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ORIGINAL ARTICLE

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Objectives: To investigate the association between effort/reward imbalance (ERI) at work and sedentary lifestyle.
Methods: Cross sectional data from the ongoing Finnish Public Sector Study related to 30 433 women and 7718 men aged 17–64 were used (n = 35 918 after exclusion of participants with missing values in covariates). From the responses to a questionnaire, an aggregated mean score for ERI in a work unit was assigned to each participant. The outcome was sedentary lifestyle defined as <2.00 metabolic equivalent task (MET) hours/day. Logistic regression with generalised estimating equations was used as an analysis method to include both individual and work unit level predictors in the models. Adjustments were made for age, marital status, occupational status, job contract, smoking, and heavy drinking.
Results: Twenty five per cent of women and 27% of men had a sedentary lifestyle. High individual level ERI was associated with a higher likelihood of sedentary lifestyle both among women (odds ratio (OR) = 1.08, 95% CI 1.01 to 1.16) and men (OR = 1.17, 95% CI 1.02 to 1.33). These associations were not explained by relevant confounders and they were also independent of work unit level job strain measured as a ratio of job demands and control.
Conclusions: A mismatch between high occupational effort spent and low reward received in turn seems to be associated with an increased risk of sedentary lifestyle, although this association is relatively weak.

Of the major work stress models, the effort/reward imbalance (ERI) model[1–3] is the most contemporary. The model posits that effort at work is spent as a part of a contract based on the norm of social reciprocity. Rewards are distributed by three transmitter systems: money (adequate salary), esteem (for example, respect and support), and security/career opportunities (for example, promotion prospects, job security, and status consistency). Imbalance between high efforts and low rewards defines work stress, a condition that in the long run is assumed to increase illness susceptibility. The model has predicted several ill health outcomes, such as cardiovascular morbidity and mortality, psychosomatic symptoms, and psychiatric disorder among a wide range of working populations with diverse sociodemographic profiles.[4] Of health behaviours and characteristics, smoking,[5 6] alcohol dependence,[7] and higher body mass index[8 9] have been associated with higher ERI.

Little is known whether high ERI also increases the risk for sedentary lifestyle. High cost/low gain conditions at work, such as having a demanding but an unstable job, or achieving at a high level without being offered any promotion prospects[10] could generate feelings of frustration and general passivity and apathy, which might spill over to leisure time. The alienation from work could result in social disengagement and adoption of unhealthy behaviours such as sedentary lifestyle.[11] Indeed, the association between passive work and lower leisure time physical activity has received support in earlier studies.[12 13]

To date, the Whitehall II study of British civil servants is probably the only investigation that has tested the association between ERI and physical activity, although examining this association was not the main goal of the study.[14] Unexpectedly, in this study people who exercised reported a less favourable effort-reward ratio at work.

The present study examined the association between ERI and sedentary lifestyle and tested whether ERI links with physical inactivity independent of job strain as defined by a ratio of job demands to job control[15] as prior research on work stress and physical activity mainly relates to the model of job strain.

METHODS

Study design and study population

Cross sectional data were obtained from the Finnish Public Sector Study, an ongoing prospective study to explore the relation of behavioural and psychosocial factors with health among public sector employees.[16 17] The study is focused on the entire personnel of 10 towns and 21 hospitals in the areas where the towns are located (n = 70 961). In 2000–02, 32 293 municipal and 16 299 hospital employees responded to a postal questionnaire survey. The response rates for municipal and hospital samples were 67% and 69%, respectively, and the total response rate was 68%. The size of our sample equals about one fifth of all Finnish full time workers employed by the municipalities, and includes manual workers (for example, cleaners, maintenance staff), lower grade non-manual employees (for example, registered nurses, secretaries), and higher grade non-manual employees (for example, teachers, physicians). The most common occupations of the respondents were registered nurse (23%, n = 10 990), teacher (19%, n = 9315), practical nurse (13%, n = 6221), and cleaner (10%, n = 4659). The mean age in the sample was 44.6 (range 17–65, SD = 9.42) years.

Similar methods of data collection were used in both subsamples (municipal and hospital). We tested the similarity of the two samples by comparing leisure time physical activity in two large occupational groups (registered nurses and physicians) between the hospital and the municipal samples. No significant differences were obtained between the subsamples. When the total subsamples were compared with each other, the prevalence of sedentary lifestyle was

Abbreviations: ERI, effort/reward imbalance; MET, metabolic equivalent task.

slightly higher among municipal employees (26% *v* 24%, p<0.001).

Any differences with the eligible population were small. In the municipal sample, figures for participants versus eligible population (n = 47 351) were as follows: mean age 44.9 versus 44.5 years, proportion of women 77% versus 72%, proportions of higher grade non-manual, lower grade non-manual, and manual employees 34%, 46%, 20% versus 35%, 42%, and 22%, respectively. The corresponding figures for the hospital sample (n = 23 610) were: mean age 43.1 versus 43.1 years, proportion of women 87% versus 84%, proportions of higher grade non-manual, lower grade non-manual, and manual employees 16%, 77%, 8% versus 13%, 81%, and 7%, respectively.

Respondents who did not provide information about their leisure time physical activity were excluded (n = 1478). We also excluded those with missing data on age (n = 27). Moreover, a part of the sample (seven hospitals) did not contain the ERI measure and there were also some other missing cases for individual level ERI (n = 8861). Besides, some of the work units consisted of less than three employees and were excluded (n = 2219). In consequence, the data set of the present study comprised 30 433 women and 7718 men aged 17–64 years. Compared with the included participants, the participants with missing value for leisure time physical activity were more often female (86% *v* 80%) and lower level non-manual (72% *v* 53%). The participants with missing values for individual ERI were also more often women (87%) and lower level non-manual (79%). This was due to the fact that most of the missing cases for ERI came from the seven hospitals and the majority of hospital workers are lower grade non-manual women.

Ethical approval for the study was obtained from the Ethics Committee of the Finnish Institute of Occupational Health.

Effort/reward imbalance

A standard measure of ERI in Finnish was not available in this study. The questionnaire used included one question about effort in work and three questions about rewards. These measures were used to construct the proxy measure of ERI.

Effort was measured with the following question: "How much do you feel you invest in your job in terms of skill and energy?" Rewards were assessed with a scale containing three questions about feelings of getting in return from work in terms of (1) income and job benefits, (2) recognition and prestige, and (3) personal satisfaction (Cronbach's $\alpha = 0.64$).[5] Response format for all the questions was a five-point Likert scale ranging from 1 ("very little") to 5 ("very much"). Greater values indicated greater effort and rewards. Rewards were assessed as a mean score of the three rewards questions. In regard to the scales calculated for total rewards, if half or more of the component items were missing, a value of missing was recorded in the total. Following the recommendation made in most recent studies, the indicator of ERI was obtained by calculating the ratio between the response score in the effort scale and the mean response score in the reward scale.[4] Thus, larger values indicated larger imbalance.

Due to the multilevel nature of the data, we used aggregated ERI scores according to work units in addition to individual scores. The work unit of each respondent was identified from the employers' records based on a five-level organisational hierarchy classification. For each work unit, we calculated the mean of ERI and this aggregated score was assigned to each member of the work unit. These scores were based on the responses of all workers in the same work unit excluding the respondent in question. If the number of participants in the work unit was less than three, these participants were excluded from the analysis (n = 2219). Thus, in all cases, the work unit level scores for ERI were based on values derived from three or more individual respondents. The number of work unit levels used in the analyses was 2592 for women and 1631 for men.

Finally, as the individual ERI scores were not normally distributed, the distribution of both the individual and work unit level scores was divided into tertiles to indicate low, intermediate, and high imbalance.[5 8]

Sedentary lifestyle

Participants were asked to report the average amount of time spent per week on leisure and on the journey to and from work in physical activity corresponding to the activity intensity of walking, vigorous walking, jogging, and running. The time spent at each activity in hours per week was multiplied by its typical energy expenditure, expressed in metabolic equivalent tasks (METs). One MET is the caloric need per kilogram of body weight per hour of activity, divided by the caloric need per kilogram per hour at rest. Activity MET index was expressed as the sum score of leisure MET hours/week.[18] The total physical activity score for each respondent is not a measure of total time spent on physical activity; it is a relative measure of how much energy is expended on physical activity.[19] MET index was further dichotomised: respondents whose volume of activity was <2.00 MET hours/day were classified as having a sedentary lifestyle.[18]

Covariates

Covariates included sex, age, occupational status (manual, lower grade non-manual, higher grade non-manual; based on the Statistics Finland classification of the five-digit occupational titles), and job contract (permanent *v* temporary); all obtained from the employers' records. In addition, marital status (married or cohabiting *v* other), current smoking status (non-smoker *v* smoker), and heavy drinking were included. Heavy drinking was defined as an average weekly consumption of absolute alcohol of 190 g or more for women[20] and more than 275 g for men.[17] The selected covariates have been associated with lower physical activity in earlier studies.[21–27]

To assess whether the association between ERI and physical activity is independent of work stress as indicated by the job strain model, we measured job control and job demands. The standard measure of job strain model was not available in this study, although the questions available were derived from the Job Content Questionnaire.[28] Job control was assessed by a nine-item indicator consisting of two subscales measuring decision authority and skill discretion (Cronbach's $\alpha = 0.82$; range = 1–5; three year test-retest reliability $r = 0.70$). The job demands scale was the mean of two items inquiring about workload and pace of work (Cronbach's $\alpha = 0.71$; range = 1–5; three year test-retest reliability $r = 0.55$). The mean scores for each of the two constructs were computed. Higher scores represented higher level of perceived job control and job demands. In regard to the scales calculated for total control and total demands, if half or more of the component items were missing, a value of missing was recorded in the total. Job strain was assessed as the ratio of job demands to job control.[29] We assessed job strain as a ratio since it is not possible to aggregate the four-category measure of job strain.

Statistical analysis

According to the prerequisites of multilevel analyses, our dataset included individuals (employees) nested within work units in towns and hospitals. Using the multilevel analysis we were able to take this hierarchical structure of the data set into account and include both individual and work unit level

Table 1 Study population characteristics and the prevalence of sedentary lifestyle* (n = 38 151)

	Women (n = 30 433)		Men (n = 7718)	
	n (%)	Sedentary %	n (%)	Sedentary %
Age (years)				
18–34	5095 (17)	20	1230 (16)	20
35–50	15693 (51)	25	3760 (49)	27
51–64	9645 (32)	28	2728 (35)	32
		p<0.001		p<0.001
Marital status				
Married or cohabiting	22470 (75)	25	6128 (80)	27
Other	7651 (25)	24	1507 (20)	30
		p = 0.076		p = 0.012
Occupational status				
Manual	3786 (13)	31	2562 (34)	32
Lower grade non-manual	17761 (59)	24	2090 (28)	26
Higher grade non-manual	8344 (28)	25	2821 (38)	24
		p<0.001		p<0.001
Type of job contract				
Permanent	24817 (83)	25	6617 (87)	28
Temporary	5278 (17)	23	1006 (13)	21
		p<0.001		p<0.001
Smoking status				
Non-smoker	24521 (83)	23	5631 (76)	24
Current smoker	5139 (17)	30	1810 (24)	36
		p<0.001		p<0.001
Heavy drinking†				
No	27969 (92)	25	6725 (88)	27
Yes	2332 (8)	25	955 (12)	32
		p = 0.780		p<0.001

p Values from χ test for trend (Mantel-Haenszel) for age and occupational status and from χ^2 test for other variables.
*<2.00 metabolic equivalent task (MET) hours/day.
†Average weekly consumption ⩾190 g of absolute alcohol for women and >275 g for men.

predictors in the models. To test within-unit agreement, we computed an average deviation index from the item mean (AD_M index) for the components of ERI.[30] The AD_M values for effort and reward were 0.53 and 0.70, respectively. This indicated a significant within-unit agreement and supported the aggregation of unit members' ERI to the work unit level.

Logistic regression with generalised estimating equations (GEE) method[31] were performed to estimate the association between individual and work unit level ERI and the likelihood of sedentary lifestyle, as expressed by odds ratios (ORs) and their 95% confidence intervals (CIs). The hypothetically least adverse work condition (the bottom tertile of ERI) was selected as the reference category. Separate analyses were carried out for women and men.

Four logistic regression models were constructed. In the first step, only age was adjusted for. In the second step, marital status, job contract, occupational status, smoking, and heavy drinking were added to the model to examine whether these covariates affected the association. These two models were restricted to participants with no missing data in any of the covariates (n = 35 918). We tested the differences in terms of sex, age, socioeconomic status, and sedentary lifestyle between the included participants and the total sample before these exclusions. No differences were found.

Furthermore, we tested whether associations between individual and work unit level ERI and sedentary lifestyle were independent of subsample (hospital or municipal) by applying interaction terms subsample × ERI measures in the adjusted model (model 2).

The final two models tested whether the associations of individual and work unit level ERI with sedentary lifestyle were independent of the job strain model by additionally controlling for work unit level and individual level job strain.

For the analyses we used the multilevel GENMOD GEE estimating procedure in SAS V8 program package.

RESULTS

The characteristics of the cohort are displayed in table 1. Compared with women, men were slightly older, more often married or cohabiting, and their occupational status was more likely to be manual or higher grade non-manual. Moreover, the rates of smoking and heavy drinking were higher for men than for women.

The percentages of women and men performing leisure time physical activity <2.00 MET hours/day were 25% and 27%, respectively. Prevalence of sedentary lifestyle increased with age and was highest among manual workers. In the youngest age group (18–34 year olds), 20% of both women and men were categorised as sedentary. The corresponding figures for the oldest age group (50–64 year olds) were 28% for women and 32% for men. Among both women and men, one third of manual workers reported leisure time physical activity <2.00 MET hours/day. For non-manual employees, this proportion was one fourth. In addition, men living without a partner, permanent employees, smokers, and male heavy drinkers reported significantly more often low leisure time physical activity than their counterparts.

Table 2 summarises the results from logistic regression analyses with GEE method on the associations between ERI and sedentary lifestyle. In the age adjusted model, the likelihood of sedentary lifestyle was 10% higher for women with high individual ERI and 22% higher for men with high individual ERI compared with their counterparts with low individual ERI. Adjustment for marital status, occupational status, job contract, smoking, and heavy drinking (model 2), led to an attenuation in the ORs but the relationships at the individual level remained statistically significant (OR = 1.08,

Table 2 Relation of individual and work unit level effort-reward imbalance with sedentary lifestyle: adjusted odds ratios (ORs) and their 95% confidence intervals (CIs) from logistic regression models with generalised estimating equations (n = 35 918)

	n	Model 1	Model 2
Women			
Individual level			
Low imbalance	8976	1	1
Intermediate imbalance	11062	0.97 (0.91 to 1.03)	0.97(0.90 to 1.03)
High imbalance	8749	1.10 (1.03 to 1.18)	1.08 (1.01 to 1.16)
Work unit level			
Low imbalance	9506	1	1
Intermediate imbalance	9922	0.96 (0.90 to 1.03)	0.95 (0.89 to 1.02)
High imbalance	9359	1.04 (0.97 to 1.12)	1.00 (0.93 to 1.07)
Men			
Individual level			
Low imbalance	2619	1	1
Intermediate imbalance	2403	0.96 (0.84 to 1.10)	0.96 (0.84 to 1.09)
High imbalance	2109	1.22 (1.07 to 1.39)	1.17 (1.02 to 1.33)
Work unit level			
Low imbalance	2381	1	1
Intermediate imbalance	1964	1.05 (0.90 to 1.22)	1.04 (0.89 to 1.22)
High imbalance	2786	1.13 (0.98 to 1.30)	1.05 (0.91 to 1.21)

Only participants with no missing data in any of the covariates were included in these models.
Model 1 includes adjustment for age.
Model 2 includes adjustment for age, marital status, occupational status, job contract, smoking, and heavy drinking.

95% CI 1.01 to 1.16 for women and OR = 1.17, 95% CI 1.02 to 1.33 for men).

We tested whether the relationship between ERI measures and sedentary lifestyle varied by subsample (hospital or municipal) by applying interaction terms in the models 2. However, none of the interaction terms reached statistical significance (data not shown).

Additional adjustment for work unit level job strain did not alter the ORs of high individual ERI (OR = 1.08, 95% CI 1.00 to 1.15 for women and OR = 1.16, 95% CI 1.02 to 1.32 for men). However, the significant relationships disappeared after further adjustment for individual level job strain (data not shown).

DISCUSSION

We investigated the relation between ERI and sedentary lifestyle defined as <2.00 MET hours/day in a population of 38 151 Finnish public sector employees. The results showed that a mismatch between occupational effort and rewards at an individual level was associated with an increased risk of sedentary lifestyle both among women and men. This result was explained neither by work unit level ERI nor a variety of individual level confounders such as age,[23] socioeconomic position,[21 24–27] marital status,[21] smoking,[21 22 27] and alcohol consumption.[26] The result is in accordance with previous findings suggesting that ERI is associated with health related outcomes.

Technological progress and the decline of manufacturing jobs have led to decreasing occupational physical demands. Sedentary work is becoming more and more dominant.[10] As physical demands have reduced in work, there may be some adverse health consequences associated with decreased physical activity for those workers whose jobs have low physical demands[32] and who are also physically passive during their leisure time.

Our findings indicate a weak rather than strong association between ERI and physical activity, the excess risk of sedentary lifestyle being 20% for men with high ERI and 10% for women with high ERI. Indeed, the association reached statistical significance when individual scores were used to indicate ERI but not with work unit aggregated scores that may be more imprecise estimates, as they are insensitive to the variation in ERI within work units.

Besides, this study was not based on the assumption that ERI is the major determinant of sedentary lifestyle, because it is well established that physical activity is a multifactorial behaviour influenced by a range of demographic, biological, psychological, behavioural, social, cultural, and physical environmental factors.[26] Besides, it is possible that ERI has bidirectional effects on physical activity: high ERI may produce decreased physical activity in some workers, whereas in others it could be associated with increased physical activity. For example, employees who are more prone to depression may decrease their physical activity when facing ERI conditions. On the other hand, higher physical activity may act as a stress reduction mechanism for workers with active lifestyle. If this was the case in our data, our findings would represent the neutralising effect of variables going in different directions for different people, which can lead to the overall finding of no or only a weak relation between ERI and sedentary lifestyle.

The results of the study by Kuper *et al* using the Whitehall II data showed that people who exercised reported a higher effort-reward ratio at work.[14] However, their results cannot be directly compared with our results as there are many differences between these two studies. Firstly, Kuper *et al* used a different measure of physical activity—time spent in moderate or vigorous activity per week—rather than MET hours as used in the present study. Secondly, the main goal of their study was not the relationship between ERI and physical activity but the link between psychosocial work environment and health functioning. Thus, the analyses controlled only for age and not a large set of potential confounding factors as in our analysis. Thirdly, their study was based on a predominantly white-collar office based population and did not include employees younger than 35 years.

Previous research on work stress and leisure time physical activity prominently relates to job strain model. Low control,[13 33 34] high demands,[12 34] and high job strain[12 13] in women and/or in men have been associated with lower physical activity. However, other studies have been unable to find these relationships.[35 36]

In our data, the associations between individual ERI and sedentary lifestyle persisted after further adjustment for work unit level measure of an alternative work stress model—the demand/control model of job strain—which assumes that excessive demands interact with low control in generating increased risk of ill health.[15] However, the significant association disappeared after an additional adjustment for individual level job strain. Conditions of low control and low rewards often occur simultaneously in the same work environment.[3] This was also the case in the present study: 53% of participants with low rewards also reported low control. Similarly, conditions of low effort and low demands seem to often overlap as 46% of participants with low effort also perceived their job demands as low. Considering the conceptual overlap between the ERI model and the job strain model, it is possible that mutual adjustments for these models represent overcontrol for their effects.

Study strengths

Advantages of the present study include a large sample of women and men, an acceptable percentage of participation, and non-response occurring randomly enough to limit the potential for selection bias. In addition, our study used a well validated measure of physical activity. MET measure has proved to be useful in epidemiological studies, where MET scores can be ascribed to respondents according their self-reported physical activity levels and then relate to health risk outcomes.[37]

Workers' self-reports alone are often used to determine ERI. Such an assessment strategy is open to bias due to individual differences in perceiving, experiencing, and interpreting psychosocial factors at work. An alternative approach, which was used in this study, is to model the effect of ERI additionally with an work unit level score—for example, by assigning an aggregated mean score of ERI in each work unit to each participant. This made it possible to use a multilevel analytical approach, a particular strength of this study.

Furthermore, our study included several relevant confounders known to be associated with physical activity. Lastly, as far as we are aware, this is the first study whose main objective was to test the association between ERI and sedentary lifestyle.

Study limitations

Several limitations of this study need to be taken into account. Firstly, the design of the study was cross sectional and did not allow for the evaluation of causal relationships. Sedentary lifestyle might affect the experience of ERI at work, but such reversed causality between ERI and sedentary lifestyle is a less likely explanation for results based on work unit level ERI indicator. A person's physical activity level is unlikely to influence such scores. Nevertheless, it is possible that sedentary respondents were selected more often to workplaces characterised by higher ERI. Longitudinal studies are needed to address the question of whether high ERI causes subsequent decrease in physical activity.

Secondly, this survey relied on self-reports of leisure time physical activity, which can cause recall and response bias. Physical activity is complex behaviour and differences in perception could have contributed to variance in responses.[38]

Thirdly, the level of physical activity within work, which was not measured in this study, could be a strong confounding factor. Occupational status, which was recorded in the present study, is associated with the level of physical activity undertaken within work, but clearly it does not capture the whole effect. Lower grade or higher grade non-manuals are likely to do relatively little manual work, whereas those categorised as manual workers noticeably vary in the amount of physical activity that is undertaken in their work.

Fourthly, personality factors not measured in this study, such as self-efficacy, attitudes toward exercise,[38] personality traits, and overcommitment, could have an effect on physical activity. In particular overcommitment, which refers to a personal pattern of coping with work demands—excessive striving in combination with a strong desire to be approved of and esteemed[1 2]—might be a confounding factor in the relation between ERI and sedentary lifestyle. People characterised by a motivational pattern of excessive work commitment and a high need for approval (overcommitment) are at increased risk of strain stemming from non-symmetric exchange. Overcommitment is hypothesised to modify (increase) the health effects produced by ERI.[2] In fact, overcommitment might be connected to one possible mechanism linking ERI to sedentary lifestyle. High ERI could generate feelings of frustration, passivity, and apathy, which might spill over to leisure time. Moreover, the alienation from work could result in adoption of a passive and unhealthy lifestyle. Of the ERI model, particularly overcommitment could be related to alienation as overcommitment is a motivational pattern, and a lack of motivation could lead to some form of disengagement from the environment. Unfortunately, we were not able to examine this in the present study because our questionnaire did not include the measure of overcommitment.

Fifthly, in connection with the third limitation, our measure of ERI was crude compared with the original measure.[2] However, both studies using original and proxy measures have found support for the ERI model, indicating an effect of ERI regardless of the measure being used.[39] Previous reports of this study cohort have shown an association between high ERI and increased body mass index and smoking intensity, an indication of the predictive validity of our ERI measure. In spite of this, there is a possibility that our measure did not fully capture the ERI model, and the Cronbach's alpha for the rewards scale was rather moderate. These issues may have underestimated the associations observed. Moreover, the Finnish versions of the job control and demands measures were derived from the Job Content Questionnaire, but they were not identical with the original measures. If this reduced validity of the job strain assessment, then the independent effect of ERI on sedentary lifestyle may have been overestimated. Further research with original ERI and job strain measures is therefore needed to confirm the present findings.

A final point of attention is that although the large size and diversity of the sample guarantees a certain generalisation of the results, the present data were female-dominated and from the Finnish public sector. As a relatively high proportion of the participants were healthcare workers, it is probable that the sample is more aware of stress and exercise related issues than other workers might be. Accordingly, replication of these results by other investigators in other countries and samples is important.

CONCLUSIONS

The health benefits of regular leisure time physical activity are widely recognised.[19] We have shown that a high work stress in terms of high cost/low gain could be associated with sedentary lifestyle. Nevertheless, the weak associations suggest that other factors that have strongly predicted sedentary lifestyle in previous studies, such as socioeconomic differences, might be more important in attempts to increase leisure time physical activity among workers.

Main messages

- Physical activity is a multifactorial behaviour influenced by a range of demographic, biological, psychological, behavioural, social, cultural, and physical environmental factors.
- There was a weak association between high effort/reward imbalance at work and sedentary lifestyle in a large sample of Finnish public sector employees.
- The statistically significant effect was evident only for employees' perceptions of effort/reward imbalance, whereas no effect at the aggregated work unit level was found.

Policy implications

- High cost/low gain conditions at work may promote sedentary lifestyle, which is an important health risk factor and among the major targets of health promotion. Improving the balance between employees' efforts and the reward structure of organisations could possibly help to increase non-work physical activity.

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