the existing research mainly documenting correlations, the present study has the purpose to add plausible causal evidence. Therefore, it is essential to address two problems of endogeneity emerging in this context. First, unobserved characteristics affecting LTPA and job satisfaction (e.g., individual lifestyle; enjoyment of physical activity, time preferences) have to be taken into account as they could result in selection effects. Second, it can be argued that job satisfaction might also have spillover effects on physical activity[26] leading to potential reverse causality. If these two problems are ignored, estimated coefficients will be biased and inconsistent.

Additionally, this study aims to contribute to the existing literature by providing new insights into the mechanisms through which LTPA could affect job satisfaction. Therefore, the mediating role of health and the moderating role of work stress is examined (Figure 1). For both

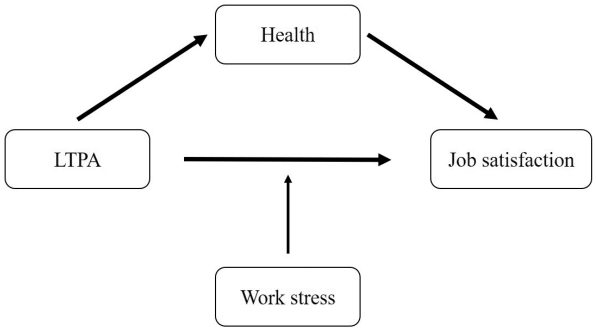

FIGURE 1 Relationship between LTPA and job satisfaction and the role of health and work stress

purposes, a rich panel dataset from 2001 to 2019 is utilized. The data include information on individuals' job satisfaction, income, working hours, as well as individual- and job-related characteristics, such as the frequency of physical activity. Moreover, the panel structure and large sample size allow dealing with different sources of endogeneity by estimating fixed effects models and estimating a dynamic panel model.

2 | METHODS

2.1 | Data sources

In order to examine the relationship between LTPA and job satisfaction, survey panel data of employed persons from the German Socio-Economic Panel (GSOEP) are used.[27] The GSOEP is a German household panel survey conducted annually by the German Institute of Economic Research since 1984. All household members older than 17 years are surveyed individually each year. The interviews are usually conducted using Computer Assisted Personal Interviewing (CAPI). Thereby, a variety of topics including household composition, occupational biographies, employment, earnings, health, and satisfaction indicators are covered. The GSOEP data are publicly available. Participating in the GSOEP is voluntary and based on informed and written consent. Ethical permission for the GSOEP was granted by the Scientific Advisory Board of the DIW Berlin. In the past, these data have been used to examine various labor market outcomes of physical activity including effects on income,[28] and have been utilized to investigate job-related aspects such as job search.[29] The present study uses data from the period 2001-2019 since the relevant information on physical activity and job characteristics was not available in the other waves. Specifically, only the years 2001, 2003, 2005, 2007-2009, 2011, 2013, 2015, 2017, and 2019 provide the required information for the empirical analysis. Given the focus on job satisfaction, the sample includes individuals who work at least 10 hours a week. The final sample size consists of n = 106 259 observations.

2.2 | Measures and variables

Table 1 summarizes the variables of this study and their measurement. The dependent variable of the regression will be individuals' self-reported job satisfaction which was assessed on an 11-point scale. It is based on the question: "How satisfied are you with your job?" and the response options range from 0 = dissatisfied to 10 = satisfied.

The predictor of interest is the frequency of LTPA measured on a four-point scale with the following categories: at least once a week, at least once a month, less often, or never. Previous research has shown that a certain level of frequency is needed to yield well-being or economic benefits of physical activity.[28] Consequently, the variable is recoded into three categories: Weekly (*LTPA weekly*) and monthly physical activity (*LTPA monthly*) which were included in the empirical model, and less frequent activity (*LTPA infrequently*) representing the reference category.

To take into account other variables determining job satisfaction, the model considers numerous control variables. At the individual level, studies have identified a u-shaped relationship between age and job satisfaction.[10] Hence, our empirical model includes both age (*Age*) and its squared term (Age^2) to control for a potential non-linear relationship. In addition, the following individual characteristics commonly used in previous research to predict job satisfaction are part of the model as well: Gender (*Male*), marital status (*Married*), number of children (*Children*), household size (*HH size*), years of education (*Education*), and if the individual suffers from poor health (*Poor health*).[5]

Moreover, this study controls for job characteristics as previous studies have identified that the level of job satisfaction depends on individuals' working conditions.[30] Important predictors are income (*Gross Income*), working hours (*Workload*), and overtime working hours (*Overtime workload*). In addition, the model takes into account the type of contract (*Temporal job*), job changes in the past (*Job change*), tenure at the current employer (*Job tenure*), and the subjective match between employees' education and the job (*Education match*). Also, the empirical model considers the size of the company[29] and the job status of the individual differentiating between *Self-employed*, *Blue-collar*, *White-collar*, *Public servant*, and *Apprentice*. By controlling for the different job statuses, the differences in the physical demands of different types of employment are also considered. Finally, state, year, and industry fixed effects are included since previous studies have shown

TABLE 1 Descriptive statistics (No. of observations: n = 106 259; 2001-2019)

Variable	Mean	SD
Job satisfaction (0 = completely dissatisfied; 10 = completely satisfied)	7.113	1.954
Leisure-time physical activity		
LTPA weekly (0 = no, 1 = yes)	0.435	0.265
LTPA monthly (0 = no, 1 = yes)	0.076	0.496
LTPA infrequently (0 = no, 1 = yes; Ref.)	0.489	0.500
Individual characteristics		
Poor health (0 = other, 1 = at least poor health)	0.109	0.312
Age (in years)	43.11	11.11
Age^2 (in years)	1982.25	952.86
Male (0 = female, 1 = male)	0.513	0.500
Married (0 = other, 1 = married)	0.620	0.485
Children (number)	0.790	1.036
Household size (number)	2.984	1.315
Education (in years)	12.72	2.720
Job characteristics		
Gross income (€/month)	2677	2010
Workload (h/week)	38.31	11.49
Overtime workload (h/week)	2.131	3.419
Temporal job (0 = permanent; 1 = temporal)	0.113	0.316
Job change (0 = no, 1 = job change in the past)	0.136	0.343
Company tenure (in years)	11.04	10.16
Education match (1 = other, 1 = high fit between job and education)	0.596	0.491
Company size		
Company10 (0 = other, 1 = 1-10 employees)	0.144	0.351
Company100 (0 = other, 1 = 11-100 employees)	0.285	0.451
Company2000 (0 = other, 1 = 101-2000 employees)	0.311	0.463
Company>2000 (0 = other, 1 = more than 2000 employees; Ref.)	0.260	0.439
Job status		
Self-employed (0 = other, 1 = self-employed)	0.032	0.177
Blue collar (0 = other, 1 = blue-collar)	0.251	0.433
Apprentice (0 = other, 1 = apprentice)	0.029	0.167
White collar (0 = other, 1 = white-collar, Ref.)	0.610	0.488
Public servant (0 = other, 1 = public servant)	0.079	0.270

that job satisfaction depends on the type of industry, region, and differs over time.[16] The industries are classified according to NACE Rev. 2 (Statistical classification of economic activities in the European Community). In total, the empirical analysis controls for 59 different industries. Region refers to the 16 states in Germany.

2.3 | Empirical analysis

Based on the theoretical model, the following econometric Equation (3) can be formulated:

$$U_{it} = \beta_1 LTPA_{it} + \beta_2 H_{it} + \beta_3 X_{it} + \beta_1 J_{it} + \beta_4 I_{it} + \beta_5 Y_t + \beta_6 S_{it} \quad (3)$$

where U_{it} describes the level of job satisfaction and $LTPA_{it}$ describes how physically active an individual is during leisure time. In addition, H_{it} controls for an individual's health status, X_{it} for further individual characteristics, and J_{it} for job-specific characteristics. Finally, industry (I_{it}), year (Y_t), and state (S_{it}) fixed effects are considered.

To test the relationship between physical activity and job satisfaction, first, an OLS model based on the pooled data is estimated. However, since the OLS estimator is only unbiased if the explanatory variables are uncorrelated with the error term, the second model considers individual fixed effects. It is likely that unobserved individual effects are part of the error term and are potentially linked to both job satisfaction and the explanatory variable, in particular LTPA (e.g., preference, genetics). By including individual fixed effects those unobserved time-invariant characteristics are controlled for. Reverse causality could represent an additional problem, as current levels of job satisfaction might affect LTPA. As a consequence, a lagged job satisfaction variable U_{it-1} should be included in the model as well. However, when including a lagged dependent variable in a fixed effects framework, a dynamic panel data bias could potentially bias the estimated coefficients. A standard way of addressing this problem would be the use of instrumental variables. However, in the available dataset, no information qualifying for an appropriate instrument was available. An alternative is to utilize the panel structure and employ the Blundell and Bond

(BB)[31] generalized methods of moments (GMM) systems estimator. The BB uses past observations as instruments and estimates a system of two equations simultaneously[32]:

$$U_{it} = \beta_1 \Delta U_{it-1} + \beta_2 \Delta PA_{it} + \beta_3 \Delta H_{it} + \beta_4 \Delta X_{it} + \beta_5 \Delta J_{it} + \beta_6 \Delta I_{it} + \beta_7 \Delta Y_{it} + \beta_8 \Delta S_{it} \quad (4)$$

$$U_{it} = \beta_1 U_{it-1} + \beta_2 PA_{it} + \beta_3 H_{it} + \beta_4 X_{it} + \beta_5 J_{it} + \beta_6 I_{it} + \beta_7 Y_{it} + \beta_8 S_{it} \quad (5)$$

In Equation (4), all variables are transformed into first differences, whereas Equation (5) uses the untransformed levels of the same variables. As noted by Krug and Eberl,[32] computationally, the differences basically work as additional observations. The endogenous variables are then instrumented by the internal instruments represented by the lagged variables in differences and levels. The system BB estimator allows distinguishing between strictly exogenous variables, endogenous variables, and so-called predetermined variables which are not correlated with past or present values of the error term, but are allowed to be correlated with future values. In the framework of this study, the physical activity variables and the health variable are considered endogenous and the past values of job satisfaction and job-related characteristics including the working conditions, the job status, and the job branch are treated as predetermined. All remaining variables are considered exogenous.

For the identification assumptions to hold, the validity of the instruments has to be ensured. Therefore, two potential issues have to be considered. First, when applying the dynamic panel BB estimator it is important to consider the degree of autocorrelation in the data in order to identify the appropriate number of lags used as instruments. In all estimated BB models, the AR (1) and AR (2) were significant for the endogenous variables. Hence, the instrumenting started with the third lag as AR (3) was insignificant. As recommended by Roodman,[33] the predetermined variables were instrumented starting with the first lag. Another important assumption for the validity of the results is the exogeneity of the instruments. It can be tested by the Hansen J-test[34] which tests the overidentification restriction of the instruments by analyzing the sample analogue of the moment conditions used in the models. For all BB models, the null hypothesis of the Hansen J-test can be rejected as the *P*-values are well above the threshold of 0.1. Although the tests for serial correlation and the overidentification restriction do not indicate any problems with the identification assumption, it is still possible that unobserved confounders affect the validity of the exclusion restriction. Consequently, a falsification test is conducted with two alternative outcomes which are not affected by the treatment, but are potentially linked to confounders that correlate with the treatment and the outcome. The two outcomes selected are satisfaction with housing and family. Previous research has demonstrated that the different satisfaction domains could be linked due to unobserved individual characteristics or preferences.[35] The results show no significant effect of the instrumented physical activity variables on these dimensions. This insignificance strengthens the case that the instrumental variables are only linked to job satisfaction through the pathway of physical activity (Table A1).

Finally, to shed light on the moderators and mediators of the relationship between LTPA and job satisfaction, further analyses were conducted. First, the role of subjective health as a mediator was examined. Therefore, we followed the approach by Baron and Kenny[36] and estimated three separate models. In the first model, subjective health is regressed on physical activity. In the second model, job satisfaction is regressed on physical activity without subjective health and in the third model, job satisfaction is regressed on physical activity including subjective health. Then, the different coefficients are compared by conducting the Sobel-test.[37] The approach has already been applied in a similar context by Lera-López, Ollo-López, and Sánchez-Santos[38] when studying the effect of physical activity on life satisfaction and the role of subjective health as a mediator. Second, based on the assumption that physical activity is in particularly helpful in terms of dealing with work stress, the sample was split based on the fact that employees have to work overtime hours or not. Research has shown that overtime working hours significantly correlate with work-related stress[26] and hence can be utilized as a proxy.

2.4 | Results

Table 1 shows the descriptive statistics of the sample. The average job satisfaction of the respondents is 7.11 on a scale from 0 to 10. Overall, 43.5% of the respondents are physically active during leisure time at least once a week and 7.6% once a month. Over the years the descriptive characteristics of the sample are varying slightly (Table A2).

Table 2 displays the results of the regression analyses for the full sample. A side-to-side comparison reveals changes in the estimated coefficients based on the applied estimator. The OLS results indicate a significant positive effect of *LTPA weekly* on job satisfaction ($P < 0.001$). The coefficient indicates a significant increase of 0.07 on an 11-point scale measuring job satisfaction. When looking at a lower frequency of monthly physical activity, the effect becomes insignificant ($P = 0.304$). The fixed effects estimator in column two differences out an individual time-invariant fixed effect which could be related to some independent variables.

TABLE 2 Regression results full sample with the dependent variable: Job satisfaction (0-10)

	Pooled OLS	Fixed effects	BB System GMM
LTPA weekly	0.070*** (0.000)	0.030* (0.077)	0.181* (0.094)
LTPA monthly	−0.023 (0.304)	−0.014 (0.558)	0.063 (0.762)
Lagged job satisfaction	–	–	0.540*** (0.000)
Poor health	−1.234*** (0.000)	−0.632*** (0.000)	−0.879*** (0.000)
Age	−0.060*** (0.000)	−0.057*** (0.000)	−0.010 (0.460)
Age^2	0.001*** (0.000)	0.000*** (0.000)	0.000 (0.360)
Male	0.017 (0.249)	–	0.075 (0.201)
Married	0.037** (0.011)	0.031 (0.260)	−0.001 (0.960)
Children	0.050*** (0.000)	0.019 (0.165)	0.018 (0.192)
HH size	0.034*** (0.000)	0.010 (0.395)	0.018* (0.094)
Education	−0.031*** (0.000)	−0.045** (0.030)	−0.028** (0.022)
Gross income	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.002)
Workload	−0.008*** (0.000)	−0.003*** (0.001)	−0.011* (0.060)
Overtime workload	−0.008*** (0.000)	−0.008*** (0.000)	0.003 (0.845)
Temporal job	−0.091*** (0.000)	−0.023 (0.398)	0.241 (0.268)
Job change	0.184*** (0.000)	0.287*** (0.000)	0.636** (0.017)
Company tenure	−0.010*** (0.000)	−0.052*** (0.000)	0.002 (0.498)
Education match	0.097*** (0.000)	0.070*** (0.001)	0.015 (0.851)
Company10	0.075*** (0.001)	−0.179*** (0.000)	0.121 (0.297)
Company100	−0.007 (0.672)	−0.130*** (0.000)	0.059 (0.534)
Company2000	−0.032** (0.047)	−0.049** (0.030)	0.028 (0.400)
Self-employed	0.206*** (0.000)	0.143** (0.048)	−0.103 (0.657)
Blue collar	−0.211*** (0.000)	−0.238*** (0.000)	−0.082 (0.499)
Public servant	0.086*** (0.002)	0.154* (0.083)	0.008 (0.960)
Apprentice	0.266*** (0.000)	0.330*** (0.000)	−0.364 (0.475)
Constant	9.498*** (0.000)	11.006*** (0.000)	4.415** (0.048)
Industry fixed effects	Included	Included	Included
Regional fixed effects	Included	Included	Included
Time fixed effects	Included	Included	Included
AR(3) *P*-value	–	–	0.905
Hansen's *J* test			0.492
R-squared	0.073	0.043	–
Observations	106 259	106 259	80 606
Number of groups	–	34 481	25 224
Number of instruments	–	–	922

Note: Displayed are the coefficients; *P*-values in parentheses; ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$. Reference categories are: LTPA infrequent (Physical activity), Company>2000 (Company size), White collar (Job status), Mining (Industry), North Rhine-Westphalia (State).

Regarding the LTPA variables, similar results can be observed as *LTPA weekly* is still significant ($P = 0.076$) and *LTPA monthly* remains insignificant ($P = 0.558$). However, the coefficient of weekly LTPA is considerably smaller with only 0.03.

In order to address both omitted variables and reverse causality, the BB model is estimated. The results reveal a dynamic nature of job satisfaction as the lagged dependent variable is highly significant. Again, only participating weekly in LTPA has a significant positive effect on job satisfaction ($P = 0.094$). However, the coefficient is considerably higher as it indicates a significant increase in job satisfaction of 0.181. With respect to the socio-demographic and job-related control variables, the findings are mostly

in line with previous literature studying the determinants of job satisfaction.[11]

Turning to the mechanisms through which LTPA might affect job satisfaction, first, the role of subjective health as a mediator of the above relationship is examined (Table 3). Therefore, the procedure of Baron and Kenny[36] is applied to the OLS and fixed effects models. For the BB model, the Baron and Kenny[36] approach would have resulted in biased results as dynamic models differing in terms of sample size and lag structure would have been estimated across the different steps. First, the variable indicating poor or bad health is regressed on physical activity and the usual covariates. The results show a significant negative effect of weekly ($P < 0.001$) and monthly physical activity ($P < 0.001$) which indicates that physically active individuals are less likely to report

TABLE 3 Regression of the mediation analysis based on Baron and Kenny (58)

	Step 1		Step 2		Step3	
	Poor health		Job satisfaction		Job satisfaction	
	Pooled OLS	Fixed effects	Pooled OLS	Fixed effects	Pooled OLS	Fixed effects
LTPA weekly	−0.043*** (0.000)	−0.019*** (0.000)	0.123*** (0.000)	0.042** (0.013)	0.070*** (0.000)	0.030* (0.077)
LTPA monthly	−0.034*** (0.000)	−0.015*** (0.000)	0.018 (0.437)	−0.005 (0.831)	−0.023 (0.304)	−0.014 (0.558)
Poor health	–	–	–	–	−1.234*** (0.000)	−0.632*** (0.000)
Age	0.005*** (0.001)	−0.001 (0.002)	−0.064*** (0.004)	−0.056*** (0.014)	−0.060*** (0.004)	−0.057*** (0.014)
Age^2	−0.000 (0.000)	0.000*** (0.000)	0.001*** (0.000)	0.000*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
Male	−0.018*** (0.000)	–	0.039*** (0.009)	–	0.017 (0.249)	–
Married	−0.012*** (0.000)	−0.005 (0.294)	0.051*** (0.001)	0.033 (0.224)	0.037** (0.011)	0.031 (0.260)
Children	0.002 (0.101)	0.002 (0.370)	0.047*** (0.000)	0.018 (0.200)	0.050*** (0.000)	0.019 (0.165)
HH size	−0.007*** (0.000)	−0.001 (0.486)	0.043*** (0.000)	0.011 (0.349)	0.034*** (0.000)	0.010 (0.395)
Education	−0.004*** (0.000)	−0.003 (0.378)	−0.026*** (0.000)	−0.043** (0.038)	−0.031*** (0.000)	−0.045** (0.030)
Gross income	−0.000*** (0.000)	−0.000*** (0.001)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Workload	0.001*** (0.000)	0.001*** (0.002)	−0.009*** (0.000)	−0.004*** (0.000)	−0.008*** (0.000)	−0.003*** (0.001)
Overtime workload	−0.000 (0.156)	−0.002*** (0.000)	−0.007*** (0.000)	−0.007*** (0.001)	−0.008*** (0.000)	−0.008*** (0.000)
Temporal job	0.004 (0.282)	0.000 (0.971)	−0.102*** (0.000)	−0.022 (0.411)	−0.091*** (0.000)	−0.023 (0.398)
Job change	−0.000 (0.968)	−0.012*** (0.001)	0.186*** (0.000)	0.295*** (0.000)	0.184*** (0.000)	0.287*** (0.000)
Company tenure	0.000 (0.672)	0.001*** (0.000)	−0.010*** (0.000)	−0.053*** (0.000)	−0.010*** (0.000)	−0.052*** (0.000)
Education match	−0.015*** (0.000)	−0.002 (0.543)	0.116*** (0.000)	0.072*** (0.001)	0.097*** (0.000)	0.070*** (0.001)
Company10	−0.011*** (0.001)	0.004 (0.522)	0.088*** (0.000)	−0.180*** (0.000)	0.075*** (0.001)	−0.179*** (0.000)
Company100	−0.011*** (0.000)	0.001 (0.848)	0.005 (0.770)	−0.129*** (0.000)	−0.007 (0.672)	−0.130*** (0.000)
Company2000	−0.007*** (0.007)	0.003 (0.501)	−0.024 (0.141)	−0.051** (0.024)	−0.032** (0.047)	−0.049** (0.030)
Self-employed	0.002 (0.757)	−0.001 (0.939)	0.200*** (0.000)	0.144** (0.048)	0.206*** (0.000)	0.143** (0.048)
Blue collar	0.007** (0.012)	−0.009* (0.056)	−0.219*** (0.000)	−0.232*** (0.000)	−0.211*** (0.000)	−0.238*** (0.000)
Public servant	0.007 (0.126)	−0.007 (0.632)	0.077*** (0.006)	0.161* (0.072)	0.086*** (0.002)	0.154* (0.083)
Apprentice	0.002 (0.737)	−0.008 (0.437)	0.272*** (0.000)	0.336*** (0.000)	0.266*** (0.000)	0.330*** (0.000)
Constant	0.039 (0.373)	0.099 (0.393)	9.436*** (0.000)	10.867*** (0.000)	9.498*** (0.000)	11.006*** (0.000)
Industry fixed effects	Included	Included	Included	Included	Included	Included
Regional fixed effects	Included	Included	Included	Included	Included	Included
Time fixed effects	Included	Included	Included	Included	Included	Included
R-squared	0.030	0.010	0.035	0.031	0.073	0.043
Observations	109 853	109 853	106 347	106 347	106 259	106 259

Note: Displayed are the coefficients; *P*-values in parentheses; ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$. Reference categories are: LTPA infrequent (Physical activity); Company >2000 (Company size), White collar (Job status), Mining (Industry), North Rhine-Westphalia (State).

(Continues)

poor or bad health. In a second step, job satisfaction is regressed on physical activity, but without controlling for subjective health. In line with the results presented in Table 2, a significant effect can only be observed for weekly LTPA ($P < 0.001$). In comparison to the previously estimated models including the subjective health indicator, the coefficients are higher for both estimators, but the explanatory power of the model decreases. The Sobel-test[37] reveals that the difference between the coefficients is significant for the OLS ($Z = 20.41$, $P < 0.001$) and the fixed effects model ($Z = 6.18$, $P < 0.001$).

Additionally, to investigate the role of physical activity in the context of recovery from work stress, the sample is differentiated between employees who have overtime work hours and those who have not (Table 4). In line with the results of the full sample, a significant effect can only be observed for weekly LTPA. Notably, this effect only occurs in the sample with overtime work hours in the OLS ($P < 0.001$) and fixed effects model ($P = 0.043$). The coefficients of the BB estimator are not significant in both samples (No overtime hours: $P = 0.385$; With overtime hours: $P = 0.454$).

3 | DISCUSSION

This study aims to contribute new evidence to the relationship between LTPA and job satisfaction by focusing on this particular domain of life satisfaction. The key findings indicate a positive spillover effect of weekly LTPA on job satisfaction meaning that individuals who are weekly physically active in their leisure time report higher levels of job satisfaction. These results confirm previous findings from Wheatley and Bickerton[22] while using a richer dataset in terms of socio-demographic and in particular job-related control variables. However, a frequency of LTPA below at least once a week does not yield any significant benefits. This finding is in line with previous research demonstrating a dose–response relationship between physical activity and physical and mental health benefits in general.[39]

By utilizing the panel structure of the data, an unobserved heterogeneity bias due to correlated omitted variables and potential reverse causality from job satisfaction to LTPA is avoided and plausible causal evidence is added to the existing literature. The effect of weekly LTPA remains significant in the fixed effects and dynamic BB model. However, in the BB model, the coefficient of weekly LTPA is considerably higher in comparison to the pooled OLS and fixed effects model, potentially indicating a downward bias when not accounting for the dynamic nature of job satisfaction and state dependence. A similar pattern has been observed by Lenzen, Gannon, and Rose.[40] Also, the considerably higher confidence intervals and standard errors in the BB model may be partially responsible for the different coefficient sizes. Thus, the differences in coefficients should be treated with caution.

It should be noted that the contribution of weekly LTPA to job satisfaction, in particular in the OLS and fixed effects model, appears to be relatively small. However, when comparing the coefficients to the effects of the respective gross wage variables, the effects are equivalent to a monthly pay raise of 725€ (OLS), 363€ (FE), and 2636€ (BB), suggesting considerable economic relevance.

The relatively scarce literature on the determinants of job satisfaction suggests two plausible mechanisms through which LTPA could impact the level of job satisfaction: a mediation effect of subjective health and a moderating effect of enhancing the recovery process from work stress. The results of a mediation analysis clearly show that LTPA positively impacts subjective health and that in turn, subjective health has a significant mediator role in the relationship between LTPA and job satisfaction. Potential reasons for this effect might be that higher levels of health lead to better productivity. The second mechanism is examined by looking at the moderating role of work stress. The results indicate that the positive relationship between physical activity and job satisfaction can only be observed for those employees who have overtime work hours. Since overtime work hours are closely related to work stress,[24] it could indicate that the recovery from work demands serves as a significant moderator of this relationship. It also confirms previous studies using a smaller sample on the important role of physical activity in the recovery process of employees.[26] However, it is important to point out that the coefficients of the BB model were not significant. Although this difference could result from the smaller size of the subsamples, the findings should be interpreted with caution as reverse causality and the dynamic nature of job satisfaction are not accounted for and hence the present evidence can only be considered suggestive.

The results have implications for both employees and employers alike. From an employee perspective, it is important to be regularly physically active to create those positive spillover effects on job satisfaction and this is in particular importance when working under higher levels of stress. Also, with job satisfaction being an integral part of overall life satisfaction, the positive effects on job satisfaction describe one of the mechanisms of how physical activity impacts life satisfaction in general. From an employer's perspective, it can be recommended that to increase job satisfaction, offering more physical activity opportunities outside the work environment could be an effective instrument (e.g., collaborations with commercial fitness centers). In particular, existing research on

TABLE 4 Regression models (Sample differentiated by Overtime workload [1 = Yes; 0 = No])

	Overtime Workload (=0)			Overtime Workload (>0)		
	Pooled OLS	**Fixed effects**	**BB System GMM**	**Pooled OLS**	**Fixed effects**	**BB System GMM**
LTPA weekly	0.030 (0.128)	0.020 (0.487)	0.131 (0.377)	0.103*** (0.000)	0.050** (0.039)	0.152 (0.212)
LTPA monthly	−0.060* (0.096)	−0.011 (0.792)	0.082 (0.762)	−0.005 (0.878)	0.006 (0.859)	0.307 (0.255)
L.Job_satis	–	–	0.558*** (0.000)	–	–	0.466*** (0.000)
Poor health	−1.226*** (0.000)	−0.576*** (0.000)	−0.634*** (0.001)	−1.237*** (0.000)	−0.609*** (0.000)	−1.017*** (0.000)
Age	−0.061*** (0.000)	−0.044* (0.057)	−0.020 (0.281)	−0.055*** (0.000)	−0.071*** (0.000)	−0.005 (0.795)
Age^2	0.001*** (0.000)	0.000** (0.017)	0.000 (0.272)	0.001*** (0.000)	0.000*** (0.002)	0.000 (0.658)
Male	−0.007 (0.764)	–	0.057 (0.506)	0.050** (0.015)	–	0.135* (0.076)
Married	0.043** (0.049)	−0.017 (0.725)	−0.007 (0.831)	0.028 (0.170)	0.048 (0.210)	0.017 (0.552)
Children	0.010 (0.495)	0.043* (0.067)	−0.036* (0.092)	0.085*** (0.000)	0.015 (0.443)	0.048*** (0.008)
HH size	0.060*** (0.000)	0.016 (0.404)	0.041** (0.012)	0.007 (0.515)	0.010 (0.556)	−0.012 (0.431)
Education	−0.037*** (0.000)	−0.058 (0.107)	−0.030* (0.095)	−0.029*** (0.000)	−0.019 (0.574)	−0.020 (0.140)
Gross income	0.000*** (0.000)	0.000*** (0.000)	0.000 (0.105)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.006)
Workload	−0.007*** (0.000)	−0.000 (0.846)	−0.016* (0.057)	−0.011*** (0.000)	−0.010*** (0.000)	−0.009 (0.216)
Temporal job	−0.131*** (0.000)	−0.038 (0.395)	−0.067 (0.848)	−0.054* (0.095)	0.029 (0.483)	0.289 (0.279)
Job change	0.151*** (0.000)	0.231*** (0.000)	0.721*** (0.008)	0.224*** (0.000)	0.315*** (0.000)	0.147 (0.661)
Company tenure	−0.011*** (0.000)	−0.051*** (0.000)	−0.000 (0.930)	−0.009*** (0.000)	−0.055*** (0.000)	−0.003 (0.291)
Company10	0.089*** (0.006)	−0.081 (0.143)	−0.183 (0.284)	0.072** (0.027)	−0.289*** (0.000)	0.315** (0.046)
Company100	0.035 (0.188)	−0.052 (0.240)	0.011 (0.938)	−0.043* (0.064)	−0.216*** (0.000)	0.058 (0.598)
Company2000	0.006 (0.826)	−0.036 (0.360)	−0.054 (0.693)	−0.048** (0.021)	−0.068** (0.034)	0.052 (0.625)
Education match	0.139*** (0.000)	0.076** (0.033)	−0.061 (0.637)	0.061*** (0.001)	0.031 (0.311)	0.018 (0.862)
Self-employed	−0.467 (0.492)	0.039 (0.977)	5.835 (0.394)	−0.976 (0.199)	−2.668 (0.199)	0.801 (0.873)
Blue collar	−0.279*** (0.000)	−0.242*** (0.000)	−0.260* (0.086)	−0.163*** (0.000)	−0.171*** (0.000)	−0.032 (0.817)
Public servant	0.080* (0.054)	0.049 (0.733)	−0.028 (0.893)	0.091** (0.014)	0.125 (0.384)	0.155 (0.418)
Apprentice	0.298*** (0.000)	0.366*** (0.000)	−0.255 (0.656)	0.196*** (0.007)	0.252** (0.015)	0.445 (0.580)
Constant	9.513*** (0.000)	10.371*** (0.000)	4.279*** (0.000)	9.760*** (0.000)	11.655*** (0.000)	4.213** (0.031)
Industry-fixed effects	Included	Included	Included	Included	Included	Included
Regional-fixed effects	Included	Included	Included	Included	Included	Included
Time-fixed effects	Included	Included	Included	Included	Included	Included
AR(3) *P*-value	–	–	0.138	–	–	0.509
Hansen's *J*	–	–	0.562	–	–	0.893
R-squared	0.078	0.040	–	0.071	0.046	–
Observations	48 292	48 292	35 357	54 555	54 555	42 510
Number of groups	–	22 991	16 300	–	22 014	16 631
Number of instruments	–	–	868	–	–	889

Note: Displayed are the coefficients; *P*-values in parentheses; ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$. Reference categories are: LTPA infrequent (Physical activity); Company>2000 (Company size), White collar (Job status), Mining (Industry), North Rhine-Westphalia (State).

(Continues)

worksite physical activity interventions has produced inconclusive results in this context.[20]

The limitations of this study represent avenues for future research. First, the study only differentiates between levels of frequency, but does not consider intensity or duration. Hence, more research focusing on the intensity and duration of LTPA is needed. Second, future research should focus on the mediating role of health by using more detailed and objective health measures since this study only utilizes a broad subjective measure. Finally, more research on the moderating effect of work stress is required. Differentiation between different forms of work stress and more psychological insights into how physical activity enhances the recovery process could make valuable additions to the existing research body.

DISCLOSURE

Approval of the research protocol: N/A. *Informed consent:* All authors have given their informal consent to be included in the study. *Registry and the registration no. of the study/trial:* N/A. *Animal studies:* N/A. *Conflict of interest:* The authors declare no conflict of interest.

AUTHOR CONTIBUTIONS

SD designed the study and carried out the statistical analysis and drafted the manuscript. PW and CB helped to draft the manuscript and reviewed the results. All authors provided feedback to the manuscript, have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

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DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

CODE AVAILABILITY

The analysis has been conducted in stata15. The code is available on request.

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REFERENCES

1. Zhang Z, Chen W. A systematic review of the relationship between physical activity and happiness. *J Happiness Stud*. 2019;20(4):1305-1322.
2. Downward P, Dawson P. Is it pleasure or health from leisure that we benefit from most? An analysis of well-being alternatives and implications for policy. *Soc Indic Res*. 2016;126(1):443-465.
3. Van Praag BM, Frijters P, Ferrer-i-Carbonell A. The anatomy of subjective well-being. *J Econ Behav Organ*. 2003;51(1):29-49.
4. Wicker P, Coates D, Breuer C. The effect of a four-week fitness program on satisfaction with health and life. *Int J Public Health*. 2015;60(1):41-47.
5. Clark AE. Job satisfaction and gender: why are women so happy at work? *Labour Econ*. 1997;4(4):341-372.
6. Böckerman P, Ilmakunnas P. The job satisfaction-productivity nexus: a study using matched survey and register data. *ILR Rev*. 2012;65(2):244-262.
7. Lee BY, Wang J, Weststar J. Work hour congruence: the effect on job satisfaction and absenteeism. *Int J Hum Resour Manag*. 2015;26(5):657-675.
8. Srivastava S. Job satisfaction and organizational commitment relationship: effect of personality variables. *Vision*. 2013;17(2):159-167.
9. Tschopp C, Grote G, Gerber M. How career orientation shapes the job satisfaction–turnover intention link. *J Organ Behav*. 2014;35(2):151-171.
10. Clark AE, Oswald AJ. Satisfaction and comparison income. *J Public Econ*. 1996;61(3):359-381.
11. Gazioglu S, Tansel A. Job satisfaction in Britain: individual and job related factors. *Appl Econ*. 2006;38(10):1163-1171.
12. Eskildsen JK, Kristensen K, Westlund AH. Work motivation and job satisfaction in the Nordic countries. *Empl Relat*. 2004;26(2):122-136.
13. Staines GL. Spillover versus compensation: a review of the literature on the relationship between work and nonwork. *Hum Relat*. 1980;33(2):111-129.
14. Du D, Derks D, Bakker AB. Daily spillover from family to work: a test of the work–home resources model. *J Occup Health Psych*. 2018;23(2):237-247.
15. Mojza EJ, Sonnentag S, Bornemann C. Volunteer work as a valuable leisure-time activity: a day-level study on volunteer work, non-work experiences, and well-being at work. *J Occup Organ Psychol*. 2011;84(1):123-152.
16. Clark AE. Job satisfaction in Britain. *Br J Ind Relat*. 1996;34(2):189-217.
17. Johnson S, Cooper C, Cartwright S, Donald I, Taylor P, Millet C. The experience of work-related stress across occupations. *J Manag Psychol*. 2005;20(2):178-187.
18. Sonnentag S, Jelden S. Job stressors and the pursuit of sport activities: a day-level perspective. *J Occup Health Psychol*. 2009;14(2):165-181.
19. Coffeng JK, Boot CR, Duijts SF, Twisk JW, van Mechelen W, Hendriksen IJ. Effectiveness of a worksite social & physical environment intervention on need for recovery, physical activity and relaxation; results of a randomized controlled trial. *PLoS One*. 2014;9(12):1-26.
20. Proper KI, Staal BJ, Hildebrandt VH, van der Beek AJ, van Mechelen W. Effectiveness of physical activity programs at

worksites with respect to work-related outcomes. *Scand J Work Environ Health*. 2002;28(2):75-84.
21. Hecht TD, Boies K. Structure and correlates of spillover from nonwork to work: an examination of nonwork activities, well-being, and work outcomes. *J Occup Health Psychol*. 2009;14(4):414-426.
22. Wheatley D, Bickerton C. Subjective well-being and engagement in arts, culture and sport. *J Cult Econ*. 2017;41(1):23-45.
23. de-Pedro-Jiménez D, Meneses-Monroy A, de Diego-Cordero R, Hernández-Martín MM, Moreno-Pimentel AG, Romero-Saldaña M. Occupational and leisure-time physical activity related to job stress and job satisfaction: correspondence analysis on a population-based study. *Int J Env Res Pub Health*. 2021;18(21):1-12.
24. Arslan SS, Alemdaroğlu İ, Karaduman AA, Yilmaz ÖT. The effects of physical activity on sleep quality, job satisfaction, and quality of life in office workers. *Work*. 2021;63(1):3-7.
25. Marín-Farrona MJ, León-Jiménez M, García-Unanue J, Gallardo L, Liguori G, López-Fernández J. Influence of non-occupational physical activity on burnout syndrome, job satisfaction, stress and recovery in fitness professionals. *Int J Environ Res Public Health*. 2021;18(18):2-11.
26. Sonnentag S, Zijlstra FRH. Job characteristics and off-job activities as predictors of need for recovery, well-being, and fatigue. *J Appl Psychol*. 2006;91(2):330-350.
27. GSOEP. *Data for Year 1984–2019*. DIW; 2021. version 36.
28. Lechner M. Long-run labour market and health effects of individual sports activities. *J Health Econ*. 2009;28(4):839-854.
29. Cornelißen T. The interaction of job satisfaction, job search, and job changes. An empirical investigation with German panel data. *J Happiness Stud*. 2009;10(3):367-384.
30. Fahr R. Job design and job satisfaction—empirical evidence for Germany? *Manag Rev*. 2011;22(1):28-46.
31. Blundell R, Bond S. Initial conditions and moment restrictions in dynamic panel data models. *J Econom*. 1998;87(1):115-143.
32. Krug G, Eberl A. What explains the negative effect of unemployment on health? An analysis accounting for reverse causality. *Res Soc Stratif Mobil*. 2018;55:25-39.
33. Roodman D. How to do xtabond2: an introduction to difference and system GMM in Stata. *Stata J*. 2009;9(1):86-136.
34. Hansen LP. Large sample properties of generalized method of moments estimators. *Econometrica*. 1982;50(4):1029-1054.
35. Rojas M. Life satisfaction and satisfaction in domains of life: is it a simple relationship? *J Happiness Stud*. 2006;7(4):467-497.
36. Baron RM, Kenny DA. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol*. 1986;51(6):1173-1182.
37. Sobel ME. Asymptotic confidence intervals for indirect effects in structural equation models. *Sociol Methodol*. 1982;13:290-312.
38. Lera-López F, Ollo-López A, Sánchez-Santos JM. How does physical activity make you feel better? The mediational role of perceived health. *Appl Res Qual Life*. 2017;12(3):511-531.
39. Hamer M, Stamatakis E, Steptoe A. Dose-response relationship between physical activity and mental health: the Scottish health survey. *Br J Sport Med*. 2009;43(14):1111-1114.
40. Lenzen S, Gannon B, Rose C. A dynamic microeconomic analysis of the impact of physical activity on cognition among older people. *Econ Hum Biol*. 2020;39:1-37.

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APPENDIX A

TABLE A1 Falsification test of BB models

	Housing satisfaction	Family satisfaction
LTPA weekly	0.067 (0.467)	−0.010 (0.921)
LTPA monthly	0.213 (0.203)	−0.078 (0.691)
Lagged housing satis.	0.440*** (0.000)	–
Lagged family satis.	–	0.494*** (0.000)
Poor health	−0.451*** (0.003)	−0.649*** (0.000)
Age	−0.017 (0.182)	−0.057*** (0.000)
Age^2	0.000 (0.112)	0.001*** (0.000)
Male	−0.016 (0.757)	0.053 (0.355)
Married	0.237*** (0.000)	0.351*** (0.000)
Children	−0.040*** (0.003)	−0.087*** (0.000)
HH size	0.015 (0.148)	0.079*** (0.000)
Education	0.015 (0.177)	−0.001 (0.949)
Gross income	0.000* (0.078)	−0.000 (0.223)
Workload	−0.005 (0.352)	−0.005 (0.357)
Overtime workload	−0.005 (0.700)	0.008 (0.629)
Temporal job	0.123 (0.564)	−0.095 (0.632)
Job change	0.277 (0.172)	−0.038 (0.857)
Company tenure	0.008*** (0.000)	0.000 (0.911)
Education match	−0.032 (0.647)	−0.036 (0.667)
Company10	0.100 (0.330)	−0.066 (0.558)
Company100	0.086 (0.296)	−0.040 (0.681)
Company2000	0.034 (0.695)	−0.038 (0.689)
Self-employed	0.121 (0.552)	0.340 (0.176)
Blue collar	−0.040 (0.698)	0.006 (0.958)
Public servant	0.099 (0.448)	0.180 (0.268)
Apprentice	−0.573 (0.179)	−0.781 (0.128)
Constant	5.742*** (0.000)	5.731*** (0.000)
Industry-fixed effects	Included	Included
Regional-fixed effects	Included	Included
Time-fixed effects	Included	Included
AR(3) *P*-value	0.319	0.968
Hansen's *J* test	0.985	0.717
Observations	86 923	57 524
Number of groups	27 346	21 803
Number of instruments	922	918

Note: Displayed are the coefficients; *P*-values in parentheses; ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$. Reference categories are: LTPA infrequent (Physical activity); Company>2000 (Company size), White collar (Job status), Mining (Industry), North Rhine-Westphalia (State). The family satisfaction model was estimated for the period 2008-2019.

TABLE A2 Descriptive statistics by year in the sample

Variable	Y2001	Y2003	Y2005	Y2007	Y2008	Y2009	Y2011	Y2013	Y2015	Y2017	Y2019
Job satisfaction	7.179 (1.971)	7.075 (1.914)	7.011 (1.970)	6.980 (1.923)	6.991 (1.933)	6.979 (2.032)	7.152 (2.002)	7.165 (1.969)	7.202 (1.926)	7.154 (1.936)	7.239 (1.895)
LTPA weekly	0.319 (0.466)	0.386 (0.487)	0.370 (0.483)	0.390 (0.488)	0.440 (0.496)	0.407 (0.491)	0.405 (0.491)	0.502 (0.500)	0.457 (0.498)	0.479 (0.500)	0.559 (0.497)
LTPA monthly	0.078 (0.268)	0.100 (0.300)	0.093 (0.290)	0.093 (0.290)	0.095 (0.294)	0.090 (0.286)	0.082 (0.274)	0.058 (0.234)	0.064 (0.245)	0.058 (0.234)	0.051 (0.219)
LTPA infrequently	0.604 (0.489)	0.514 (0.500)	0.537 (0.499)	0.517 (0.500)	0.464 (0.499)	0.503 (0.500)	0.514 (0.500)	0.440 (0.496)	0.479 (0.500)	0.462 (0.499)	0.390 (0.488)
Individual characteristics											
Poor health	0.091 (0.287)	0.100 (0.300)	0.106 (0.308)	0.100 (0.301)	0.106 (0.308)	0.105 (0.307)	0.118 (0.322)	0.116 (0.320)	0.115 (0.319)	0.117 (0.322)	0.115 (0.319)
Age	40.26 (11.09)	41.06 (11.00)	42.14 (11.09)	42.62 (11.19)	43.08 (11.13)	43.39 (11.38)	42.75 (10.51)	43.22 (10.85)	43.85 (10.96)	44.74 (11.00)	45.53 (11.25)
Age^2	1743 (910.06)	1807 (914.45)	1898 (932.40)	1941 (949.06)	1979 (948.24)	2012 (974.22)	1938 (903.70)	1985 (927.64)	2042 (950.22)	2122 (970.34)	2199 (999.49)
Male	0.562 (0.496)	0.547 (0.498)	0.542 (0.498)	0.534 (0.499)	0.527 (0.499)	0.522 (0.500)	0.517 (0.500)	0.486 (0.500)	0.491 (0.500)	0.485 (0.500)	0.472 (0.500)
Married	0.632 (0.482)	0.619 (0.486)	0.626 (0.484)	0.617 (0.486)	0.615 (0.487)	0.606 (0.489)	0.632 (0.482)	0.608 (0.488)	0.623 (0.485)	0.624 (0.484)	0.613 (0.487)
Children	0.704 (0.942)	0.674 (0.930)	0.640 (0.937)	0.616 (0.908)	0.588 (0.890)	0.562 (0.873)	1.058 (1.167)	1.026 (1.156)	0.929 (1.101)	0.851 (1.069)	0.785 (1.040)
Household size	2.972 (1.266)	2.935 (1.268)	2.903 (1.262)	2.855 (1.226)	2.832 (1.219)	2.806 (1.218)	3.182 (1.352)	3.135 (1.389)	3.097 (1.367)	3.005 (1.352)	2.935 (1.363)
Education	12.25 (2.536)	12.40 (2.583)	12.72 (2.728)	12.80 (2.716)	12.83 (2.731)	12.82 (2.721)	12.86 (2.754)	12.78 (2.714)	12.66 (2.737)	12.76 (2.763)	12.93 (2.784)
Job characteristics											
Gross income	2205 (1384)	2403 (1579)	2635 (2002)	2640 (2122)	2672 (2120)	2670 (2138)	2693 (2275)	2620 (1969)	2739 (1959)	2882 (1929)	3072 (2185)
Workload	39.77 (11.06)	39.16 (11.00)	39.44 (11.37)	39.62 (11.78)	39.51 (11.64)	39.30 (11.84)	38.43 (12.18)	37.42 (11.46)	37.05 (11.29)	36.90 (11.09)	36.62 (10.92)
Overtime workload	2.145 (3.459)	2.033 (3.347)	2.126 (3.572)	2.309 (3.703)	2.287 (3.583)	2.142 (3.604)	2.290 (3.609)	2.089 (3.270)	2.130 (3.283)	1.976 (3.124)	1.975 (3.173)
Temporal job	0.112 (0.315)	0.102 (0.303)	0.096 (0.295)	0.111 (0.314)	0.112 (0.315)	0.115 (0.319)	0.120 (0.325)	0.141 (0.348)	0.128 (0.335)	0.100 (0.300)	0.094 (0.291)
Job change	0.133 (0.340)	0.109 (0.311)	0.108 (0.310)	0.125 (0.330)	0.123 (0.328)	0.123 (0.328)	0.151 (0.358)	0.150 (0.357)	0.148 (0.355)	0.146 (0.353)	0.153 (0.360)

(Continues)

TABLE A2 (Continued)

Variable	Y2001	Y2003	Y2005	Y2007	Y2008	Y2009	Y2011	Y2013	Y2015	Y2017	Y2019
Company tenure	10.08 (9.659)	10.62 (9.808)	11.38 (9.974)	11.34 (9.977)	11.58 (10.21)	11.72 (10.40)	10.94 (9.901)	10.88 (10.16)	10.77 (10.18)	11.02 (10.43)	11.23 (10.70)
Education match	0.559 (0.496)	0.583 (0.493)	0.596 (0.491)	0.601 (0.490)	0.605 (0.489)	0.607 (0.489)	0.607 (0.489)	0.598 (0.490)	0.591 (0.492)	0.604 (0.489)	0.596 (0.491)
Company10	0.095 (0.294)	0.102 (0.302)	0.120 (0.324)	0.190 (0.392)	0.187 (0.390)	0.192 (0.394)	0.188 (0.391)	0.137 (0.344)	0.139 (0.346)	0.123 (0.328)	0.118 (0.323)
Company100	0.372 (0.483)	0.360 (0.480)	0.348 (0.476)	0.266 (0.442)	0.271 (0.445)	0.274 (0.446)	0.275 (0.446)	0.269 (0.444)	0.267 (0.442)	0.245 (0.430)	0.238 (0.426)
Company2000	0.314 (0.464)	0.318 (0.466)	0.304 (0.460)	0.309 (0.462)	0.310 (0.463)	0.301 (0.459)	0.300 (0.458)	0.321 (0.467)	0.310 (0.462)	0.315 (0.465)	0.314 (0.464)
Company>2000	0.219 (0.413)	0.220 (0.414)	0.229 (0.420)	0.235 (0.424)	0.232 (0.422)	0.233 (0.423)	0.238 (0.426)	0.273 (0.445)	0.285 (0.451)	0.317 (0.465)	0.329 (0.470)
Self-employed	0.048 (0.214)	0.049 (0.216)	0.062 (0.241)	0.060 (0.237)	0.061 (0.239)	0.061 (0.239)	0.052 (0.223)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Blue collar	0.326 (0.469)	0.300 (0.458)	0.279 (0.448)	0.278 (0.448)	0.273 (0.446)	0.260 (0.439)	0.242 (0.428)	0.221 (0.415)	0.231 (0.422)	0.216 (0.411)	0.188 (0.391)
Apprentice	0.049 (0.216)	0.042 (0.200)	0.041 (0.197)	0.036 (0.186)	0.034 (0.182)	0.037 (0.189)	0.029 (0.167)	0.040 (0.196)	0.025 (0.155)	0.000 (0.000)	0.000 (0.000)
White collar	0.505 (0.500)	0.535 (0.499)	0.530 (0.499)	0.541 (0.498)	0.548 (0.498)	0.560 (0.496)	0.599 (0.490)	0.658 (0.474)	0.670 (0.470)	0.708 (0.455)	0.738 (0.440)
Public servant	0.072 (0.259)	0.074 (0.262)	0.089 (0.285)	0.085 (0.279)	0.084 (0.277)	0.082 (0.275)	0.078 (0.269)	0.081 (0.273)	0.074 (0.262)	0.076 (0.265)	0.074 (0.262)
No. of observations	8662	7566	8275	8698	7951	8558	11 505	11 451	10 902	11 928	10 763

Note: Displayed are the mean values; standard deviations in parentheses.