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Insights on physical behavior while working from home: An ecological momentary assessment study

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Abstract

Ever since the COVID-19 pandemic, working from home (WFH) has emerged as a common alternative work environment, but the possible influence on daily physical behavior (PB) (i.e., physical activity (PA), sedentary behavior (SB)) remains unclear. This study aimed to examine daily associations between PB and the work environment (i.e., WFH, working at the office (WAO)), as well as to explore and identify patterns of PB within each work environment.

An observational study using a dual-accelerometer system to continuously assess PB for at least 5 days was conducted. The sample consisted of 55 participants providing 276 days of assessment. Additional demographic, contextual, and psychological variables were measured via baseline questionnaire and several smartphone prompts per day. To analyze the effects of the work environment on PB, multilevel analyses were conducted. For the identification of patterns within each work environment, latent class trajectory modelling was applied.

Associations between the work environment and various PA parameters were found, indicating that WFH has a negative effect on MVPA time, steps, and physical activity intensity (MET), but a positive effect on short PA bouts (≤5 min). No associations between the work environment and any SB parameter (i.e., SB time, SB breaks, SB bouts) were found. Latent class trajectory modelling revealed three MVPA patterns for days WFH, and two patterns for days WAO.

Given the growing prevalence of WFH and the positive health effects associated with MVPA, daily-tailored solutions to enhance MPVA while WFH are urgently needed.

KEYWORDS
accelerometry, physical activity, physical behavior, sedentary behavior, working from home

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Additional supporting information may be found online in the Supporting Information section.

1 | INTRODUCTION

New work environments are increasingly important within everyday work routines. Rapid technological developments in information- and communication technology have led to the opportunity to work remotely from a variety of physical places other than the conventional office, for example, to perform work from home.[1] However, despite several benefits of working from home (WFH) including saving daily commuting time[2] or enhancing work-life balance,[1] a relatively rare usage has been observed in the past decade. In 2019 for example, only 2.9% of employees worldwide performed work exclusively or mainly from home.[3]

With the outbreak of the COVID-19 pandemic in March 2020 and related measures to reduce the spread of the virus, an unprecedented and sudden shift to WFH across many countries around the world (e.g., in Germany) was introduced. Today, even 3 years after the beginning of this natural experiment, WFH has become an integral part of the working world suggesting that the future of work is likely to be hybrid combining days working remotely, predominantly from home, and days working in-person at the office.[4] Given this change in the nature of work towards new work models, which all can be located on a continuum with fully in-person work and fully remote work representing the two ends,[5] new opportunities and challenges for promoting health arise.

In modern society, everyday life for many working adults is characterized by low levels of physical activity (PA) and high levels of sedentary behavior (SB). Regarding daily environments of physical behavior (PB) (i.e., including both PA and SB), especially the workplace represents a main contributor to those PB patterns.[6] While PA, defined as any bodily movement which increases energy expenditure >1.5 metabolic equivalents (MET),[7] depicts a major protective factor for the prevention of non-communicable diseases like cardiovascular diseases, diabetes and obesity,[8] SB, defined as any waking behavior in a sitting, reclining or lying posture with an energy expenditure ≤1.5 MET,[9] appears as a major risk factor for health.[10] Importantly, several studies suggest that both behaviors have independent effects on somatic and mental health.[11,12] Hence, given the increasing importance of WFH as an alternative work environment, and the strong epidemiological evidence on the health effects of PB, there is an urgent need to better understand how WFH affects PB.

Summarizing the extant literature on the relationship between WFH and PB, evidence is rather inconclusive; while some studies found similar levels of SB and PA while WFH compared with while working at the office (WAO),[13–15] other studies found an increase in SB time[15] or a decrease in PA during WFH.[2,16–18] A possible explanation for divergent findings may be discrepancies in study characteristics (e.g., study design, measurement tools, operationalization of PA and SB). First, several studies investigating PB within the context of WFH have been cross-sectional combined with retrospective data, providing only limited assessments per participant.[2,16] Therefore, these studies focused on differences between participants and do not account for potential fluctuation of PB across time that varies between days within individuals. Second, a majority of studies[2,15,16] have assessed PB by the use of self-reports, which are prone to biases (e.g., social desirability, inaccurate memory).[19,20] And last, various operationalizations of PA and SB were used which limits the comparability of results. In general, the operationalization of PB may vary as a function of different ways of quantitative parametrization. Thus, PB can be expressed as frequency-related parameters (e.g., number of sedentary breaks per days), time-related parameters (e.g., time of PB during a specified time frame), and intensity-related parameters (e.g., MET). Additional contextual parameters (e.g., domain of each PB such as work, transportation, or leisure time) may provide further valuable background information.

To overcome the above-mentioned limitations, we conducted an ecological momentary assessment study. Given the natural co-dependency of all PB (i.e., sleep, SB, various intensities of PA) over a predefined time frame[9] and the call to assess PB over a whole 24-h cycle,[21] we captured PB by the use of a dual-sensor system 24 h per day. Additional psychological and contextual variables were assessed in real time and in real life to minimize retrospective and heuristic biases.[22] The aim of this study was twofold. First, we wanted to investigate whether the work environment influences PB. Based on the results of previous studies,[13,14,17] we hypothesized that the work environment (i.e., WFH, WAO) affects PA (hypothesis 1), but not SB (hypothesis 2). Due to the high number of various parameters known for the operationalization of PA and SB, eight different parameters to investigate the effect of the work environment on PA (i.e., time spent in light physical activity (LPA), representing hypothesis 1_a; time spent in moderate-to-vigorous-physical activity (MVPA), representing hypothesis 1_b; physical activity intensity (MET), representing hypothesis 1_c; steps, representing hypothesis 1_d; short PA bouts (≤5 min), representing hypothesis 1_e; short-to-moderate PA bouts (5–19 min), representing hypothesis 1_f; moderate-to-long PA bouts (20–39 min), representing hypothesis 1_g; long PA bouts (≥40 min), representing hypothesis 1_h) and six different parameters to investigate the effect of the work environment on SB (i.e., time spent in SB, representing hypothesis 2_a; sedentary break frequency, representing hypothesis 2_b; short SB bouts (≤5 min), representing hypothesis 2_c; short-to-moderate SB bouts (5–19 min), representing hypothesis 2_d; moderate-to-long SB bouts (20–39 min), representing hypothesis 2_e; long SB bouts (≥40 min), representing hypothesis 2_f) were used. Given recent evidence suggesting associations between PB and psychological constructs such as mood or stress,[12,23] we adjusted for the potential confounding role of these constructs in all of our analyses. The second objective was to explore the effect of the work environment on PB by uncovering possible hidden trajectories of PB within days WFH and days WAO. As it is reasonable to assume that changes in the work environment lead to changes in PB patterns,[24] we conducted further analyses to gain deeper insights into whether the same number of patterns can be found within each work environment and whether potential patterns are comparable across work environments.

2 | MATERIALS AND METHODS

2.1 | Study design and sample

An observational study over a minimum of five working days using a within-subject design was conducted. During this assessment period, participants were instructed to wear two accelerometers (Move 4) continuously for 24 h per day, and to complete several random e-diary prompts on a provided study smartphone (Nokia 6, Nokia Corporation, Espoo, Finland, nokia.com). We recruited working adults ≥18 years from different organizations in Karlsruhe and the surrounding area between July 2021 and March 2022. The inclusion criteria were as follows: (a) predominantly office-based work, (b) having the possibility to WFH and WAO, and (c) no restrictions in performing daily activities (i.e., no disease or injury). A total of 64 participants completed measurements of PB providing 378 days of assessment. Due to compliance reasons, that is <3 valid days of a minimum accelerometer wear time ≥10 h wakeful time per day, two participants were excluded for further analysis.[25] Additionally, 90 nonvalid days among different participants were excluded because neither the wear time of one sensor nor the wear time of both sensors combined was ≥10 h of wakeful time. Since one of the objectives of the following analyses was to compare PB between WFH days and WAO days, seven participants were excluded because they either reported only valid days WFH or only valid days WAO. After all, the final sample used for further data analysis consisted of 55 participants providing 276 valid days of assessment (135 days WAO, 141 days WFH). The study was performed in accordance with the Declaration of Helsinki and approved by the Human Research Ethics Committee of the Karlsruhe Institute of Technology (KIT). After receiving written and oral information regarding the study procedures, all participants provided their written informed consent. Participants were free to withdraw from the study at any time.

2.2 | Measures

2.2.1 | Accelerometry

PB was continuously collected by the use of two accelerometers (Move 4), one placed on the right thigh, and one placed on the hip. The two sensors captured movement and body position with a range of ±16 g and a sampling frequency of 64 Hz was used. Raw acceleration data were stored on an internal memory card. To eliminate artifacts, data were processed by a band-pass filter (0.25–11 Hz). A previous study by Anastasopoulou et al.[26] has validated the Move accelerometer using indirect calorimetry as the gold standard. Participants were instructed to wear both sensors 24 h per day during the entire measurement period.

2.2.2 | Baseline questionnaire

Sociodemographic characteristics including age (years), sex (female vs. male), body mass index (kg/m^2), and household size (number of persons living in the same household as the participant), as well as work-related characteristics including the use of a separate room while WFH (yes vs. no), and distance to the conventional workplace (km), were assessed at baseline via questionnaire provided on the smartphone.

2.2.3 | Ecological momentary assessment

Eight e-diary prompts per day were provided between 9.00 am and 8.00 pm via an acoustic, visual, and vibration signal by smartphone. With the first e-diary prompt in the morning, every participant specified the daily location of work (home vs. office), sleep duration of the previous night (h), and rated the perceived sleep quality of the previous night on a visual analogue scale (0–100). The other seven prompts were randomly triggered at various time points throughout the day to assess momentary mood, momentary social stress, momentary activity-related stress, and momentary work ability as follows: Momentary mood was assessed with a 6-item short scale developed and validated by Wilhelm and Schoebi.[27] The bipolar items were implemented on visual analog scales (0–100) in reversed polarity and mixed order. In general, the scale captures three basic mood dimensions, namely valence, determined by the items

(a) unwell to well and (b) content to discontent, energetic arousal, determined by the items (a) full energy to without energy (b) tired to awake, and calmness, determined by the items (a) relaxed to tense, (b) agitated to calm. Momentary social stress was measured by one question regarding the participants' current social environment combined with two rating items. First, participants were asked by whom they were surrounded at the moment of the prompt (i.e., partner, family, friends, colleagues, acquaintances, strangers, others, nobody). Second, the mean score of the following two items, both rated on a Likert scale ranging from 1 ("not at all") to 7 ("very much"), was computed: "I would prefer to be alone (if with someone)/I would prefer to have company (if alone)", "I find being with these people pleasant (if with someone)/I find it pleasant to be alone (if alone)" (reversed).[28] To assess momentary activity-related stress, the mean score of the following three items, all rated on a Likert scale ranging from 1 ("not at all") to 7 ("very much"), was used: "I would prefer doing something else", "This activity is difficult for me", "This is a pleasant activity" (reversed).[28] Momentary self-perceived work ability was assessed with the following item of the Work Ability Index rated on a 10-point Likert scale from 0 ("cannot currently work at all") to 10 ("work ability at its best"): "Assume that your work ability at its best has a value of 10 points. How many points would you give your current work ability?".[29] German translations of all questions and items were presented to the participants. As our analyses focused on the day-level and the e-diary prompts were triggered multiple times a day, daily averages for all momentary variables were calculated.

2.3 | Data preprocessing and statistical analyses

To parameterize PB, we calculated various parameters (e.g., energy expenditure, steps, body position) in intervals of 1 minute by using the proprietary software DataAnalyzer (version 1.13.7; movisense.com). Based on the parameters "body position" and "energy expenditure" (MET), as well as in line with the international definition of SB[9] and published thresholds to further specify PA into LPA and MVPA,[30] we classified each minute of the data file as either sleep, LPA, MVPA or SB. Moreover, we categorized SB and PA time in accordance with previous research[31] into bouts (periods of uninterrupted SB/PA time) as follows: (a) ≤5 min = short bouts, (b) 5–19 min = short-to-moderate bouts, (c) 20–39 min = moderate-to-long bouts and (d) ≥ 40 min = long bouts. Last, we aggregated all parameters either as sum or mean per day.

To analyze whether the work environment influences PB, multi-level analyses (SPSS, version 27; IBM) were conducted. A total of 14 two-level models with days of assessment (level 1) nested within participants (level 2) were calculated, with one model for each PB parameter as outcome variable. The final analyses were completed in five stages. First, to examine the amount of variance on the within-vs. between-person-level, intraclass correlation coefficients for all models were estimated by calculating unconditional (null-)models. Second, the time-variant predictor work environment (i.e., WFH = 0, WAO = 1) was included at level 1 within all models. Third, to adjust for potential confounding factors which may influence PB and the association between the work environment and PB, the following control variables were included: (a) age (years), sex (male vs. female), body mass index (kg/m^2), household size (number of cohabitants), and distance to work (km) as between-person (level 2) variables, and (b) valence (0–100), sleep quality (0–100), sleep duration (h), social stress (1–7), activity stress (1–7), and work ability (1–10) as within-person (level 1) variables. All within-person control variables were centered on the participant mean. Fourth, random effects (i.e., individual variation on the sample mean effect) for each PB parameter (μ_{ij}) were included. While random intercepts were used for all models, random slope parameters were only computed if they did improve the models ($p < 0.05$). Last, standardized beta coefficients were calculated according to established procedures[32] to compare the effect of the work environment on each PB parameter.

As an example, the final model of the outcome variable "MVPA time" is shown in the equation below. The remaining 13 final models can be found in the equations presented in the Supporting Information (Equation 1–Equation 13).

$$
\begin{aligned}
Y(\text{MVPA time})_{ij} = {} & \gamma_{00} + \gamma_{01}(\text{sex}) + \gamma_{02}(\text{age}) \\
& + \gamma_{03}(\text{body mass index}) + \gamma_{04}(\text{household size}) \\
& + \gamma_{05}(\text{distance to work}) + \gamma_{10}(\text{valence}) \\
& + \gamma_{20}(\text{sleep quality}) + \gamma_{30}(\text{sleep duration}) \\
& + \gamma_{40}(\text{social stress}) + \gamma_{50}(\text{activity stress}) \\
& + \gamma_{60}(\text{work ability}) + \gamma_{70}(\text{work environment}) + \mu_{0j}
\end{aligned}
$$

For identifying trajectories of PB within days WFH and days WAO, latent class trajectory modelling was applied using the statistic software programs R (R Core Team, 2021) and RStudio (RStudio Team, 2021). Based on the standardized beta coefficients of the 14 multilevel models, we exploratory selected our parameter of interest (i.e., MVPA time) for the identifications of trajectories on days WFH and days WAO. By following a stepwise approach proposed by Lennon and colleagues,[33] the optimal models for days WFH and days WAO were constructed. We started with defining the number of groups by comparing models with 1–7 classes. Based on the lowest value of the Bayesian information criteria, we continued our analyses with a 3-profile solution for WFH days and a 2-profile solution for WAO days (Table S1). Subsequently, we refined these models by examining the optimal model structure (i.e., simple fixed effects model, several random effects model) and by checking a number of model adequacy assessments (i.e., average posterior probability of assignments, odds of correct classification, relative entropy). Strongest improvements in model fit were observed among the four random quadratic effect models with different variance structures and different variance–covariance matrices (Table S2 and Table S3). Given the lowest values of the Bayesian information criteria and a sufficient number of days within classes, we selected model I as best-fitting model for days WFH. For days WAO, we also chose model I as final model because the two models with lower values of the Bayesian information criteria showed one class with a small number of days ($n=3$). As latent class trajectory modelling illustrates changes in the outcomes of interest over a predefined time period, we accumulated minutes spent in MVPA for four time frames throughout the day: (a) morning (9.00 am to 11.59 pm), (b) noon (12.00 pm to 2.59 pm), (c) afternoon (3.00 pm to 5.59 pm), and (d) evening (6.00 pm to 8.59 pm).

TABLE 1 Characteristics of the study population.

Variable	Mean ± SD or n (%)
Age (years) ($n=53$)	35.9 ± 10.5
Sex ($n=53$)	
Female	34 (64.2)
Male	19 (34.5)
BMI (kg/m^2) ($n=53$)	23.0 ± 3.8
Job characteristics[a] ($n=48$)	
Full-time (100%)	28 (58.3)
More than part-time (51%–100%)	12 (25.0)
Part time (50%)	8 (16.7)
Household members ($n=49$)	
No others	10 (20.4)
Partner	31 (63.3)
Children	14 (28.6)
Relatives	6 (12.2)
Pets	12 (24.5)
Worked from home before COVID-19 ($n=49$)	
Yes	15 (30.6)
No	34 (69.4)
Separate room while WFH ($n=49$)	
Yes	24 (49.0)
No	25 (51.0)
Distance to work (km) ($n=49$)	19.08 ± 22.38

Note: Percentages may not be equal to 100% because of the possibility to make multiple choices.

Abbreviations: BMI, body mass index; SD, standard deviation.

[a]The classification 'full-time' ≙ a working time of 40 hours/week.

3 | RESULTS

3.1 | Participant characteristics

Characteristics of the study population are shown in Table 1. Participants (64.2% female) had a mean age of 35.9 years (standard deviation = 10.5), and a mean body mass index of 23.0 (standard deviation = 3.8) kg/m^2, respectively. Intraclass correlation coefficients of the null models ranged from 0.13 (model 1_g "PA bouts moderate-to-long") to 0.70 (model 1_a "time spent in LPA"), indicating that a minimum of 30% and a maximum of 87% of the variances in the outcome variables "time spent in LPA" and "PA bouts moderate-to-long" were due to within-subject fluctuation. On average, valid data on PB were obtained for 5.0 workdays per participant (2.56 ± 0.96 days WFH, 2.45 ± 0.86 days WAO). The accelerometer placed on the thigh was worn for 18.72 ± 4.51 h/participant/day while WFH and for 17.97 ± 4.10 h/participant/day while WAO. The accelerometer placed on the hip was worn for 17.50 ± 4.69 h/participant/day while WFH and for 17.05 ± 4.33 h/participant/day while WAO. In terms of days WFH, participants provided between one and five valid days (13% of the participants provided 1 valid day, 36% of the participants provided two valid days, 35% of the participants provided three valid days, 15% of the participants provided four valid days, and 2% of the participants provided five valid days). Concerning days WAO, participants provided between one and four valid days (16% of the participants provided one valid day, 29% of the participants provided two valid days, 47% of the participants provided three valid days, and 7% of the participants provided four valid days).

3.2 | Descriptive statistics

As shown in Table 2, time spent in LPA was higher on days WFH than on days WAO. However, lower levels of MVPA were observed during days WFH than during days WAO. Regarding PA bouts, highest differences were found for short PA bouts (≤5 min). In particular, more short PA bouts were observed on days WFH than on days WAO. With regard to SB parameters, higher levels of time spent in SB were found during days WFH compared with days WAO. Highest differences in the number of SB bouts were observed among short bouts

TABLE 2 Descriptive statistics of PB parameters by work environment.

Variable	days WAO ($n = 135$)	days WFH ($n = 141$)
Parameters of PA		
LPA time (h/day)	2.21 ± 1.15	2.33 ± 1.20
MVPA time (h/day)	1.18 ± 0.85	0.87 ± 0.70
Physical activity intensity (MET) (per day)	1.54 ± 0.20	1.48 ± 0.22
Steps (no/day)	7548 ± 3944	6299 ± 3779
PA bouts short (no/day)	23.44 ± 11.42	25.82 ± 11.37
PA bouts short-to-moderate (no/day)	8.64 ± 3.63	7.88 ± 4.03
PA bouts moderate-to-long (no/day)	2.59 ± 1.65	1.99 ± 1.66
PA bouts long (no/day)	1.35 ± 1.35	1.38 ± 1.44
Parameters of SB		
SB time (h/day)	9.61 ± 2.53	9.92 ± 2.55
SB breaks (no/day)	36.01 ± 12.34	37.06 ± 11.49
SB bouts short (no/day)	16.30 ± 9.35	17.21 ± 8.93
SB bouts short-to-moderate (no/day)	10.44 ± 4.99	10.53 ± 4.38
SB bouts moderate-to-long (no/day)	5.43 ± 2.51	5.22 ± 2.52
SB bouts long (no/day)	3.79 ± 1.78	4.14 ± 2.10

Note: Data are presented as mean ± standard deviation (SD).

Abbreviations: LPA, light physical activity; MET, metabolic equivalents; MVPA, moderate-to-vigorous physical activity; PA, physical activity; SB, sedentary behavior; WAO, working at the office; WFH, working from home.

(≤5 min) and long bouts (≥40 min) with more short and more long SB bouts being made on days WFH compared with days WAO.

3.3 | Effects of the work environment on PA (hypothesis 1)

Table 3 shows the results of the multilevel analyses on the multiple PA parameters as outcome variables. Stable significant effects of the work environment were found across five models (Model 1_b: MVPA time, Model 1_c: MET, Model 1_d: Steps, Model 1_e: short PA bouts, Model 1_g: moderate-to-long PA bouts). In detail, significantly less minutes of MVPA (Model 1_b; $\beta = -0.187$, $p < 0.01$), less physical activity intensity (MET) (Model 1_c; $\beta = -0.108$, $p < 0.05$), less steps (Model 1_d; $\beta = -0.178$, $p < 0.05$), less moderate-to-long PA bouts (Model 1_g; $\beta = -0.182$, $p < 0.01$), but more short PA bouts (Model 1_e; $\beta = 0.151$, $p < 0.05$) were observed on days WFH compared with days WAO, thereby preliminary verifying hypotheses 1_b, 1_c, 1_d, 1_e, and 1_g based on our data. Contrary to hypotheses 1_a, 1_f, and 1_h, the work environment did not significantly predict time spent in LPA (Model 1_a), number of short-to-moderate PA bouts (Model 1_f), and number of long PA bouts (Model 1_h) based on our data. Additionally, several covariates were significantly associated with PA (for details see Table 3).

3.4 | Effects of the work environment on SB (hypothesis 2)

In line with our second hypothesis, multilevel analyses (Table 4) revealed no association between the work environment and any examined SB parameter. In detail, the work environment did not influence SB time (Model 2_a), number of SB breaks (Model 2_b), number of short SB bouts (Model 2_c), number of short-to-moderate SB bouts (Model 2_d), number of moderate-to-long SB bouts (Model 2_e) and number of long SB bouts (Model 2_f). Thus, based on the data of this study, we preliminary verified hypotheses 2_a–2_f. Across all models, none of the within-subject predictors (valence, sleep quality, sleep duration, social stress, activity stress, work ability) or the between-subject predictors (age, sex, body mass index, household size, distance to work) significantly influenced SB.

3.5 | Patterns of MVPA

Based on the latent class trajectory analyses, three different MVPA profiles for WFH days and two different MVPA profiles for WAO days were defined (Figure 1 and Figure 2). The three distinct classes within days WFH are characterized by (after)noon active, low active, and increasing active trajectories, that included 24 (17%), 95 (67%), and 22 (16%) days, respectively. Within days WAO, the two distinct trajectories are characterized by a low active profile (121 days; 90%), and an increasingly active profile (14 days; 10%). For WFH days, further exploratory analysis revealed that 26 participants switched between daily patterns of MVPA within the study period (Table S4). We also performed the latent class trajectory modelling with data of MVPA aggregated at the person-level, but no distinct trajectories were found. An overview of the temporal course of MVPA for all valid days per participant while WFH and WAO is shown in supplement figures S1a and S1b.

4 | DISCUSSION

This ecological momentary assessment study investigated the influence of the work environment on PB. Using

TABLE 3 Multilevel model analyses to predict PA-related outcomes: fixed and random effects.

Models of PA-related Outcomes					Model 1_e-1_h: PA bouts			
	Model 1_a: LPA time	Model 1_b: MVPA time	Model 1_c: MET	Model 1_d: Steps	short	short-to-moderate	moderate-to-long	long
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Fixed effects								
Intercept	3.47 (1.11)**	1.72 (0.65) *	1.69 (0.18)**	11064.8 (3108.4)**	31.71 (7.24)**	12.09 (2.31)**	3.66 (0.96)**	1.61 (1.07)
Sex[a]	0.14 (0.34)	0.41 (0.20)*	0.09 (0.05)	320.3 (944.9)	1.04 (2.19)	−0.91 (0.70)	−0.02 (0.29)	0.08 (0.33)
Age	0.002 (0.021)	0.013 (0.012)	0.004 (0.003)	−4.6 (58.3)	−0.11 (0.14)	−0.005 (0.043)	−0.0009 (0.0178)	0.03 (0.02)
BMI	−0.06 (0.05)	−0.06 (0.03)*	−0.01 (0.01)	−250.3 (135.8)	−0.27 (0.31)	−0.20 (0.10)	−0.04 (0.04)	−0.07 (0.05)
Valence	0.002 (0.005)	0.015 (0.004)**	0.003 (0.001)**	59.5 (23.0)*	0.004 (0.066)	−0.018 (0.027)	−0.003 (0.012)	0.02 (0.01)*
Sleep quality	−0.0002 (0.0031)	−0.004 (0.003)	−0.00007 (0.00065)	−9.2 (13.7)	−0.09 (0.04)*	0.004 (0.016)	0.003 (0.007)	0.002 (0.005)
Sleep duration	−0.001 (0.001)	−0.00002 (0.00103)	−0.0001 (0.0003)	−2.1 (5.6)	0.0002 (0.0163)	0.004 (0.006)	−0.002 (0.003)	−0.003 (0.002)
Social stress	−0.08 (0.18)	0.04 (0.15)	−0.02 (0.04)	19.3 (815.1)	0.69 (3.66)	0.18 (0.91)	0.04 (0.41)	0.19 (0.30)
Activity stress	−0.07 (0.18)	0.04 (0.16)	0.02 (0.04)	1064.0 (843.1)	0.54 (2.45)	−0.76 (0.92)	−0.07 (0.43)	0.33 (0.31)
Work ability	0.04 (0.06)	−0.01 (0.05)	−0.002 (0.014)	−85.4 (298.8)	−1.42 (0.84)	−0.49 (0.31)	−0.04 (0.15)	0.12 (0.11)
Household size	0.12 (0.18)	0.07 (0.10)	0.0007 (0.0290)	740.5 (498.5)	−0.64 (1.14)	0.85 (0.36)*	−0.01 (0.15)	0.15 (0.17)
Distance to work	−0.004 (0.007)	0.004 (0.004)	0.001 (0.001)	32.9 (20.2)	0.07 (0.05)	0.002 (0.015)	−0.009 (0.006)	−0.001 (0.007)
WFH[b]	0.09 (0.15)	−0.30 (0.08)**	−0.05 (0.02)*	−1388.1 (449.0)*	3.60 (1.32)*	−0.87 (0.64)	−0.62 (0.23)**	0.07 (0.16)
Random effects								
Intercept	0.90 (0.27)**	0.31 (0.09)**	0.02 (0.01)**	6680059.9 (2024345.8)**	29.94 (11.53)**	0.28 (1.51)	0.27 (0.22)	0.76 (0.23)**
Social Stress	—	—	—	—	265.36 (120.29)*	—	—	—
WFH[b]	0.31 (0.12)*	—	—	—	—	4.20 (1.97)*	—	—
Residual	0.34 (0.05)**	0.33 (0.04)**	0.02 (0.00)**	9529122.3 (1052875.4)**	71.69 (8.93)**	10.07 (1.28)**	2.53 (0.29)**	1.27 (0.14)**

Note: Data were presented as unstandardized estimates (b) and standard errors (SE).

Note: $^*p<0.05$; $^{**}p<0.01$.

Abbreviations: BMI, body mass index; LPA, light physical activity; MET, metabolic equivalents; MVPA, moderate-to-vigorous physical activity; PA, physical activity; WFH, working from home.

[a]Compared with females.

[b]Compared with working at the office (WAO).

TABLE 4 Multilevel model analyses to predict SB-related outcomes: fixed and random effects.

Models of SB-related Outcomes						
			Model 2_c-2_f: SB bouts			
	Model 2_a: SB time	Model 2_b: SB breaks	short	short-to-moderate	moderate-to-long	long
	b (SE)a	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Fixed effects						
Intercept	10.32 (1.99)**	49.98 (7.62)**	22.81 (5.66)**	17.73 (3.27)**	8.35 (1.48)**	3.28 (1.47)*
Sex[a]	−0.80 (0.60)	−0.64 (2.30)	0.23 (1.71)	0.35 (0.99)	−0.45 (0.44)	−0.53 (0.45)
Age	−0.05 (0.04)	−0.11 (0.14)	−0.01 (0.11)	−0.05 (0.06)	−0.03 (0.03)	−0.03 (0.03)
BMI	0.07 (0.09)	−0.57 (0.33)	−0.36 (0.25)	−0.27 (0.14)	−0.09 (0.06)	0.07 (0.06)
Valence	−0.03 (0.01)	−0.004 (0.077)	0.013 (0.056)	0.034 (0.030)	−0.023 (0.018)	−0.020 (0.011)
Sleep quality	−0.0004 (0.0083)	−0.05 (0.04)	−0.05 (0.03)	−0.0002 (0.0180)	0.01 (0.01)	−0.004 (0.006)
Sleep duration	0.001 (0.003)	0.001 (0.018)	−0.008 (0.014)	−0.003 (0.007)	0.005 (0.004)	−0.002 (0.002)
Social stress	0.53 (0.48)	0.03 (2.62)	−0.53 (1.98)	0.77 (1.07)	1.10 (0.64)	−0.26 (0.37)
Activity stress	−0.37 (0.49)	0.47 (2.67)	0.13 (2.06)	0.34 (1.11)	0.06 (0.66)	−0.10 (0.37)
Work ability	−0.18 (0.16)	−1.14 (0.89)	−1.10 (0.71)	−0.25 (0.38)	−0.07 (0.23)	0.01 (0.12)
Household size	−0.10 (0.32)	0.49 (1.20)	0.10 (0.89)	0.22 (0.52)	0.24 (0.23)	−0.01 (0.24)
Distance to work	0.003 (0.013)	0.059 (0.049)	0.037 (0.037)	0.004 (0.021)	0.004 (0.010)	0.0002 (0.0095)
WFH[b]	0.16 (0.37)	1.78 (1.84)	1.95 (1.09)	0.05 (0.59)	−0.36 (0.35)	0.36 (0.26)
Random effects						
Intercept	2.25 (0.88)**	15.24 (15.09)	15.92 (7.63)*	5.83 (2.27)*	0.55 (0.46)	1.24 (0.49)*
Social Stress	—	—	—	—	—	—
WFH[b]	1.53 (0.62)*	31.5 (15.66)*	—	—	—	0.70 (0.33)*
Residual	2.73 (0.35)**	84.51 (10.77)**	57.53 (6.56)**	16.59 (1.85)**	5.96 (0.66)**	1.62 (0.20)**

Note: Data were presented as unstandardized estimates (b) and standard errors (SE).

Note: *$p < 0.05$; ** $p < 0.01$.

Abbreviations: BMI, body mass index; SB, sedentary behavior; WFH, working from home.

[a]Compared with females.

[b]Compared with working at the office (WAO).

a dual-sensor system, multiple PA and SB parameters, which were not only limited to broad overall summary measures of time spent in PA and SB as in several previous studies,[15,16] were determined. Our results provide first evidence that the work environment is associated with various quantitative dimensions of PA including one duration-related parameter (i.e., time spent in MVPA), two frequency-related parameters (i.e., number of short PA bouts, number of moderate-long PA bouts), and two intensity-related parameters (i.e., MET, steps), preliminary confirming hypotheses 1_b, 1_c, 1_d, 1_e, and 1_g. Most important, the largest effect of the work environment was found for the outcome MVPA, indicating that WFH has a negative impact on time spent in MVPA. This finding is in line with a previous study from Brusaca et al.,[17] reporting that office workers spent 21 min less MVPA time on days WFH during the COVID-19 pandemic compared with days at the conventional workplace before the outbreak of the pandemic. One explanation underlying this observation could be that workers do not have to (active) commute to the workplace on days WFH, resulting in less PA for transportation purposes. Given guidelines for adults on PA recommending at least 150 min of moderate or 75 min of vigorous PA or an equivalent combination of both per week,[34] this finding, a mean decrease of 18 min in daily levels of MVPA while WFH, has important public health implications, especially since recent evidence suggests that a high amount of daily MVPA is required to attenuate the mortality risk associated with high sitting time which is most prevalent among office workers.[35–37] In particular,

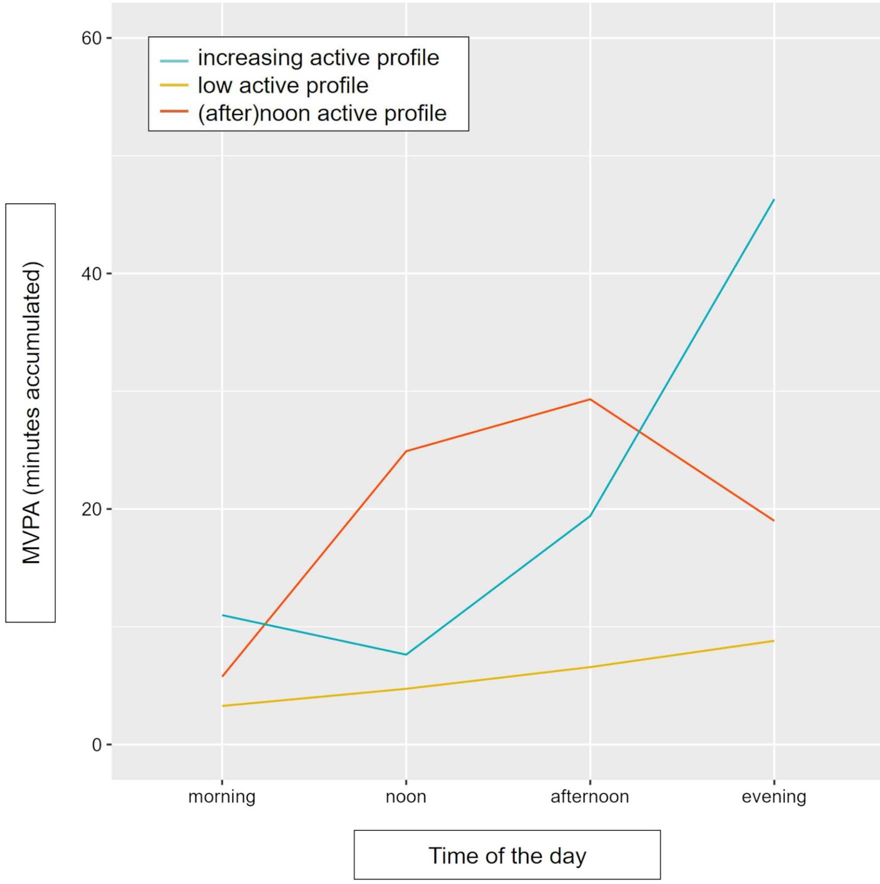

FIGURE 1 Trajectories of moderate-to-vigorous physical activity (MVPA) within days working from home (WFH). The x-axis depicts the time of the day (morning, noon, afternoon, evening). The y-axis depicts accumulated minutes of MVPA per time of the day.

our findings suggest that the work environment plays an important role in accumulating daily time spent in MVPA. Supporting evidence for this assumption was found by a recent study from Loef et al.,[38] revealing that home workers are less likely to perform a minimum of 150 min of MVPA per week during the pandemic than location workers. Hence, there seem to be an urgent need for the development of innovative solutions for enhancing MVPA within the WFH environment.

Another main finding of our study is that the work environment is associated with short PA bouts, indicating that on days WFH more short PA bouts are being made compared with days WAO. To the best of our knowledge, no study to date has examined the influence of the work environment on uninterrupted PA periods of any length (e.g., PA bouts ≥5 min). Given previous research suggesting that besides the total amount of time spent in PB (e.g., SB, LPA, MVPA), activity patterns, like short PA breaks between prolonged SB, are also associated with mental and somatic health outcomes,[39,40] this finding adds first evidence that WFH may provide more beneficial environmental conditions than WAO for intermissions of SB. The influence of sociocultural norms on PB, as highlighted by Munir et al.,[41] might explain this finding. Because of the physical separation from colleagues, it is reasonable to assume that office workers may be no longer afraid of being judged by others for not continuously sitting at the desk during working hours, resulting in more short PA bouts to break up SB. Another possible explanation for this result might be that while WFH, office workers are able to integrate household chores (e.g., hang out the laundry) into their daily work routine, since the home environment appears as the context of two PB domains (i.e., occupation and household).[24]

In line with our expectations and previous findings,[13,14,17] our study did not find any influence of the work environment on SB. In particular, our results confirmed the hypotheses that the work environment did not influence SB duration, SB breaks, and SB bouts. However, when directly comparing levels of SB within each work environment, our results differ from the results of previous studies: while previous studies found lower levels of SB on days WFH than on days WAO,[13,14,17] we found higher levels of SB on days WFH than on days WAO. Several possible explanations including the use of different study designs, different samples, or different time points of data collection (during containment strategies within the COVID-19 pandemic vs. without containment strategies within the COVID-19 pandemic) should be considered for this inconsistency across observations.

With the usage of latent class trajectory modelling, our study provides also first evidence on daily patterns of

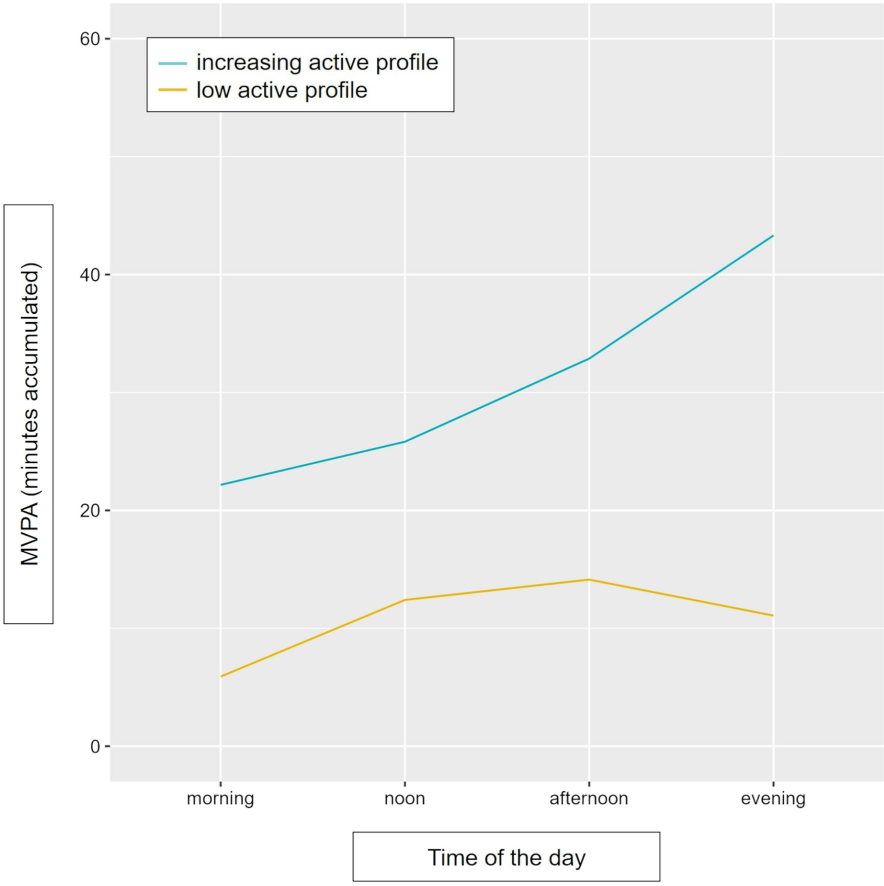

FIGURE 2 Trajectories of moderate-to-vigorous physical activity (MVPA) within days working at the office (WAO). The x-axis depicts the time of the day (morning, noon, afternoon, evening). The y-axis depicts accumulated minutes of MVPA per time of the day.

MVPA differentiated by work environment. Noteworthy, previous studies using latent class trajectory modelling to examine PB profiles mostly focused on (a) other target groups,[42] (b) focused on other time periods,[42,43] and (c) did not objectively assess PB.[42,43] Taking into account dynamic fluctuations of MVPA across the day and within individuals, we were able to identify three different trajectories on days WFH, and two different patterns on days WAO. Interestingly, we found one pattern, namely the (after) noon active pattern, only in days WFH. While the two other profiles found on days WFH, one profile with low levels of MVPA across the day and one profile with continuously increasing levels of MVPA from morning to evening, appear to be comparable with the two profiles found on days WAO and correspond with profiles suggested by other studies that examined levels of MVPA throughout the day,[6,44] no comparable pattern with high levels of MVPA in the (after) noon was found in previous studies. Again, differences in the sociocultural surrounding between the two investigated work environments may provide a possible explanation underlying this observation: since WFH allows for more flexible schedules, it is reasonable to assume that on days WFH, office workers can more easily integrate MVPA during the day (e.g., during the lunch break).

It is important to note that future interventions should focus on a day-level rather than a person-level, as values of the intraclass correlation coefficients indicated that high variances of several PB outcomes were due to within-subject differences, as we found no patterns for MVPA on a person-level but on a day-level, and as further exploratory analysis revealed that 26 participants switched between daily patterns of MVPA within the study period (Table S4). The fact that the future of work will be probably hybrid characterized by a combination of days working in person at the office and days working remotely from home, resulting in possible fluctuations of PB patterns from day to day within a person, also emphasizes the need for daily-tailored interventions to promote MVPA.

Several limitations of our study, as well as suggestions for future research, merit further discussion. First, we collected data within the pandemic situation, in which restrictions (i.e., the so-called “3G-rule”) were enforced nationwide in Germany. Thus, future studies might be interested in replicating our findings under post-pandemic conditions. Second, participants were instructed to remove accelerometers under extreme conditions including deep diving or visiting the sauna. Since these activities tend to be activities that are rarely performed in everyday life, we assume that this limitation represents a minor issue. Third, our sample size ($n = 55$) was quite small. However, our analyses did not focus on a person-level but on a day-level ($n = 276$) and our findings were stable when adding several control variables. Fourth, we did not collect data on qualitative dimensions of PB, for example on the domains in which PB occurred (i.e., work, transport, household, leisure time). As the information on these domains is crucial to gain a complete in-depth understanding of determinants of PB while WFH and to successfully initiate behavior changes within the WFH environment, context assessments like geolocation tracking should be considered as promising strategies for designing future studies. Additionally, given the need to commute to the office as one of the main differences in the daily schedule between WFH and WAO days, scientific endeavors might benefit from information on the actual mode and purpose of transport (e.g., combining e-diaries with GPS signals). Fifth, we assessed the daily work environment only one time a day within the first e-diary prompt in the morning. Given several ways to combine WFH and WAO within the same working day (e.g., WAO in the morning but WFH in the afternoon), we emphasize to assess the location of work more frequently. Future research endeavors might be interested in detecting temporal patterns of PB on such fluid working days. And last, since we included participants with a minimum of 3 valid days (≥10 h of wakeful time) within both work environments leading to the possibility that participants provide only one valid day WFH or one valid day WAO, our results may have limited representativeness of individuals' behavior in each work environment. Therefore, we call future studies to capture device-based PB within both work environments over a longer time frame.

5 | PERSPECTIVE

WFH has become an integral part of everyday working life. There is growing consensus that the future of work will be more agile and flexible in modern societies, revealing a variety of working models characterized by different levels of working in-person at the conventional office combined with different levels of working remotely at various locations, predominantly from home. Our study provided preliminary evidence that WFH, representing one pole of this hybrid-work-continuum, is negatively associated with a range of PA parameters, especially with MVPA. Given the high amount of sedentary time among office workers and recent evidence suggesting that high levels of MVPA seem to eliminate the mortality risk associated with high sitting time, this finding has important public health implications. Thus, effective daily personal interventions to enhance MVPA on days WFH are needed.

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DATA AVAILABILITY STATEMENT

Research data are not shared.

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REFERENCES

1. International Labour Organization. Challenges and opportunities of teleworking for workers and employers in the ICTS and financial services sectors. https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/publication/wcms_531111.pdfAccessedMarch23 2023.
2. Argus M, Pääsuke M. Effects of the COVID-19 lockdown on musculoskeletal pain, physical activity, and work environment in Estonian office workers transitioning to working from home. *Work*. 2021;69:741-749.
3. International Labour Organization. Working from Home: Estimating the worldwide potential. https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---travail/documents/briefingnote/wcms_743447.pdfAccessedMarch23 2023.
4. Gilson N, Coenen P, Hallman D, Holtermann A, Mathiassen SE, Straker L. Postpandemic hybrid work: opportunities and challenges for physical activity and public health. *Br J Sports Med*. 2022;56:1203-1204.
5. Hilberath C, Kilmann J, Lovich D, et al. Hybrid Work Is the New Remote Work. https://www.bcg.com/publications/2020/managing-remote-work-and-optimizing-hybrid-working-models Accessed March 23 2023.
6. Thorp AA, Healy GN, Winkler E, et al. Prolonged sedentary time and physical activity in workplace and non-work contexts: a cross sectional study of office, customer service and call Centre employees. *Int J Behav Nutr Phys Act*. 2012;9:128.
7. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep*. 1985;100:126-131.
8. Löllgen H, Löllgen D. Risikoreduktion kardiovaskulärer Erkrankungen durch körperliche Aktivität [risk reduction of cardiovascular diseases through physical activity]. *Internist (Berl)*. 2012;53:20-29.
9. Tremblay MS, Aubert S, Barnes JD, et al. Sedentary behavior research network (SBRN)—terminology consensus project process and outcome. *Int J Behav Nutr Phys Act*. 2017;14:75.
10. Saunders TJ, McIsaac T, Douillette K, et al. Sedentary behaviour and health in adults: an overview of systematic reviews. *Appl Physiol Nutr Metab*. 2020;45:197-217.

11. Owen N, Healy GN, Matthews CE, Dunstan DW. Too much sitting: the population health science of sedentary behavior. *Exerc Sport Sci Rev*. 2010;38:105-113.
12. Giurgiu M, Koch ED, Ottenbacher J, Plotnikoff RC, Ebner-Priemer UW, Reichert M. Sedentary behavior in everyday life relates negatively to mood: an ambulatory assessment study. *Scand J Med Sci Sports*. 2019;29:1340-1351.
13. Hallman DM, Januario LB, Mathiassen SE, Heiden M, Svensson S, Bergström G. Working from home during the COVID-19 outbreak in Sweden: effects on 24-h time-use in office workers. *BMC Public Health*. 2021;21:528.
14. Widar L, Wiitavaara B, Boman E, Heiden M. Psychophysiological reactivity, postures and movements among academic staff: a comparison between teleworking days and office days. *Int J Environ Res Public Health*. 2021;18:9537.
15. McDowell CP, Herring MP, Lansing J, Brower C, Meyer JD. Working from home and job loss due to the COVID-19 pandemic are associated with greater time in sedentary behaviors. *Front Public Health*. 2020;8:597619.
16. Guler MA, Guler K, Guneser Gulec M, Ozdoglar E. Working from home during a pandemic: investigation of the impact of COVID-19 on employee health and productivity. *J Occup Environ Med*. 2021;63:731-741.
17. Brusaca LA, Barbieri DF, Mathiassen SE, Holtermann A, Oliveira AB. Physical Behaviours in Brazilian office workers working from home during the COVID-19 pandemic, compared to before the pandemic: a compositional data analysis. *Int J Environ Res Public Health*. 2021;18:6278.
18. Massar SAA, Ong JL, Lau T, et al. Working-from-home persistently influences sleep and physical activity 2 years after the Covid-19 pandemic onset: a longitudinal sleep tracker and electronic diary-based study. *Front Psychol*. 2023;14:1145893.
19. Prince SA, Cardilli L, Reed JL, et al. A comparison of self-reported and device measured sedentary behaviour in adults: a systematic review and meta-analysis. *Int J Behav Nutr Phys Act*. 2020;17:31.
20. Prince SA, Adamo KB, Hamel ME, Hardt J, Connor Gorber S, Tremblay M. A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *Int J Behav Nutr Phys Act*. 2008;5:56.
21. Migueles JH, Cadenas-Sanchez C, Ekelund U, et al. Accelerometer data collection and processing criteria to assess physical activity and other outcomes: a systematic review and practical considerations. *Sports Med*. 2017;47:1821-1845.
22. Reichert M, Giurgiu M, Koch E, et al. Ambulatory assessment for physical activity research: state of the science, best practices and future directions. *Psychol Sport Exerc*. 2020;50:101742.
23. Biddle S. Physical activity and mental health: evidence is growing. *World Psychiatry*. 2016;15:176-177.
24. Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J. An ecological approach to creating active living communities. *Annu Rev Public Health*. 2006;27:297-322.
25. Troiano RP, Berrigan D, Dodd KW, Mâsse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*. 2008;40:181-188.
26. Anastasopoulou P, Tubic M, Schmidt S, Neumann R, Woll A, Härtel S. Validation and comparison of two methods to assess human energy expenditure during free-living activities. *PLoS One*. 2014;9:e90606.
27. Wilhelm P, Schoebi D. Assessing mood in daily life. *Euro J Psych Assess*. 2007;23:258-267.
28. Reininghaus U, Kempton MJ, Valmaggia L, et al. Stress sensitivity, aberrant salience, and threat anticipation in early psychosis: an experience sampling study. *Schizophr Bull*. 2016;42:712-722.
29. Hasselhorn H-M, Freude G. *Der Work-Ability-Index: Ein Leitfaden [the Work Ability Index: A Guide]*. Wirtschaftsverlag NW Verlag für neue Wissenschaft GmbH; 2007:54p.
30. Butte NF, Ekelund U, Westerterp KR. Assessing physical activity using wearable monitors: measures of physical activity. *Med Sci Sports Exerc*. 2012;44:5-12.
31. Giurgiu M, Nissen R, Müller G, Ebner-Priemer UW, Reichert M, Clark B. Drivers of productivity: being physically active increases yet sedentary bouts and lack of sleep decrease work ability. *Scand J Med Sci Sports*. 2021;31:1921-1931.
32. Hox JJ, Roberts JK. Multilevel analysis. *Handbook of Advanced Multilevel Analysis*. Routledge; 2014.
33. Lennon H, Kelly S, Sperrin M, et al. Framework to construct and interpret latent class trajectory modelling. *BMJ Open*. 2018;8:e020683.
34. World Health Organization. WHO guidelines on physical activity and sedentary behaviour. https://apps.who.int/iris/rest/bitstreams/1315866/retrieveAccessedMarch 23.
35. Prince SA, Elliott CG, Scott K, Visintini S, Reed JL. Device-measured physical activity, sedentary behaviour and cardiometabolic health and fitness across occupational groups: a systematic review and meta-analysis. *Int J Behav Nutr Phys Act*. 2019;16:30.
36. Ekelund U, Tarp J, Fagerland MW, et al. Joint associations of accelero-meter measured physical activity and sedentary time with all-cause mortality: a harmonised meta-analysis in more than 44 000 middle-aged and older individuals. *Br J Sports Med*. 2020;54:1499-1506.
37. Ekelund U, Steene-Johannessen J, Brown WJ, et al. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *The Lancet*. 2016;388:1302-1310.
38. Loef B, van Oostrom SH, van der Noordt M, Proper KI. Working from home during the COVID-19 pandemic and its longitudinal association with physical activity and sedentary behavior. *Scand J Work Environ Health*. 2022;48:380-390.
39. Healy GN, Dunstan DW, Salmon J, et al. Breaks in sedentary time: beneficial associations with metabolic risk. *Diabetes Care*. 2008;31:661-666.
40. Giurgiu M, Koch ED, Plotnikoff RC, Ebner-Priemer UW, Reichert M. Breaking up sedentary behavior optimally to enhance mood. *Med Sci Sports Exerc*. 2020;52:457-465.
41. Munir F, Biddle SJH, Davies MJ, et al. Stand more AT work (SMArT work): using the behaviour change wheel to develop an intervention to reduce sitting time in the workplace. *BMC Public Health*. 2018;18:319.
42. Hofman A, Limpens MAM, Crom TOE d, Ikram MA, Luik AI, Voortman T. Trajectories and determinants of physical activity during COVID-19 pandemic: a population-based study of middle-aged and elderly individuals in The Netherlands. *Nutrients*. 2021;13:3832.
43. Wennman H, Kronholm E, Partonen T, et al. Physical activity and sleep profiles in Finnish men and women. *BMC Public Health*. 2014;14:82.

44. Kurita S, Shibata A, Ishii K, Koohsari MJ, Owen N, Oka K. Patterns of objectively assessed sedentary time and physical activity among Japanese workers: a cross sectional observational study. *BMJ Open*. 2019;9:e021690.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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