Title: Is all activity equal? Associations between different domains of physical activity and depressive symptom severity among 261,121 European adults

Running title: Domain-specific physical activity and depression

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Abstract

Background: Physical activity is often associated with better mental health. However, there is evidence that the domain of physical activity influences the strength and direction of this association. Therefore, this study aimed to examine the associations between different domains of physical activity and depression among a large sample of adults living in the European Union. Methods: Cross-sectional analyses were conducted on 261,121 adults, recruited in the European Health Interview Survey (wave 2). Validated items were used to assess physical activity domains (i.e. work-related, transport-related, leisure-time aerobic and muscle-strengthening) and depression symptom severity (8-item Personal Health Questionnaire). Generalized linear models with Poisson regressions provided adjusted prevalence ratios (APR) of depressive symptom severity categories across the physical activity domains. Results: Compared to doing no physical activity, any physical effort at work (APR:0.82-0.86), moderate, high and very high levels of transport-related (APR:0.69-0.83) and aerobic leisure-time activity (APR:0.78-0.87), and 3 days/week of muscle-strengthening (APR:0.93) were associated with a lower prevalence of mild depressive symptom severity. Moreover, doing any level of physical activity in any domain was mostly associated with a lower prevalence of moderate (APR:0.43-0.80), moderate-severe (APR:0.34-0.82) and severe (APR:0.26-0.56) depressive symptoms. Conclusions: Favorable associations were seen between any domain (leisure-time, transport- and work-related) of physical activity and depressive symptom severity. The more severe the symptoms, the stronger the associations. Both modalities of leisure-time physical activity (aerobic and muscle-strengthening) demonstrated beneficial associations with depression, but slightly more so for aerobic physical activity.

Main Text

Introduction

The World Health Organisation (WHO) has reported that the proportion of the population with depression is about 4.4% worldwide (World Health Organisation, 2017). Depression is a major contributor to the global burden of disease and is predicted to be the leading condition in 2030. Moreover, an analysis of the public health impact of chronic disease in 60 countries across the world has concluded that depression produces the greatest decrement in health (Moussavi et al., 2007).

Mental illnesses are associated with physical health-related morbidity and mortality (Firth et al., 2019). For example, a meta-analysis concluded that depression is an independent risk factor for coronary heart disease and myocardial infarction (Gan et al., 2014). In addition, people with mental illness, including depression, are less physically active than the general population (Vancampfort et al., 2017). This suggests that helping those with depression to engage in more physical activity may be good for both mental and physical health. Meta-analytic evidence has suggested that physical activity can confer protected effects for depression (Schuch et al., 2018), as well as be an effective add-on treatment to usual care (Ashdown-Franks et al., 2020).

The field of physical activity for health is complex. It is likely psychosocial outcomes of physical activity may not be affected equally across different physical activity types or domains. However, the acknowledgment of these broader contextual factors has largely been lacking in prior research, where the emphasis has been simply on the volume or intensity of physical activity (Teychenne et al., 2020). Domains typically studied include physical activity undertaken in leisure-time, at work, and for transport (getting to and from places). In a meta-analysis of different domains of physical activity and mental health outcomes, White et al.

found that leisure-time physical activity was included in 95% of the studies, and measures across more than one domain of physical activity in adults were reported in only 19 of 97 studies selected, making it difficult to compare across domains within the same study (White et al., 2017). While favorable associations with mental health were reported for both leisure-time and transport-related physical activity, the opposite was found for work-related physical activity and no association was found with household physical activity. Similar findings were reported in a large cross-sectional study in Brazil (Werneck, Stubbs, Szwarcwald, & Silva, 2020), where lower depressive symptoms were shown for those with higher levels of leisure-time and transport-related physical activity. Conversely, both work-related and household physical activity were associated with higher depressive symptoms (Werneck et al., 2020). In contrast, in a large cross-sectional study amongst Scottish adults (Hamer, Stamatakis, & Steptoe, 2009), all types of physical activity – all activity sessions, sports, walking, and domestic activities – were associated with reduced odds of psychological distress. In Australian women, Peeters et al. (Peeters, van Gellecum, van Uffelen, Burton, & Brown, 2014) found positive associations for leisure-time/transport physical activity, household and gardening activity and well-being.

Although the greatest volume and consistency for an association between physical activity and depression has been shown for leisure-time physical activity, most studies have not differentiated between participation in aerobic activity and muscle-strengthening, with both typically assessed in leisure-time. Muscle-strengthening exercise is defined as "voluntary activity that includes the use of weight machines, exercise bands, hand-held weights, or own body weight (e.g. push-ups or sit-ups)" (J. A. Bennie, Shakespear-Druery, & De Cocker, 2020). Recent evidence shows that greater frequency of muscle-strengthening exercise – itself a key part of national and international physical activity guidelines – is associated with a reduced

likelihood of reporting depressive symptoms, especially when undertaken alongside moderate-to-vigorous aerobic activity (J. A. Bennie, Teychenne, De Cocker, & Biddle, 2019).

In summary, while physical activity is beneficially associated with depressive symptoms, some studies indicate that this association varies according to the physical activity domain. However, few large-scale studies have tested this within the same population sample. Moreover, none have examined leisure-time physical activity separately for aerobic and muscle-strengthening exercise alongside other domains of physical activity. The aim of the present exploratory study, therefore, was to investigate the associations between different domains of physical activity (work-related physical activity, transport-related physical activity, and leisure-time aerobic and muscle-strengthening exercise) and depressive symptom severity.

Materials and Methods

Study design and procedures

Data were drawn from the cross-sectional European Health Interview Survey (EHIS Wave 2: 2013-2014). The EHIS Wave 2 was commissioned by the European Union to measure the health status and health determinants of European Union citizens aged ≥17 years. The study was reviewed and approved by the German Federal Commissioner for Data Protection and Freedom of Information (BfDI) (Hintzpeter et al., 2019). Details about the EHIS Wave 2 are available elsewhere (Eurostat & Commission, 2013; Hintzpeter et al., 2019). In brief, nationally representative samples of adults from 27 participating European Union countries were recruited using a multi-stage sampling technique. Data were collected via a combination of face-to-face, computer-assisted telephone, and computer-assisted web-based interviews. Participation in the study was voluntary and each participant gave informed written consent.

Study sample

Sample sizes within countries ranged from 3,774 (Iceland) to 24,016 (Germany) for adults aged 17 to 75+ years. A total of 316,333 participants initially responded. The response rate was above 50% in most countries (except in Denmark, Germany, Luxembourg, Austria, and Finland), with the highest in Cyprus and Portugal (above 90%). We excluded those aged <18 years (9,453, 3.0% of the original sample), and those who did not respond to the Patient Health Questionnaire (47,455, 15.0% of the original sample), leaving a total sample of 261,121 adults. The adults excluded from the present analyses were slightly more male (48.6%), lower educated (23.4% primary or less), more living in densely-populated areas (45.6%) and had a slightly higher income (22.2% highest quintile), better health (50.3% good self-rated health) and lower BMI (25.8 kg/m²) compared to the current analytic sample (see Table 1). There was no difference in age between adults excluded and included in the present analyses.

Measures

Physical activity domains (exposure variables)

The physical activity module used within the EHIS is a short, domain-specific physical activity questionnaire (EHIS-PAQ), based on previous large-scale health interview surveys (Finger et al., 2015). This EHIS-PAQ measures work-related, transport-related, and leisure-time physical activity in a typical week and distinguishes between aerobic and muscle-strengthening activities undertaken in leisure-time. The EHIS-PAQ showed good evidence for reliability (ICC=0.43-0.73) and validity (ρ=0.15-0.43) for the measurement of domain-specific physical activity (Baumeister et al., 2016). Details of all items and answering options are presented in Supplementary Table 1.

To assess *work-related physical activity*, participants were asked to report the intensity of activities they did for paid and unpaid work, around the home, taking care of family, and studying or training. Response options were as follows: 'mostly sitting or standing', 'mostly walking or tasks of moderate physical effort', 'mostly heavy labor or physically demanding work', or 'not performing any working tasks'.

To assess *transport-related (commuting) physical activity*, participants reported the frequency of walking for at least 10 minutes continuously (0-7 days) and the duration spent walking on a typical day [(five options: '10-20 minutes/day' (recoded to '20'); '30-59 minutes/day' ('45'); '1 hour to less than 2 hours/day' ('90'); '2 hours to less than 3 hours/day' ('150'); and '≥3 hours/day' ('180')] (Finger et al., 2015). The same questions were used to assess the time spent cycling for transport. The frequency was then multiplied by the duration of the activity to calculate a weekly duration. Per EHIS-PAQ protocol (Baumeister et al., 2016; Dorner, Wilfinger, Hoffman, & Lackinger, 2019; Finger et al., 2015), transport-related physical activity was calculated by summing the weekly duration of walking and cycling.

Finally, participants reported the frequency (0-7 days) and duration (open-ended for hours and minutes per week) they spent carrying out sports, fitness and recreational *(leisure) physical activity* in a typical week. The frequency was multiplied by the duration to get a weekly volume of aerobic leisure-time physical activity. For muscle-strengthening activities, participants reported the frequency (0-7) in a typical week.

Depressive symptom severity (outcome variables)

The Patient Health Questionnaire (PHQ-8), an 8-item depression screening instrument, was used to assess mental health. The PHQ-8 was derived originally from the Brief Patient Health

Questionnaire, Depression Module (PHQ-9), and is based on criteria for depression of the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (DSM-IV). The PHQ-8 is considered a reliable and valid tool to assess depressive symptom severity in population-based studies (Eurostat & Commission, 2013; Kroenke et al., 2009), going beyond the prevalence of depressive symptoms (Hapke, Cohrdes, & Nübel, 2019).

The PHQ-8 assesses the frequency (using a 4-point severity scale) of experiencing eight symptoms of depression and/or functional impairment experienced in the past two weeks. As per protocol (Kroenke et al., 2009), total scores were calculated (possible range: 0-24) and then categorized as follows: 0–4 representing 'no significant depressive symptoms'; 'mild depressive symptoms': 5-9; 'moderate depressive symptoms': 10-14; 'moderate-severe depressive symptoms': 15-19; and 'severe depressive symptoms': 20-24.

Covariates

Due to their previously established associations with the exposure and outcome variables (Choi, Lee, Lee, Kang, & Choi, 2017; Chu et al., 2018; Talala, Huurre, Aro, Martelin, & Prättälä, 2008), sociodemographic variables (i.e. sex, age, education, occupational status, income, and degree of urbanization) and lifestyle variables (i.e. self-rated health, limitations in general activity due to health problems, body mass index (BMI), smoking habits), all assessed using standard survey items, were included as covariates in the models (see Table 1). Details of the background, development, and justification of all EHIS Wave 2 survey items have been described elsewhere (Eurostat & Commission, 2013).

<< Please insert Table 1 about here >>

Descriptive analyses were conducted in SPSS version 25 using the Complex Samples module to allow for weighting and clustering by country level. The weighting factor takes into account the unit's probability of selection, corrects for non-response and oversampling/under-sampling of certain population groups, and adjusts/calibrates the sample to external data relating to the distribution of persons in the target population (**Eurostat & Commission, 2013**). The weighting factors were calculated in a three-step process, depending on the sampling procedure, estimated of the response probability and the population structure. To describe the study sample, weighted percentages (%) were used across all covariates, exposure variables and depressive symptom severity categories.

To examine whether and how the physical activity exposure variables were associated with the depressive symptom severity outcome categories, we conducted generalized linear models with Poisson regressions with robust error variance to calculate prevalence ratios. The exposure variables were categorized before conducting the analyses. For work-related physical activity, those mostly sitting or standing were categorized as the reference group. For the other physical activity domains, the reference groups were the inactive individuals reporting no days/minutes spent in the respective domain of physical activity. The remaining values were then stratified into 'low', 'moderate', 'high' and 'very high' based on percentiles 20, 40 and 60 for transport-related and aerobic (leisure-time) physical activity. For muscle-strengthening activities, the categories were based on the number of days doing this activity per week. We ran separate models for each binary outcome variable (yes vs no): (i) mild depressive symptoms (reference = no significant depressive symptoms); (ii) moderate (ref = no significant depressive symptoms); (iii) moderate-severe (ref = no significant depressive symptoms); (iv) severe depressive symptoms (ref = no significant depressive symptoms).

We conducted unadjusted and adjusted models: (i) 'Model A' (unadjusted); (ii) 'Model B' (adjusted for sex, age, education, occupational status, income, and degree of urbanization); (iii) 'Model C' (adjusted for Model B + self-rated health, limitations due to health problems, BMI, smoking habits); (iv) 'Model D' (adjusted for Model C + the respective other physical activity variables + country). Before running the models, we tested for multicollinearity among potential covariates using tests of variance inflation factor (VIF), with a VIF ≥2 indicating multicollinearity ([Cohen, Cohen, West, & Aiken, 2013](#)). No evidence of collinearity among covariates was found (VIF <1.67).

Sensitivity analyses were conducted to examine whether the associations differed when the analyses were stratified based on sex, age, and having limitations due to health problems. All analyses were undertaken in 2020.

Results

<u>Study participants</u>

Participants' characteristics are presented in Table 1. Domain-specific physical activity and depressive symptom severity, for the total sample and split by sex and age, are presented in Table 2.

<< Please insert Table 2 about here >>

<u>Associations between physical activity domains and depressive symptom severity</u>

Table 3 shows the fully adjusted prevalence ratios (APR) for each category of depressive symptom severity by physical activity domain (results from model D). The prevalence ratios

from model A (unadjusted), B (adjusted for socio-demographic variables) and C (adjusted for socio-demographic and lifestyle variables) are presented in Supplementary Table 2-4.

Compared to those mostly sitting or standing at work, any physical effort during work was associated with a lower prevalence of mild depressive symptoms (APR: 0.82-0.86) (see Figure 1 – panel A). There was an inverse linear association between moderate, high and very high levels of transport (APR: 0.69-0.83) and aerobic leisure-time (APR: 0.78-0.87) physical activity, with the prevalence of mild depressive symptoms. For muscle-strengthening, only a frequency of 3 days per week was related to a lower prevalence of mild depressive symptoms (APR: 0.93) compared to no muscle-strengthening (see Table 3 and Figure 1 – panel A).

<< Please insert Table 3 about here >>

Compared to those engaging in no physical activity, any physical effort at work (respectively APR: 0.69-0.72, APR: 0.62-0.68, APR: 0.52-0.53), any level of transport-related physical activity (respectively APR: 0.43-0.77, APR: 0.34-0.36, APR: 0.26-0.54), any level of aerobic leisure-time physical activity (respectively APR: 0.56-0.76, APR: 0.49-0.70, APR: 0.39-0.46), and any frequency of muscle-strengthening (except ≥4 days/week for severe depressive symptoms; respectively APR: 0.72-0.80, APR: 0.61-0.82, APR: 0.41-0.56) was associated with a lower prevalence of moderate, moderate-severe, and severe depressive symptoms (see Table 3 and Figure 1 – panels B-D).

<< Please insert Figure 1 about here >>

Sensitivity analyses

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Overall, with a few exceptions, the patterns of associations between the domains of physical activity and depressive symptom severity were broadly similar for men and women, for mid-aged and older age, and the different categories of limitations (Supplementary Tables 5-7).

The key finding in the sex-stratified analyses (see Supplementary Table 5) was that in women, higher levels of physical effort at work showed higher mild depressive symptoms (APR: 1.08) and no associations with moderate, moderate-severe and severe depressive symptoms. The age-stratified analyses (see Supplementary Table 6) showed that amongst the youngest group (18-34 years), leisure-time physical activity was positively associated with mild and moderate depressive symptoms and not associated with moderate-severe and severe depressive symptoms (versus negative associations in the older age groups). Analyses stratified by functional limitations (see Supplementary Table 7) only showed differences between the categories in the association between muscle-strengthening and mild depressive symptoms (positive association in those with no limitations vs no association in those with moderate and severe limitations).

Discussion

The key findings were that overall, and across all domains of physical activity, any level of activity compared to none showed lower adjusted prevalence ratios for moderate, moderate-severe, and severe depressive symptoms. Moreover, for each depressive symptom severity category, the odds were lower (more favorable) for transport and aerobic leisure-time physical activity domains, compared with muscle-strengthening activity. Also, the more severe the symptoms, the stronger the associations.

To our knowledge, this is the largest study to date to investigate the association between different domains of physical activity and depression amongst adults. In addition, it is the first study to distinguish between leisure-time aerobic and muscle-strengthening physical activity

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when compared with other domains of physical activity and their associations with depression. Moreover, we were able to test for dose-dependent associations of physical activity domains and depressive symptom severity.

Meta-analytical evidence of observational studies suggests that mental health effects of physical activity differ by domains, such that favorable associations with mental health are reported for leisure-time and transport-related physical activity, while work-related physical activity has shown small unfavorable associations (White et al., 2017). Our data support the view that leisure-time and transport-related physical activity are favorably associated with depression, thus confirming the results from that meta-analysis (White et al., 2017) and those of previous large datasets (Hamer et al., 2009; Peeters et al., 2014; Werneck et al., 2020). In contrast, for work-related physical activity, our results differ from the findings in Brazil (the only large-scale study that did also include work-related physical activity) (Werneck et al., 2020) and the meta-analytic evidence (White et al., 2017). These studies found an unfavorable association with depression, with greater work-related physical activity being associated with higher depressive symptoms. We found the opposite. In comparison to those who mostly adopted a sitting or standing posture at work, there were reduced odds of depressive symptoms for those adopting moderate physical effort and those undertaking heavy labor or physically demanding work. This was the case across all levels of depression severity. However, sensitivity analyses showed that for women, heavy labor or physically demanding jobs was associated with greater odds of mild depression, but not associated with moderate, moderate-severe and severe depressive symptoms. Future studies may need to account for sex differences and such differences may account for some of the equivocal results regarding work-related activity in the literature. Also, the association between work-related physical activity and

mental health may depend on the occupation type (White, Bennie, Abbott, & Teychenne, 2020).

Work-related physical activity has recently generated a great deal of discussion through what has been termed the 'occupational physical activity paradox', although this has been primarily focussed on cardiovascular outcomes (Holtermann, Krause, van der Beek, & Straker, 2018). Holtermann et al. (Holtermann et al., 2018) contrast the likely effects of leisure-time and work-related physical activity. For example, work-related physical activity may not have the same beneficial physical health effects as leisure-time physical activity (and some argue may have negative effects) because work-related activity may be too low in intensity or too long in duration, may be undertaken with low psychological control, and may increase levels of inflammation. Whether such factors influence mental health is yet to be determined, although the notion of choice and control might be important. That said, many occupations with minimal physical effort, such as call center or telephone support-related occupations, may also offer limited choice and control. There is much research still to be done regarding physical activity in work and associations with mental health. Factors beyond physical effort are likely to be important, such as choice, enjoyment, engagement, social interactions, rewards, and physical environment, and as such, these may play a key role in influencing the direction of the association between work-related physical activity and mental health.

Consistent with prior research (Werneck et al., 2020; White et al., 2017), our study showed transport-related physical activity was inversely associated with depressive symptoms. However, since active transport can take many forms and be undertaken in varied environments, such factors require further investigation. For example, differences between walking and cycling are important, and local environmental conditions – safety, terrain,

weather – also need consideration. As with work-related physical activity, whether people can choose active over more sedentary forms of travel may also be important.

The present study is the first study to address several domains of physical activity by differentiating aerobic and muscle-strengthening forms of leisure-time physical activity when considering mental health outcomes. Our findings suggest that both types of leisure-time physical activity (i.e. aerobic and muscle-strengthening activity) are inversely associated with depressive symptoms, although aerobic physical activity demonstrated stronger associations. This reflects the results reported by Bennie et al. (J. A. Bennie et al., 2019) using large-scale American data. The same authors have shown that meeting guidelines for both aerobic and muscle-strengthening activity are associated with the lowest likelihood of reporting depressive symptoms (J. A. Bennie, De Cocker, Biddle, & Teychenne, 2020; J. A. Bennie et al., 2019), although further prospective studies are required to confirm these findings and the direction of associations.

Muscle-strengthening physical activity is currently understudied in comparison to aerobic activity (J. A. Bennie, Shakespear-Druery, et al., 2020). Muscle-strengthening may contribute to lowered depression symptom severity through biological mechanisms of neuroplasticity, neuroendocrine responses, and reduced inflammation, as well as improved physical and cognitive function and quality of life (Li, Peng, Xiang, Han, & Li, 2018). But it is equally likely to tap into psychosocial mechanisms such as positive changes to physical self-perceptions and body image, as well as through changes in skill mastery and self-efficacy (Kandola, Ashdown-Franks, Hendrikse, Sabiston, & Stubbs, 2019). A challenge for this field is encouraging greater participation in muscle-strengthening activity that does not rely on attendance at structured or gym-based sessions (e.g. home-based).

Overall, our results have implications for the promotion of physical activity. Findings suggest that differentiating domains of physical activity might not be as important as previously suggested, at least for depression. This suggests that any form of physical activity, whether at home, work or transport, could be beneficial. This might allow for greater choice and possibly boost adoption and maintenance of active behaviors. However, the sensitivity results did indicate that further nuanced analyses (e.g., by sex and age) in subsequent studies are called for. Equally, we acknowledge the cross-sectional nature of the data, and how these findings need to be replicated in longitudinal studies that assess domain-specific physical activity and other indicators of mental health. In addition, future studies on bio-behavioral mechanisms are needed to explain why and how physical activity might affect (the treatment of) depression.

Strengths of the current study are the large representative sample size, the simultaneous assessment of four domains of physical activity, including muscle-strengthening activity, and the analysis of dose-dependent associations. However, self-reported exposure and outcome variables and a cross-sectional design are limitations. Use of device-based physical activity assessment, such as through accelerometers, are becoming increasingly possible for large-scale epidemiological studies. These offer advantages for quantifying overall levels of physical activity but are still not able to assess some domains of activity. That said, it is possible that self-reported estimates from the current study include values affected by measurement errors of recall and bias. Still, the estimates provided (see Table 2) seem plausible and are comparable to those in other large-scale studies (J. Bennie et al., 2016).

Moreover, no information was available on household activities, nor on how different activities were undertaken. Further, as some socio-demographic and lifestyle variables of the analytic sample did differ from those excluded, representativeness of the present participants may be limited. Finally, it should be acknowledged that multiple models were ran, which may have led

to false significant association; however, overall findings did not change when using 99% confidence intervals (data not shown).

Conclusion

Overall, engaging in any level or domain of activity may be beneficial in the prevention and treatment of depression. We were able to confirm previous research concerning favorable associations between leisure-time and transport-related physical activity with depression symptom severity. In contrast to some, we also showed favorable associations for work-related physical activity, albeit with some sex differences. Slightly more favorable associations were evident for aerobic physical activity over muscle-strengthening. More emphasis is needed on the context of the physical activity undertaken in these different domains. This needs to include accounting for choice, control and affect.

Data Availability Statement

The datasets analyzed during the current study are available via the European Commission: [https://ec.europa.eu/eurostat/web/microdata/european-health-interview-survey].

Table 1: Participant characteristics.

	Total sample† (n=261,121)
Sociodemographic variables	
Sex: n (%)‡ male	117,893 (47.6)
Age:	
n (%)‡ 18-34 years	54,342 (25.2)
n (%)‡ 35-64 years	136,869 (51.6)
n (%)‡ 65+ years	69,910 (23.3)
Education:	
n (%)‡ primary or less	34,353 (9.9)
n (%)‡ secondary	148,747 (59.7)
n (%)‡ post-secondary	10,931 (3.9)
n (%)‡ tertiary	65,796 (26.5)
Occupational status:	
n (%)‡ student	12,438 (5.0)
n (%)‡ employed (full-time or part-time)	127,644 (53.5)
n (%)‡ fulfilling domestic tasks	13,988 (5.8)
n (%)‡ unemployed	24,263 (8.5)
n (%)‡ retired	74,986 (25.1)
n (%)‡ disabled/unable to work	6,242 (2.2)
Total household income:	
n (%)‡ quintile 1 (lowest)	48,090 (18.9)
n (%)‡ quintile 2	49,559 (19.5)
n (%)‡ quintile 3	50,445 (19.8)
n (%)‡ quintile 4	50,186 (20.5)
n (%)‡ quintile 5 (highest)	49,464 (21.3)
Degree of urbanization:	
n (%)‡ densely-populated	87,404 (36.2)
n (%)‡ intermediate-populated	78,635 (33.1)
n (%)‡ thinly-populated	94,788 (30.7)
Lifestyle variables	
Self-rated health:	
n (%)‡ very bad	4,821 (1.5)
n (%)‡ bad	19,512 (6.3)
n (%)‡ fair	65,918 (23.1)
n (%)‡ good	112,740 (45.8)
n (%)‡ very good	57,403 (23.2)
Limitation due to health problem for at least past 6 months:	
n (%)‡ severely limited	20,841 (7.2)
n (%)‡ limited but not severely	59,009 (19.7)
n (%)‡ not limited at all	178,644 (73.1)
Body mass index:	
mean (SD)	26.0 (4.7)
n (%)‡ underweight (<18.5 kg/m2)	5,186 (2.3)
n (%)‡ normal weight (18.5-24.9 kg/m2)	112,573 (46.2)
n (%)‡ overweight (25-29.9 kg/m2)	94,746 (35.6)
n (%)‡ obese (≥30 kg/m2)	43,035 (15.8)
Smoking:	
n (%)‡ daily smoking	48,781 (19.3)
n (%)‡ occasional smoking	12,280 (5.0)
n (%)‡ no smoking	198,263 (75.7)

† providing data on the 8-items Patient Health Questionnaire; ‡ weighted percentages

Table 2: Domains of physical activity (exposure) and depressive symptom severity (outcome) for the total sample and split by sex and age.

Physical activity exposure variables	Total sample† (n=261,121)	Sex		Age		
Physical effort of working tasks:		Men	Women	18-34 year-olds	35-64 year-olds	65+ year-olds
n (%)‡ mostly sitting or standing	108,667 (47.1)	47,314 (49.9)	61,353 (53.0)	28,454 (53.6)	68,977 (50.8)	29,266 (46.3)
n (%)‡ tasks of moderate physical effort	103,246 (43.5)	43,614 (37.0)	59,632 (42.7)	20,273 (36.0)	58,692 (39.3)	28,328 (51.1)
n (%)‡ mostly heavy labor/physically demanding	19,630 (9.4)	14,184 (13.1)	5,446 (4.3)	5,468 (10.4)	13,564 (9.9)	1,306 (2.6)
Transport-related physical activity:						
n (%)‡ no transport-related physical activity	57,993 (22.2)	25,881 (20.9)	32,112 (22.1)	10,253 (17.7)	31,835 (21.7)	20,678 (27.1)
n (%)‡ 10-90 minutes/week	41,753 (17.2)	17,566 (15.2)	24,187 (17.1)	8,116 (15.5)	22,991 (16.5)	13,028 (17.4)
n (%)‡ 91-140 minutes/week	55,520 (21.5)	23,554 (21.2)	31,966 (23.6)	13,424 (23.8)	33,012 (22.3)	15,567 (19.9)
n (%)‡ 141-315 minutes/week	54,293 (20.5)	24,402 (21.1)	29,891 (21.0)	13,218 (22.7)	31,863 (20.7)	14,764 (19.4)
n (%)‡ 316 or more minutes/week	49,845 (18.5)	25,770 (21.6)	24,075 (16.1)	12,864 (20.3)	29,259 (18.8)	12,016 (16.2)
Aerobic leisure-time physical activity						
n (%)‡ no aerobic leisure-time physical activity	153,044 (57.2)	67,387 (53.6)	85,657 (58.8)	26,907 (46.3)	85,637 (56.9)	54,046 (69.8)
n (%)‡ 20-210 minutes/week	20,711 (9.8)	8,835 (8.8)	11,876 (9.9)	5,712 (11.0)	12,560 (10.1)	3,569 (5.9)
n (%)‡ 211-600 minutes/week	24,849 (10.7)	10,740 (10.4)	14,109 (11.1)	7,396 (13.3)	15,439 (11.2)	4,058 (6.1)
n (%)‡ 601-1020 minutes/week	15,803 (6.2)	7,160 (6.6)	8,643 (6.1)	4,582 (7.6)	9,632 (6.4)	2,925 (4.3)
n (%)‡ 1021 or more minutes/week	40,880 (16.1)	21,182 (20.6)	19,698 (14.4)	12,594 (21.9)	23,658 (15.5)	9,773 (14.0)
Muscle-strengthening activities:						
n (%)‡ no muscle-strengthening activities	199,790 (75.5)	88,751 (73.9)	111,039 (77.7)	38,247 (66.5)	116,893 (78.1)	65,134 (83.9)
n (%)‡ 1 day/week	14,592 (6.7)	5,766 (5.6)	8,826 (7.0)	4,343 (8.1)	8,417 (6.3)	2,218 (3.8)
n (%)‡ 2 days/week	15,753 (6.8)	7,000 (6.7)	8,753 (6.5)	5,213 (9.2)	8,864 (6.3)	2,443 (3.8)
n (%)‡ 3 days/week	11,702 (4.8)	6,163 (5.6)	5,539 (4.0)	4,479 (7.6)	6,164 (4.1)	1,749 (2.7)
n (%)‡ 4 or more days/week	15,323 (6.3)	8,540 (8.1)	6,783 (4.8)	5,097 (8.7)	7,549 (5.2)	3,795 (5.8)
Mental health outcome variables						
Depressive symptom severity:						
n (%)‡ no significant depressive symptoms	205,772 (78.4)	98,136 (82.6)	107,636 (74.8)	44,795 (81.7)	109,571 (79.2)	51,406 (73.1)
n (%)‡ mild depressive symptoms	38,721 (14.9)	14,089 (12.3)	24,632 (17.2)	7,019 (13.2)	19,440 (14.6)	12,262 (17.6)
n (%)‡ moderate depressive symptoms	10,495 (4.2)	3,582 (3.2)	6,913 (5.0)	1,681 (3.3)	4,952 (3.9)	3,862 (5.7)
n (%)‡ moderate-severe depressive symptoms	4,184 (1.7)	1,418 (1.3)	2,766 (2.0)	621 (1.3)	2,008 (1.6)	1,555 (2.3)
n (%)‡ severe depressive symptoms	1,949 (0.8)	668 (0.6)	1,281 (1.0)	226 (0.5)	898 (0.8)	825 (1.3)

†providing data on the 8-itmes Patient Health Questionnaire; ‡ weighted percentages

Table 3: Adjusted prevalence ratios (95% confidence intervals) of each category of depressive symptom severity for the different physical activity domains (results from fully adjusted Poisson regression models†).

Physical activity domain		Mild depressive symptoms	Moderate depressive symptoms	Moderate-severe depressive symptoms	Severe depressive symptoms
Work	Mostly sit/stand	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Moderate physical effort	**0.86 (0.84 , 0.88)**	**0.72 (0.69 , 0.75)**	**0.62 (0.57 , 0.67)**	**0.52 (0.46 , 0.60)**
	Heavy labor/physically demanding	**0.82 (0.78 , 0.85)**	**0.69 (0.63 , 0.76)**	**0.68 (0.59 , 0.79)**	**0.53 (0.41 , 0.68)**
Transport	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (20-90 min/week)	1.00 (0.97 , 1.04)	**0.77 (0.73 , 0.83)**	**0.66 (0.59 , 0.74)**	**0.54 (0.46 , 0.64)**
	Moderate (90-140 min/week)	**0.83 (0.80 , 0.86)**	**0.58 (0.54 , 0.62)**	**0.48 (0.43 , 0.53)**	**0.37 (0.32 , 0.45)**
	High (141-315 min/week)	**0.77 (0.74 , 0.80)**	**0.46 (0.43 , 0.50)**	**0.41 (0.37 , 0.46)**	**0.30 (0.25 , 0.37)**
	Very high (≥316 min/week)	**0.69 (0.67 , 0.72)**	**0.43 (0.40 , 0.47)**	**0.34 (0.30 , 0.38)**	**0.26 (0.21 , 0.32)**
Aerobic leisure-time	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1-210 min/week)	0.97 (0.93 , 1.02)	**0.76 (0.70 , 0.83)**	**0.70 (0.60 , 0.80)**	**0.46 (0.35 , 0.60)**
	Moderate (211-600 min/week)	**0.87 (0.84 , 0.91)**	**0.64 (0.58 , 0.69)**	**0.53 (0.45 , 0.61)**	**0.39 (0.29 , 0.50)**
	High (601-1020 min/week)	**0.84 (0.80 , 0.88)**	**0.62 (0.56 , 0.69)**	**0.49 (0.40 , 0.59)**	**0.39 (0.28 , 0.53)**
	Very high (≥1021 min/week)	**0.78 (0.76 , 0.81)**	**0.56 (0.52 , 0.60)**	**0.49 (0.44 , 0.56)**	**0.40 (0.32 , 0.49)**
Muscle-strengthening	None (0 days/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1day/week)	1.04 (0.99 , 1.09)	**0.78 (0.69 , 0.86)**	**0.66 (0.54 , 0.80)**	**0.56 (0.40 , 0.76)**
	Moderate (2 days/week)	0.98 (0.94 , 1.03)	**0.72 (0.64 , 0.79)**	**0.61 (0.50 , 0.73)**	**0.53 (0.38 , 0.72)**
	High (3 days/week)	**0.93 (0.88 , 0.99)**	**0.80 (0.71 , 0.89)**	**0.82 (0.67 , 0.98)**	**0.41 (0.27 , 0.61)**
	Very high (≥4 days/week)	0.95 (0.91 , 1.00)	**0.80 (0.72 , 0.88)**	**0.78 (0.65 , 0.92)**	0.81 (0.61 , 1.05)

†adjusted for sex, age, education, occupational status, income, degree of urbanization, self-rated health, limitations due to health problems, BMI, smoking habits, and the respective other physical activity variables

Supplementary Table 1: Physical activity items and answering options used in the European Health Interview Survey

Domain	Item	Answering options
Work	"When you are working, which of the following best describes what you do? Would you say…	1. Mostly sitting or standing 2. Mostly walking or tasks of moderate physical effort 3. Mostly heavy labour or physically demanding work 4. Not performing any work
Transport	In a typical week, on how many days do you WALK for at least 10 minutes continuously in order to get to and for places?	Number of days: [1-7] 0. I never carry out such physical activities
	How much time do you spend walking to get to and from places on a typical day?	0. 10-29 minutes per day 1. 30-59 minutes per day 2. 1 hour to less than 2 hours per day 3. 2 hours to less than 3 hours per day 4. 3 hours or more per day
	In a typical week, on how many days do you BICYCLE for at least 10 minutes continuously in order to get to and for places?	Number of days: [1-7] 0. I never carry out such physical activities
	How much time do you spend bicycling to get to and from places on a typical day?	1. 10-29 minutes per day 2. 30-59 minutes per day 3. 1 hour to less than 2 hours per day 4. 2 hours to less than 3 hours per day 5. 3 hours or more per day
Leisure - aerobic	In a typical week, on how many days do you carry out sports, fitness or recreational (leisure) physical activities for at least 10 minutes continuously?	Number of days: [1-7] 0. I never carry out such physical activities
	How much time do you spend on sports, fitness or recreational (leisure) physical activities on a typical day?	☐☐ : ☐☐ per week Hours minutes
Leisure – muscle-strengthening	In a typical week, on how many days do you carry out physical activities specifically designed to STRENGHTEN your muscles such as doing resistance training or strength exercises?	Number of days: [1-7] 0. I never carry out such physical activities

Supplementary Table 2: Unadjusted prevalence ratios (95% confidence intervals) of each category of depressive symptom severity for the different physical activity domains (results from the unadjusted Poisson regression models, Model A).

Physical activity domain		Mild depressive symptoms	Moderate depressive symptoms	Moderate-severe depressive symptoms	Severe depressive symptoms
Work	Mostly sit/stand	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Moderate physical effort	**0.86 (0.84 , 0.88)**	**0.72 (0.69 , 0.75)**	**0.61 (0.57 , 0.66)**	**0.50 (0.45 , 0.57)**
	Heavy labor/physically demanding	**0.81 (0.78 , 0.84)**	**0.68 (0.62 , 0.74)**	**0.71 (0.61 , 0.81)**	**0.55 (0.43 , 0.68)**
Transport	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (20-90 min/week)	**0.95 (0.92 , 0.98)**	**0.67 (0.64 , 0.71)**	**0.55 (0.50 , 0.60)**	**0.39 (0.34 , 0.45)**
	Moderate (90-140 min/week)	**0.78 (0.76 , 0.80)**	**0.49 (0.46 , 0.52)**	**0.36 (0.33 , 0.40)**	**0.27 (0.23 , 0.31)**
	High (141-315 min/week)	**0.71 (0.70 , 0.74)**	**0.40 (0.37 , 0.42)**	**0.29 (0.27 , 0.32)**	**0.20 (0.17 , 0.23)**
	Very high (≥316 min/week)	**0.65 (0.63 , 0.67)**	**0.37 (0.34 , 0.39)**	**0.26 (0.23 , 0.29)**	**0.16 (0.14 , 0.19)**
Aerobic leisure-time	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1-210 min/week)	**0.93 (0.89 , 0.96)**	**0.67 (0.62 , 0.72)**	**0.58 (0.50 , 0.65)**	**0.31 (0.24 , 0.39)**
	Moderate (211-600 min/week)	**0.83 (0.80 , 0.86)**	**0.57 (0.52 , 0.61)**	**0.41 (0.36 , 0.47)**	**0.27 (0.21 , 0.34)**
	High (601-1020 min/week)	**0.80 (0.77 , 0.84)**	**0.54 (0.50 , 0.60)**	**0.41 (0.34 , 0.48)**	**0.28 (0.21 , 0.37)**
	Very high (≥1021 min/week)	**0.74 (0.72 , 0.77)**	**0.49 (0.46 , 0.52)**	**0.41 (0.37 , 0.46)**	**0.27 (0.22 , 0.32)**
Muscle-strengthening	None (0 days/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1day/week)	0.99 (0.95 , 1.04)	**0.72 (0.65 , 0.79)**	**0.57 (0.48 , 0.66)**	**0.42 (0.32 , 0.55)**
	Moderate (2 days/week)	**0.93 (0.89 , 0.97)**	**0.67 (0.61 , 0.74)**	**0.53 (0.45 , 0.62)**	**0.36 (0.27 , 0.47)**
	High (3 days/week)	**0.90 (0.85 , 0.94)**	**0.73 (0.66 , 0.81)**	**0.64 (0.53 , 0.75)**	**0.34 (0.24 , 0.47)**
	Very high (≥4 days/week)	**0.92 (0.88 , 0.96)**	**0.77 (0.70 , 0.84)**	**0.70 (0.60 , 0.80)**	**0.57 (0.45 , 0.71)**

Supplementary Table 3: Adjusted prevalence ratios (95% confidence intervals) of each category of depressive symptom severity for the different physical activity domains (results from the Poisson regression models adjusted for sex, age, education, occupational status, income, degree of urbanization; Model B).

Physical activity domain		Mild depressive symptoms	Moderate depressive symptoms	Moderate-severe depressive symptoms	Severe depressive symptoms
Work	Mostly sit/stand	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Moderate physical effort	**0.86 (0.84 , 0.88)**	**0.72 (0.69 , 0.75)**	**0.62 (0.57 , 0.67)**	**0.50 (0.44 , 0.57)**
	Heavy labor/physically demanding	**0.82 (0.79 , 0.86)**	**0.69 (0.63 , 0.76)**	**0.69 (0.60 , 0.79)**	**0.54 (0.42 , 0.68)**
Transport	None (0 min/week)	**1 (reference)**	**1 (reference)**	**1 (reference)**	**1 (reference)**
	Low (20-90 min/week)	**0.95 (0.92 , 0.98)**	**0.68 (0.64 , 0.72)**	**0.55 (0.50 , 0.60)**	**0.39 (0.34 , 0.45)**
	Moderate (90-140 min/week)	**079. (0.76 , 0.81)**	**0.49 (0.47 , 0.52)**	**0.37 (0.33 , 0.40)**	**0.27 (0.23 , 0.31)**
	High (141-315 min/week)	**0.72 (0.70 , 0.74)**	**0.39 (0.37 , 0.42)**	**0.30 (0.27 , 0.33)**	**0.20 (0.17 , 0.23)**
	Very high (≥316 min/week)	**0.65 (0.63 , 0.67)**	**0.36 (0.34 , 0.39)**	**0.25 (0.23 , 0.28)**	**0.17 (0.14 , 0.20)**
Aerobic leisure-time	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1-210 min/week)	**0.93 (0.89 , 0.96)**	**0.67 (0.61 , 0.72)**	**0.57 (0.49 , 0.65)**	**0.32 (0.25 , 0.41)**
	Moderate (211-600 min/week)	**0.83 (0.80 , 0.86)**	**0.56 (0.51 , 0.60)**	**0.41 (0.35 , 0.47)**	**0.26 (0.21 , 0.33)**
	High (601-1020 min/week)	**0.80 (0.76 , 0.84)**	**0.55 (0.49 , 0.60)**	**0.40 (0.34 , 0.48)**	**0.27 (0.20 , 0.36)**
	Very high (≥1021 min/week)	**0.74 (0.72 , 0.76)**	**0.49 (0.45 , 0.52)**	**0.40 (0.35 , 0.44)**	**0.26 (0.21 , 0.31)**
Muscle-strengthening	None (0 days/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1day/week)	0.99 (0.95 , 1.03)	**0.70 (0.64 , 0.78)**	**0.55 (0.47 , 0.66)**	**0.41 (0.31 , 0.54)**
	Moderate (2 days/week)	**0.94 (0.90 , 0.98)**	**0.66 (0.60 , 0.73)**	**0.51 (0.43 , 0.60)**	**0.34 (0.25 , 0.45)**
	High (3 days/week)	**0.90 (0.85 , 0.94)**	**0.71 (0.64 , 0.79)**	**0.65 (0.55 , 0.77)**	**0.31 (0.22 , 0.44)**
	Very high (≥4 days/week)	**0.92 (0.88 , 0.97)**	**0.76 (0.70 , 0.84)**	**0.69 (0.59 , 0.80)**	**0.54 (0.42 , 0.68)**

Supplementary Table 4: Adjusted prevalence ratios (95% confidence intervals) of each category of depressive symptom severity for the different physical activity domains (results from the Poisson regression models adjusted for sex, age, education, occupational status, income, degree of urbanization, self-rated health, limitations due to health problems, BMI, and smoking habits; Model C).

Physical activity domain		Mild depressive symptoms	Moderate depressive symptoms	Moderate-severe depressive symptoms	Severe depressive symptoms
Work	Mostly sit/stand	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Moderate physical effort	**0.86 (0.84 , 0.89)**	**0.72 (0.69 , 0.76)**	**0.61 (0.57 , 0.66)**	**0.53 (0.47 , 0.60)**
	Heavy labur/physically demanding	**0.83 (0.79 , 0.86)**	**0.70 (0.64 , 0.76)**	**0.70 (0.60 , 0.81)**	**0.55 (0.43 , 0.70)**
Transport	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (20-90 min/week)	**0.95 (0.92 , 0.98)**	**0.69 (0.65 , 0.73)**	**0.54 (0.49 , 0.59)**	**0.40 (0.35 , 0.45)**
	Moderate (90-140 min/week)	**0.79 (0.76 , 0.81)**	**0.50 (0.47 , 0.53)**	**0.36 (0.33 , 0.40)**	**0.27 (0.23 , 0.31)**
	High (141-315 min/week)	**0.72 (0.70 , 0.74)**	**0.40 (0.37 , 0.42)**	**0.30 (0.27 , 0.33)**	**0.20 (0.17 , 0.23)**
	Very high (≥316 min/week)	**0.64 (0.62 , 0.67)**	**0.37 (0.34 , 0.39)**	**0.25 (0.23 , 0.28)**	**0.16 (0.14 , 0.19)**
Aerobic leisure-time	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1-210 min/week)	**0.93 (0.89 , 0.96)**	**0.68 (0.63 , 0.74)**	**0.57 (0.50 , 0.65)**	**0.34 (0.26 , 0.43)**
	Moderate (211-600 min/week)	**0.83 (0.80 , 0.86)**	**0.56 (0.52 , 0.61)**	**0.41 (0.35 , 0.47)**	**0.27 (0.21 , 0.34)**
	High (601-1020 min/week)	**0.80 (0.76 , 0.84)**	**0.55 (0.50 , 0.61)**	**0.41 (0.34 , 0.48)**	**0.27 (0.20 , 0.36)**
	Very high (≥1021 min/week)	**0.74 (0.72 , 0.77)**	**0.49 (0.45 , 0.52)**	**0.39 (0.35 , 0.44)**	**0.27 (0.22 , 0.32)**
Muscle-strengthening	None (0 days/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1day/week)	0.99 (0.95 , 1.04)	**0.71 (0.64 , 0.78)**	**0.56 (0.47 , 0.66)**	**0.41 (0.30 , 0.54)**
	Moderate (2 days/week)	**0.94 (0.89 , 0.98)**	**0.67 (0.60 , 0.74)**	**0.51 (0.43 , 0.61)**	**0.35 (0.26 , 0.47)**
	High (3 days/week)	**0.89 (0.85 , 0.94)**	**0.71 (0.64 , 0.79)**	**0.64 (0.53 , 0.76)**	**0.32 (0.22 , 0.45)**
	Very high (≥4 days/week)	**0.92 (0.88 , 0.97)**	**0.76 (0.69 , 0.83)**	**0.69 (0.59 , 0.80)**	**0.55 (0.43 , 0.70)**

Supplementary Table 5: Adjusted prevalence ratios (95% confidence intervals) of each category of depressive symptom severity for the different physical activity domains (results from fully adjusted Poisson regression models†) stratified by sex.

Physical activity domain		Mild depressive symptoms MEN	Mild depressive symptoms WOMEN	Moderate depressive symptoms MEN	Moderate depressive symptoms WOMEN	Moderate-severe depressive symptoms MEN	Moderate-severe depressive symptoms WOMEN	Severe depressive symptoms MEN	Severe depressive symptoms WOMEN
Work	Mostly sit/stand	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Moderate physical effort	**0.82 (0.79 , 0.86)**	**0.88 (0.85 , 0.90)**	**0.71 (0.65 , 0.78)**	**0.71 (0.67 , 0.76)**	**0.59 (0.51 , 0.69)**	**0.62 (0.56 , 0.69)**	**0.46 (0.36 , 0.58)**	**0.54 (0.46 , 0.64)**
	Heavy labor/physically demanding	**0.83 (0.78 , 0.88)**	**1.08 (1.01 , 1.16)**	**0.66 (0.58 , 0.75)**	1.09 (0.95 , 1.23)	**0.62 (0.50 , 0.77)**	1.16 (0.94 , 1.41)	**0.42 (0.28 , 0.62)**	1.03 (0.73 , 1.41)
Transport	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (20-90 min/week)	1.04 (0.98 ,1.11)	0.96 (0.92 , 1.00)	**0.86 (0.77 , 0.97)**	**0.71 (0.66 , 0.77)**	**0.72 (0.59 , 0.87)**	**0.61 (0.53 , 0.70)**	**0.62 (0.46 , 0.84)**	**0.49 (0.40 , 0.60)**
	Moderate (90-140 min/week)	**0.86 (0.81 , 0.91)**	**0.79 (0.76 , 0.83)**	**0.64 (0.57 , 0.72)**	**0.53 (0.49 , 0.57)**	**0.55 (0.45 , 0.66)**	**0.43 (0.38 , 0.49)**	**0.39 (0.28 , 0.53)**	**0.35 (0.29 , 0.43)**
	High (141-315 min/week)	**0.82 (0.77 , 0.87)**	**0.73 (0.70 , 0.77)**	**0.54 (0.48 , 0.61)**	**0.42 (0.38 , 0.46)**	**0.38 (0.31 , 0.47)**	**0.41 (0.36 , 0.47)**	**0.30 (0.21 , 0.42)**	**0.30 (0.24 , 0.37)**
	Very high (≥316 min/week)	**0.75 (0.71 , 0.79)**	**0.68 (0.65 , 0.71)**	**0.67 (0.41 , 0.53)**	**0.44 (0.40 , 0.48)**	**0.41 (0.33 , 0.50)**	**0.32 (0.27 , 0.37)**	**0.29 (0.20 , 0.40)**	**0.26 (0.20 , 0.33)**
Aerobic leisure-time	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1-210 min/week)	0.94 (0.88 ,1.01)	0.98 (0.93 , 1.03)	**0.70 (0.60 , 0.82)**	**0.78 (0.70 , 0.86)**	**0.77 (0.59 , 0.98)**	**0.65 (0.54 , 0.78)**	**0.31 (0.17 , 0.55)**	**0.52 (0.38 , 0.70)**
	Moderate (211-600 min/week)	**0.82 (0.77 , 0.88)**	**0.89 (0.85 , 0.94)**	**0.56 (0.48 , 0.65)**	**0.67 (0.60 , 0.74)**	**0.44 (0.33 , 0.59)**	**0.56 (0.47 , 0.67)**	**0.30 (0.17 , 0.49)**	**0.42 (0.31 , 0.57)**
	High (601-1020 min/week)	**0.81 (0.74 , 0.88)**	**0.86 (0.80 , 0.91)**	**0.67 (0.56 , 0.79)**	**0.61 (0.53 , 0.69)**	**0.42 (0.28 , 0.59)**	**0.52 (0.41 , 0.65)**	**0.26 (0.12 , 0.49)**	**0.46 (0.31 , 0.65)**
	Very high (≥1021 min/week)	**0.79 (0.75 , 0.83)**	**0.81 (0.78 , 0.85)**	**0.56 (0.50 , 0.63)**	**0.60 (0.55 , 0.66)**	**0.50 (0.41 , 0.61)**	**0.52 (0.45 , 0.61)**	**0.34 (0.23 , 0.48)**	**0.46 (0.35 , 0.59)**
Muscle-strengthening	None (0 days/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1day/week)	1.06 (0.97 , 1.15)	1.00 (0.94 , 1.06)	**0.80 (0.65 , 0.96)**	**0.76 (0.65 , 0.84)**	**0.64 (0.43 , 0.90)**	**0.64 (0.51 , 0.80)**	**0.36 (0.15 , 0.71)**	**0.61 (0.41 , 0.86)**
	Moderate (2 days/week)	**0.91 (0.83 , 0.98)**	1.02 (0.96 , 1.08)	**0.73 (0.60 , 0.87)**	**0.71 (0.62 , 0.81)**	**0.50 (0.34 , 0.71)**	**0.66 (0.52 , 0.82)**	**0.17 (0.05 , 0.39)**	**0.70 (0.49 , 0.97)**
	High (3 days/week)	0.99 (0.91 ,1.08)	0.94 (0.87 , 1.01)	0.87 (0.72 , 1.04)	**0.80 (0.68 , 0.93)**	0.96 (0.71 , 1.27)	**0.79 (0.61 , 1.01)**	**0.29 (0.12 , 0.60)**	**0.52 (0.31 , 0.81)**
	Very high (≥4 days/week)	0.99 (0.92 , 1.06)	1.00 (0.94 , 1.07)	**0.77 (0.65 , 0.91)**	0.90 (0.90 , 1.03)	0.88 (0.67 , 1.14)	0.80 (0.63 , 1.04)	0.79 (0.50 , 1.19)	0.92 (0.64 , 1.27)

† adjusted for age, education, occupational status, income, degree of urbanization, self-rated health, limitations due to health problems, BMI, smoking habits, and the respective other physical activity variables

Supplementary Table 6: Adjusted prevalence ratios (95% confidence intervals) of each category of depressive symptom severity for the different physical activity domains (results from fully adjusted Poisson regression models†) stratified by age group.

|		Mild depressive symptoms			Moderate depressive symptoms		
Physical activity domain		**18-34 year-olds**	**35-64 year-olds**	**65+ year-olds**	**18-34 year-olds**	**35-64 year-olds**	**65+ year-olds**
Work	Mostly sit/stand	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Moderate physical effort	0.96 (0.91 , 1.01)	0.97 (0.94 , 1.01)	**0.60 (0.57 , 0.63)**	0.90 (0.80 , 1.01)	**0.91 (0.85 , 0.97)**	**0.37 (0.34 , 0.41)**
	Heavy labur/physically demanding	**0.88 (0.81 , 0.97)**	**0.93 (0.88 , 0.98)**	**0.57 (0.48 , 0.68)**	0.92 (0.76 , 1.10)	**0.85 (0.76 , 0.95)**	**0.29 (0.19 , 0.43)**
Transport	None (0 min/week)	**1 (reference)**	**1 (reference)**	**1 (reference)**	**1 (reference)**	**1 (reference)**	**1 (reference)**
	Low (20-90 min/week)	1.14 (1.04 , 1.24)	1.04 (0.99 , 1.09)	**0.88 (0.82 , 0.93)**	1.07 (0.90 , 1.27)	**0.79 (0.72 , 0.87)**	**0.65 (0.58 , 0.72)**
	Moderate (90-140 min/week)	0.96 (0.86 , 1.24)	**0.87 (0.76 , 0.81)**	**0.73 (0.69 , 0.78)**	**0.82 (0.70 , 0.97)**	**0.63 (0.58 , 0.69)**	**0.44 (0.39 , 0.50)**
	High (141-315 min/week)	**0.89 (0.82 , 0.96)**	**0.83 (0.83 , 0.92)**	**0.61 (0.57 , 0.66)**	**0.72 (0.61 , 0.86)**	**0.54 (0.49 , 0.60)**	**0.27 (0.24 , 0.32)**
	Very high (≥316 min/week)	**0.80 (0.74 , 0.87)**	**0.77 (0.74 , 0.81)**	**0.51 (0.47 , 0.55)**	**0.71 (0.60 , 0.84)**	**0.53 (0.48 , 0.58)**	**0.22 (0.18 , 0.26)**
Aerobic leisure-time	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1-210 min/week)	**1.32 (1.21 , 1.44)**	1.04 (0.99 , 1.10)	**0.71 (0.64 , 0.80)**	**1.32 (1.11 , 1.56)**	**0.81 (0.72 , 0.91)**	**0.47 (0.37 , 0.59)**
	Moderate (211-600 min/week)	**1.14 (1.05 , 1.24)**	**0.95 (0.90 , 0.99)**	**0.62 (0.55 , 0.69)**	1.10 (0.93 , 1.29)	**0.70 (0.62 , 0.78)**	**0.33 (0.25 , 0.43)**
	High (601-1020 min/week)	**1.20 (1.08 , 1.32)**	**0.89 (0.83 , 0.95)**	**0.56 (0.48 , 0.64)**	1.12 (0.92 , 1.37)	**0.66 (0.57 , 0.76)**	**0.37 (0.27 , 0.49)**
	Very high (≥1021 min/week)	**1.19 (1.12 , 1.28)**	**0.84 (0.80 , 0.88)**	**0.45 (0.41 , 0.49)**	1.05 (0.91 , 1.21)	**0.62 (0.56 , 0.69)**	**0.25 (0.20 , 0.30)**
Muscle-strengthening	None (0 day/week)	**1 (reference)**	**1 (reference)**	**1 (reference)**	**1 (reference)**	**1 (reference)**	**1 (reference)**
	Low (1day/week)	**1.48 (1.36 , 1.61)**	**1.08 (1.01 , 1.15)**	**0.55 (0.46 , 0.65)**	**1.26 (1.04 , 1.52)**	**0.82 (0.71 , 0.94)**	**0.36 (0.24 , 0.52)**
	Moderate (2 days/week)	**1.32 (1.22 , 1.44)**	1.02 (0.96 , 1.09)	**0.63 (0.54 , 0.74)**	**1.21 (1.00 , 1.44)**	**0.73 (0.63 , 0.85)**	**0.33 (0.22 , 0.52)**
	High (3 days/week)	**1.48 (1.36 , 1.61)**	0.97 (0.89 , 1.04)	**0.58 (0.49 , 0.70)**	**1.31 (1.08 , 1.57)**	**0.83 (0.70 , 0.98)**	**0.33 (0.20 , 0.49)**
	Very high (≥4 days/week)	**1.29 (1.18 , 1.41)**	1.00 (0.93 , 1.07)	**0.65 (0.57 , 0.73)**	**1.22 (1.01 , 1.16)**	**0.83 (0.71 , 0.97)**	**0.51 (0.39 , 0.64)**
		Moderate-severe depressive symptoms			**Severe depressive symptoms**		
		18-34 year-olds	**35-64 year-olds**	**65+ year-olds**	**18-34 year-olds**	**35-64 year-olds**	**65+ year-olds**
Work	Mostly sit/stand	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Moderate physical effort	0.94 (0.77 , 1.14)	**0.80 (0.71 , 0.89)**	**0.26 (0.22 , 0.31)**	0.83 (0.49 , 1.17)	**0.72 (0.61 , 0.86)**	**0.16 (0.12 , 0.22)**
	Heavy labor/physically demanding	0.90 (0.65 , 1.22)	0.84 (0.69 , 1.00)	**0.40 (0.22 , 0.66)**	1.19 (0.72 , 1.89)	**0.59 (0.42 , 0.80)**	**0.07 (0.00 , 0.31)**
Transport	None (0 min/week)	**1 (reference)**	**1 (reference)**	**1 (reference)**	**1 (reference)**	**1 (reference)**	**1 (reference)**
	Low (20-90 min/week)	1.06 (0.79 , 1.41)	**0.68 (0.58 , 0.79)**	**0.51 (0.42 , 0.62)**	1.21 (0.75 ,1.96)	**0.55 (0.44 , 0.70)**	**0.38 (0.28 , 0.52)**
	Moderate (90-140 min/week)	0.84 (0.64 , 1.10)	**0.52 (0.45 , 0.61)**	**0.32 (0.26 , 0.40)**	0.76 (0.46 , 1.21)	**0.44 (0.35 , 0.56)**	**0.21 (0.14 , 0.30)**
	High (141-315 min/week)	**0.66 (0.50 , 0.88)**	**0.49 (0.42 , 0.57)**	**0.24 (0.19 , 0.30)**	0.80 (0.50 , 1.29)	**0.34 (0.27 , 0.44)**	**0.14 (0.09 , 0.22)**
	Very high (≥316 min/week)	**0.67 (0.50 , 0.89)**	**0.39 (0.33 , 0.46)**	**0.16 (0.11 , 0.21)**	**0.55 (0.32 , 0.92)**	**0.34 (0.26 , 0.43)**	**0.09 (0.05 , 0.15)**
Aerobic leisure-time	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1-210 min/week)	1.22 (0.90 , 1.63)	**0.71 (0.58 , 0.85)**	**0.49 (0.32 , 0.71)**	0.81 (0.44 , 1.37)	**0.52 (0.37 , 0.72)**	**0.18 (0.06 , 0.43)**
	Moderate (211-600 min/week)	0.84 (0.61 , 1.13)	**0.57 (0.46 , 0.69)**	**0.35 (0.22 , 0.53)**	0.70 (0.39 , 1.15)	**0.38 (0.26 , 0.53)**	**0.32 (0.15 , 0.61)**
	High (601-1020 min/week)	0.79 (0.52 , 1.14)	**0.52 (0.40 , 0.67)**	**0.32 (0.18 , 0.51)**	0.77 (0.39 , 1.39)	**0.42 (0.27 , 0.62)**	**0.16 (0.04 , 0.42)**
	Very high (≥1021 min/week)	1.18 (0.94 , 1.47)	**0.48 (0.40 , 0.57)**	**0.18 (0.12 , 0.26)**	0.97 (0.65 , 1.42)	**0.43 (0.33 , 0.57)**	**0.07 (0.02 , 0.15)**
Muscle-strengthening	None (0 days/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1day/week)	1.30 (0.93 , 1.78)	**0.61 (0.46 , 0.78)**	**0.35 (0.17 , 0.64)**	0.81 (0.40 , 1.47)	**0.64 (0.42 , 0.93)**	**0.20 (0.03 , 0.61)**
	Moderate (2 days/week)	0.82 (0.56 , 1.15)	**0.68 (0.53 , 0.86)**	**0.38 (0.20 , 0.66)**	0.66 (0.32 , 1.19)	**0.61 (0.40 , 0.89)**	**0.35 (0.11 , 0.82)**
	High (3 days/week)	**1.59 (1.18 , 2.11)**	**0.70 (0.52 , 0.93)**	**0.45 (0.23 , 0.80)**	1.10 (0.60 , 1.86)	**0.24 (0.10 , 0.47)**	**0.23 (0.04 , 0.71)**
	Very high (≥4 days/week)	1.19 (0.86 , 1.62)	0.88 (0.68 , 1.11)	**0.42 (0.26 , 0.64)**	1.27 (0.75 , 2.04)	0.95 (0.65 , 1.33)	**0.39 (0.17 , 0.76)**

† adjusted for sex, education, occupational status, income, degree of urbanization, self-rated health, limitations due to health problems, BMI, smoking habits, and the respective other physical activity variables

Supplementary Table 7: Adjusted prevalence ratios (95% confidence intervals) of each category of depressive symptom severity for the different physical activity domains (results from fully adjusted Poisson regression models†) stratified by limitations due to health problems.

	Physical activity domain	Mild depressive symptoms			Moderate depressive symptoms		
		NO LIMITATIONS	LIMITED	SEVERLY LIMITED	NO LIMITATIONS	LIMITED	SEVERLY LIMITED
Work	Mostly sit/stand	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Moderate physical effort	0.91 (0.88 , 0.94)	0.83 (0.80 , 0.86)	0.89 (0.83 , 0.96)	0.85 (0.78 , 0.92)	0.73 (0.68 , 0.79)	0.74 (0.67 , 0.82)
	Heavy labor/physically demanding	0.94 (0.88 , 0.99)	0.85 (0.78 , 0.92)	0.92 (0.79 , 1.06)	0.95 (0.82 , 1.09)	0.84 (0.72 , 0.97)	0.79 (0.63 , 0.97)
Transport	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (20-90 min/week)	1.11 (1.05 ,1.17)	0.99 (0.94 , 1.05)	1.01 (0.92 , 1.10)	0.90 (0.79 , 1.01)	0.85 (0.76 , 0.94)	0.91 (0.81 , 1.03)
	Moderate (90-140 min/week)	0.95 (0.91 , 0.99)	0.88 (0.83 , 0.93)	0.89 (0.81 , 0.97)	0.76 (0.67 , 0.85)	0.70 (0.63 , 0.77)	0.73 (0.64 , 0.83)
	High (141-315 min/week)	0.91 (0.86 , 0.95)	0.82 (0.77 , 0.87)	0.85 (0.76 , 0.94)	0.66 (0.59 , 0.75)	0.60 (0.53 , 0.67)	0.58 (0.49 , 0.68)
	Very high (≥316 min/week)	0.82 (0.78 , 0.86)	0.77 (0.72 , 0.82)	0.79 (0.71 , 0.89)	0.64 (0.57 , 0.72)	0.55 (0.49 , 0.62)	0.62 (0.53 , 0.73)
Aerobic leisure-time	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1-210 min/week)	1.17 (1.11 , 1.24)	1.01 (0.94 , 1.09)	0.94 (0.80 , 1.09)	1.05 (0.91 , 1.20)	0.92 (0.80 , 1.06)	0.96 (0.78 , 1.17)
	Moderate (211-600 min/week)	1.02 (0.97 , 1.08)	1.00 (0.94 , 1.07)	0.86 (0.74 , 1.00)	0.94 (0.82 , 1.07)	0.84 (0.73 , 0.96)	0.75 (0.60 , 0.93)
	High (601-1020 min/week)	0.96 (0.89 , 1.02)	0.96 (0.88 , 1.05)	0.98 (0.82 , 1.15)	0.82 (0.69 , 0.96)	0.84 (0.70 , 0.99)	0.90 (0.71 , 1.14)
	Very high (≥1021 min/week)	0.93 (0.89 , 0.97)	0.87 (0.82 , 0.93)	0.87 (0.78 , 0.97)	0.83 (0.74 , 0.92)	0.79 (0.70 , 0.88)	0.57 (0.47 , 0.69)
Muscle-strengthening	None (0 days/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1day/week)	1.24 (1.17 , 1.32)	1.09 (1.00 , 1.19)	1.10 (0.89 , 1.35)	1.02 (0.87 , 1.20)	0.99 (0.84 , 1.18)	1.18 (0.89 , 1.53)
	Moderate (2 days/week)	1.18 (1.11 , 1.25)	1.01 (0.93 , 1.10)	0.88 (0.72 , 1.06)	1.03 (0.88 , 1.19)	0.90 (0.76 , 1.06)	0.67 (0.49 , 0.89)
	High (3 days/week)	1.10 (1.02 , 1.18)	0.93 (0.83 , 1.03)	1.13 (0.93 , 1.35)	1.16 (0.97 , 1.36)	0.85 (0.69 , 1.04)	1.01 (0.76 , 1.31)
	Very high (≥4 days/week)	1.03 (0.96 , 1.10)	0.92 (0.84 , 0.99)	1.06 (0.92 , 1.20)	0.94 (0.79 , 1.11)	0.82 (0.68 , 0.97)	0.87 (0.70 , 1.06)

		Moderate-severe depressive symptoms			Severe depressive symptoms		
		NO LIMITATIONS	LIMITED	SEVERLY LIMITED	NO LIMITATIONS	LIMITED	SEVERLY LIMITED
Work	Mostly sit/stand	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Moderate physical effort	0.93 (0.78 , 1.10)	0.64 (0.56 , 0.73)	0.65 (0.57 , 0.74)	0.98 (0.58 , 1.56)	0.72 (0.58 , 0.90)	0.48 (0.38 , 0.59)
	Heavy labor/physically demanding	1.43 (1.11 , 1.82)	0.90 (0.70 , 1.14)	0.67 (0.49 , 0.91)	0.80 (0.59 , 1.08)	0.74 (0.45 , 1.14)	0.75 (0.49 , 1.10)
Transport	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (20-90 min/week)	0.98 (0.76 ,1.26)	0.80 (0.67 , 0.96)	0.77 (0.64 , 0.91)	0.73 (0.46 , 1.15)	0.48 (0.35 , 0.66)	0.86 (0.68 , 1.08)
	Moderate (90-140 min/week)	0.80 (0.63 , 1.01)	0.65 (0.55 , 0.78)	0.64 (0.53 , 0.76)	0.81 (0.55 , 1.21)	0.41 (0.30 , 0.56)	0.57 (0.44 , 0.74)
	High (141-315 min/week)	0.76 (0.60 , 0.97)	0.55 (0.45 , 0.67)	0.65 (0.53 , 0.78)	0.61 (0.40 , 0.94)	0.45 (0.33 , 0.61)	0.47 (0.34 , 0.63)
	Very high (≥316 min/week)	0.68 (0.53 , 0.88)	0.50 (0.40 , 0.61)	0.50 (0.39 , 0.62)	0.55 (0.34 , 0.85)	0.35 (0.24 , 0.49)	0.48 (0.34 , 0.65)
Aerobic leisure-time	None (0 min/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1-210 min/week)	1.05 (0.79 , 1.38)	0.86 (0.65 , 1.08)	1.11 (0.85 , 1.42)	0.80 (0.46 , 1.30)	0.67 (0.41 , 1.03)	0.68 (0.42 , 1.05)
	Moderate (211-600 min/week)	0.98 (0.76 , 1.26)	0.78 (0.61 , 0.99)	0.64 (0.46 , 0.88)	0.39 (0.19 , 0.71)	0.74 (0.48 , 1.09)	0.68 (0.43 , 1.02)
	High (601-1020 min/week)	0.82 (0.58 , 1.13)	0.71 (0.51 , 0.96)	0.69 (0.46 , 0.98)	0.73 (0.39 , 1.27)	0.61 (0.33 , 1.01)	0.56 (0.30 , 0.96)
	Very high (≥1021 min/week)	0.68 (0.53 , 0.86)	0.79 (0.65 , 0.96)	0.39 (0.35 , 0.44)	0.70 (0.46 , 1.03)	0.49 (0.32 , 0.72)	0.66 (0.47 , 0.89)
Muscle-strengthening	None (0 days/week)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
	Low (1day/week)	0.91 (0.63 , 1.26)	1.00 (0.73 , 1.33)	1.18 (0.79 , 1.68)	1.13 (0.62 , 1.88)	0.61 (0.30 , 1.08)	1.18 (0.66 , 1.93)
	Moderate (2 days/week)	0.73 (0.50 , 1.03)	0.85 (0.62 , 1.14)	0.93 (0.65 , 1.27)	0.44 (0.17 , 0.91)	0.92 (0.54 , 1.45)	0.87 (0.51 , 1.36)
	High (3 days/week)	1.33 (0.96 , 1.80)	1.03 (0.73 , 1.40)	1.06 (0.72 , 1.49)	0.89 (0.42 , 1.65)	0.15 (0.03 , 0.46)	0.86 (0.46 , 1.45)
	Very high (≥4 days/week)	0.87 (0.60 , 1.22)	0.83 (0.61 , 1.10)	0.91 (0.68 , 1.18)	1.24 (0.70 , 2.03)	1.04 (0.65 , 1.58)	0.71 (0.44 , 1.06)

† adjusted for sex, age, education, occupational status, income, degree of urbanization, self-rated health, BMI, smoking habits, and the respective other physical activity variables

Figure 1: Associations between domain-specific physical activity and mild (A), moderate (B), moderate-severe (C) and severe (D) depressive symptoms (adjusted prevalence ratios and 95% confidence intervals from the fully adjusted model; model D)
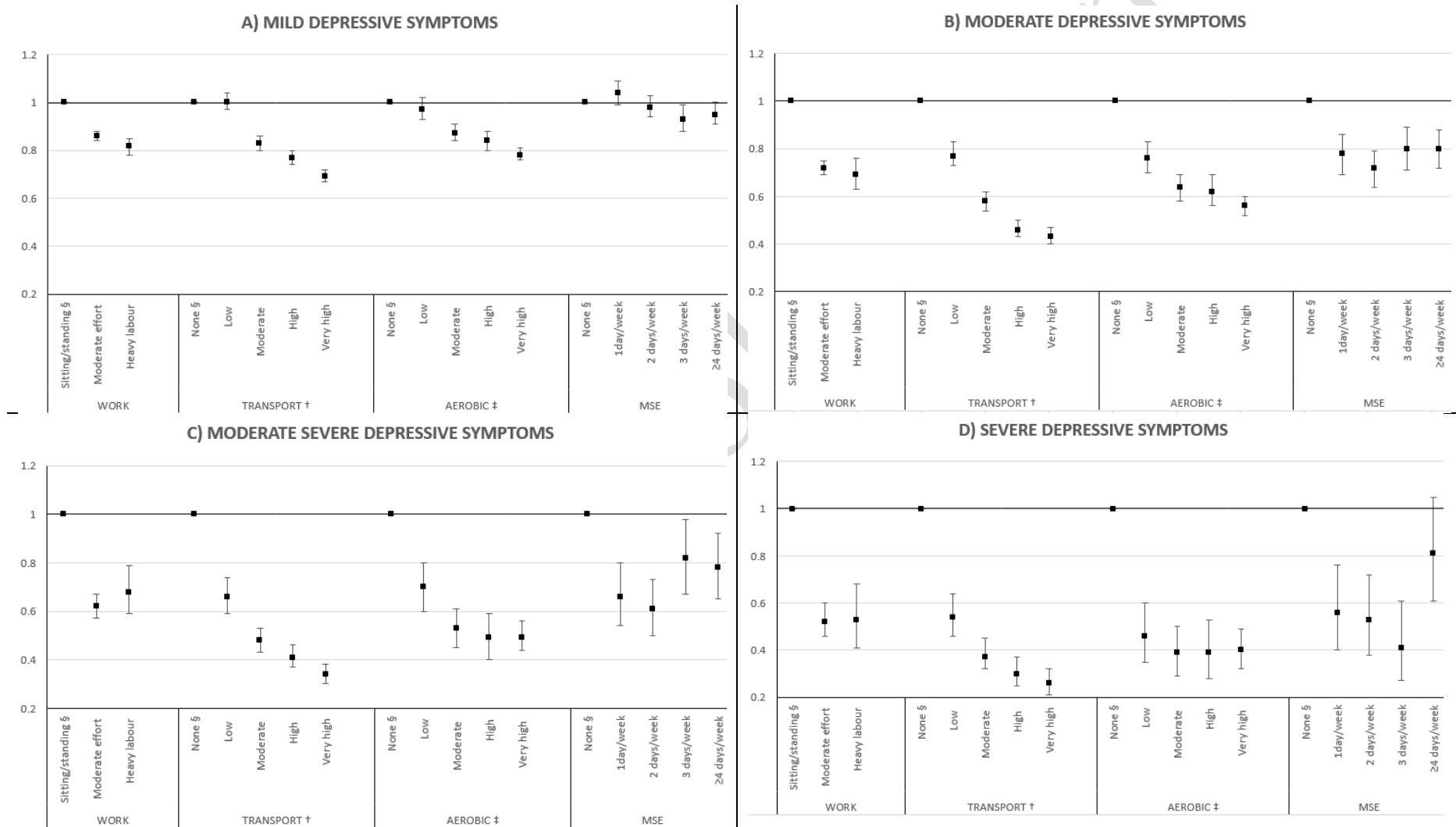
† low: 20-90 min/week; moderate: 91-140 min/week; high: 141-315 min/week; very high: ≥136 min/week; ‡ low: 1-210 min/week; moderate: 211-600 min/week; high: 601-1020 min/week; very high: ≥1021 min/week; § reference group; MSE: muscle-strengthening exercise

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