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Relationship between physical activity and predicted home presenteeism among participants with depressive symptoms with and without clinical depression. Findings from Finnish Depression and Metabolic Syndrome in Adults (FDMSA) study.

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Abbreviations: AUDIT, alcohol use disorders identification test; BDI (-21), Beck Depression Inventory; BMI, Body Mass Index; CI, confidence intervals; CVD, cardiovascular disease; DM, diabetes mellitus; DS, depressive symptoms; EQ5D, European quality of life five dimensions questionnaire; FDMSA-study, Finnish Depression and Metabolic Syndrome in Adults- study; HT, hypertension; IPAQ, International Physical Activity Questionnaire; IPW, inverse probability weighting; LD, lung disease; MDD, major depressive disorder; Migr, migraine; M.I.N.I., Mini-International Neuropsychiatric Interview; MSD, musculoskeletal disorder; PA, physical activity; PHP, predicted home presenteeism; SD, standard deviation; VAS, visual analogue scale; YLD, years lived with disability

ABSTRACT

Background and objectives: Depression can pose a major threat to an individual's ability to cope with daily activities. Aim of this study was to explore the relationship between physical activity (PA) and predicted home presenteeism (PHP) among depressive participants and further, the relationship between PHP and the severity of depressive symptoms was also studied.

Methods: Total 760 participants with depressive symptoms (DS) aged ≥ 35 years attended in this study. The study was conducted between 2008 and 2016 in municipalities within Central Finland Hospital District. DS were determined with Beck Depression Inventory (BDI-21) with cutoff score ≥ 10 and psychiatric diagnoses were confirmed by Mini-International Neuropsychiatric Interview (M.I.N.I.). PA, home presenteeism and other social-clinical factors were captured by standard self-administered questionnaires.

Results: Higher PA levels were associated with lower PHP (adjusted) among depressive patients with ($p < 0.001$) and without clinical depression ($p = 0.021$). In addition, DS (adjusted BDI) correlated with PHP ($r = 0.60$, 95% CI: 0.56 to 0.65) in such a way that the higher the BDI was, the higher the PHP was. Moreover, home presenteeism were higher among depression diagnosed participants than those without ($p = 0.002$).

Conclusion: According to this study, PA is associated with PHP among depressive patients in Finnish adult population. Physical activity seems to promote to cope better with daily activities at home despite of DS or depression diagnosis. These findings outline the importance of being physically active regarding independency of daily activities and thus should be consider in clinical practices when treating depressive patients.

Keywords: Home presenteeism, physical activity, depression, depressive symptoms

Introduction:

With population aging and increasing life expectancy also years living with disease and disability increase among population. Globally, major depressive disorder (MDD) is one of leading cause of years lived with disability (YLD) ¹ and depression has been estimated to be the most common illness globally by the year 2030 ². In the Finnish population depression is the most significant cause of sickness allowances ³ and disability retirement ⁴.

Beside economic burden to society, depression is a huge individual misery ⁵. Depression is accompanied often with other health conditions such other psychiatric comorbidity ⁶, elevated experience of pain and decreased quality of life ⁷. Depression can also be risk for many somatic diseases such as obesity, diabetes and cardiovascular diseases ⁸. Still, for example in the Finnish adult population (≥ 30 years) approximately only one third of those suffering from depression seek ja receive adequate treatment from health care units ⁹.

Today's evidence of benefits of physical activity (PA) and exercise on treatment and prevention of depression is quite clear. PA can decrease depressive symptoms (DS) ¹⁰ and also lower the risk for depression in the future ¹¹. As physical exercise is an effective intervention for depression it also could be a viable adjunct treatment in combination with antidepressants ¹².

As mostly used in literature, presenteeism describes the situation where subject works while being sick and it is workplace or occupational related and often associated with productivity loss ¹³. Again, household presenteeism or presenteeism at home are terms to describe the productivity losses in planned housework or tasks at home ^{14,15}. In home presenteeism focus is on individual's everyday life apart from work and it describes the situation or level of how much one's health disorders harm on coping everyday home chores. Still, as being a global phenomenon, generally accepted definition and consistent measurement methods of presenteeism are lacking ¹⁶. In this study home presenteeism is considered as doing housework or household chores while sick at home environment in a point of view how much these home tasks are disturbed or affected by subjects' diseases and disorders.

From previous studies we know that depression is associated with (work related) presenteeism causing vast workplace productivity losses ^{17,18}. Recent large U.S. based prevalence study has relieved that depression, general anxiety and other mental health disorders are among top health conditions causing highest estimated daily productivity loss and annual cost per person ¹⁹. Recent

studies also suggest that promoting PA can help prevent and reduce health related work presenteeism^{20–22}. Instead, the knowledge of associations between depression and home presenteeism and how PA is related to these factors is lacking. One reason for this might be the difficulty in accurate monetary quantification of these intangible factors associated with sufferers quality of life due to illnesses and therefore they are often neglected in studies²³. In summary, as increasing number of individuals are absenting (unemployment, sick leave or disability retirement) from work life due to depression and further, in a light of PA's positive effect on both depression and work related presenteeism PA may have important role on everyday home tasks in depressed individuals.

Thus, the aim of this study as a part of Finnish Depression and Metabolic Syndrome Study (FDMSA) was to explore the relationship between physical activity (PA) and predicted home presenteeism (PHP) among depressive patients. In addition, the relationship between PHP and the severity of depressive symptoms was also studied.

Materials and methods:

Design

Data of Finnish Depression and Metabolic Syndrome in Adults (FDMSA) baseline study (2008 – 2011) and its follow-up study (2012-2016) that were conducted within the municipalities in Central Finland Hospital District with the catchment area of 274 000 inhabitants were used in this study²⁴. Participants DS and clinical depression were confirmed at FDMSA baseline study stage and other study results were captured at FDMSA five year follow up stage.

At the FDMSA follow up study all participants filled out a standard self-administered questionnaire containing questions about previously diagnosed somatic disorders, home presenteeism, smoking and drinking habits, PA, sleep, quality of life and perceived pain. Data on participants' socio-economical background such as years of education, marital and employment status were also collected via questionnaire.

Participants

The study population was enrolled from patients with DS (n=760) scoring ≥ 10 in the 21-item Beck Depression Inventory²⁵ and who were 35 years of age or older at baseline FDMSA-study stage (2008-2011). Participants were either self-referred or referred by general practitioners to depression nurse

case managers and participants psychiatric diagnoses were confirmed by these trained depression nurse case managers using diagnosis structured interview (M.I.N.I.) ²⁶. The study protocol was approved by the Ethics Committee of the Central Finland Hospital District prior to the commencement of the study. All participants signed an informed written consent.

Total 760 participants with depressive symptoms which were included in the analysis, clinical depression was confirmed in 124 participants (16%). Majority of participants were female (n=514; 68%).

Physical activity questionnaire

PA was assessed by using International Physical Activity Questionnaire (IPAQ), short form – questionnaire. IPAQ was developed as an instrument for cross-national monitoring of physical activity ²⁷ and it has proven to be valid and reliable method to collect physical activity data in cross-sectional studies ²⁸. IPAQ short form consist of seven questions about participants' physical activity (in work, leisure time, commuting, exercising or sport) during last seven days. Participants were asked to assess their at least 10 minutes vigorous (hard physical effort that really makes one's breathing) and moderate (moderate physical effort that make little bit breathing) physical activity and walking sessions as days per week, hours per day and minutes per day. In addition, daily sitting time (hours and minutes per day) were also assessed. Answer were classified as IPAQ grades (low, moderate, high) via IPAQ scoring protocol ²⁹.

Depressive symptoms and psychiatric diagnosis

The severity of participants DS were captured using the 21-item Beck Depression Inventory (BDI-21) ²⁵ with the cut-off point ≥ 10 ²⁴. The psychiatric diagnosis was confirmed and obtained with a diagnostic Mini-International Neuropsychiatric Interview (M.I.N.I.) ²⁶ delivered by trained study nurse.

Anthropometric measurements

The Body Mass Index (BMI) was defined as person's weight (kg) divided by the square of the height (m). World Health Organization (WHO) has defined overweight when $BMI \geq 25$ and obesity when $BMI \geq 30$ respectively ³⁰.

Smoking and alcohol use

Smoking was assessed by asking whether subject currently smoke or not. Participants' drinking habits were evaluated by alcohol use disorders identification test and its three questions screening version (AUDIT-C)³¹. AUDIT-C is a brief practical and valid primary care screening test for heavy drinking and/or active alcohol abuse or dependence³². Subjects were asked to answer following questions: "How often did you have a drink containing alcohol (1=never; 2=monthly or less; 3=2 to 4 times a month; 4=2 to 3 times a week; 5=4 or more times a week)?", "How many drinks did you have on a typical day when you were drinking (1=1 to 2 drinks; 2=3 to 4 drinks; 3=5 to 6 drinks; 4=7 to 9 drinks; 5=10 or more drinks)?" and "How often did you have 6 or more drinks on one occasion in the past year (1=never; 2=less than monthly; 3=monthly; 4=weekly; 5=daily or almost daily)?" The AUDIT- C was scored on a scale 0 to 12 (where response option 1=0 points, 2=1 point, 3= 2 points, 4=3 points and 5=4 points). Generally, men scoring 4 (women 3) or more is considered potential hazardous/heavy drinkers and higher the score, more likely drinking is affecting to one's health and safety^{31,32}.

Home presenteeism

Home presenteeism is defined as doing housework or household chores while sick. It is an evaluation how much housework or household chores are disturbed or affected by subjects' diseases and disorders^{14,15}. In this study home presenteeism was evaluated with visual analogue scale (VAS) asking the question; "How much your diseases and symptoms have affected on your necessary housework and household chores at home during last month (extreme options were "not at all" or "completely blocked")?" Each participant was asked to mark the position to describe his/her agreement to the statement along a continuous line between these two end points. For the analysis answers were scored from 0 ("not at all") to 100 ("completely blocked").

Quality of life

Quality of life was evaluated by using European Quality of life five dimension (three level version) (EQ-5D-3L) questions³³. EQ-5D is a standardized measure of health status to provide a simple, generic measure of health for clinical and economic appraisal and its three level version (EQ-5D-3L) is most widely used instruments for measuring health-related quality of life³⁴. EQ-5D has found to be responsive to changes related to depression severity and health status and appropriate for estimating utility in depression treatment³⁵. In this study response options were recalculated (1=0 point, 2=1 point and 3=2 points) and expressed as an average per patients.

Sleeping

Participants' quality of sleep were evaluated by asking: "How tired do you feel during the first 30 minutes after you have woken up in the morning (1=very tired; 2=quite tired; 3=quite rested; 4=feel fresh)?" The answers "quite rested" or "feel fresh" was regard as a sufficient sleep.

Pain assessment

Participants' perceived pain during last seven days were assessed with two 0 to10 scale questions; pain intensity as average with score range 0 "no pain" to 10 "worst imaginable pain" and pain interference during last seven days when pain had disturbed daily activities in home or outside home with score range "no interference" (0) to "total interference" (10).

Statistical methods

The results were presented as means with standard deviations (SD) or as counts with percentages. Statistical comparisons between depression groups were done using t-test for continuous variables and Pearson's chi- square for categorical variables. Adjusted relationship between PA level and depression status with home presenteeism was analyzed using two-way analysis of variance. A possible nonlinear relationship between BDI and the home presenteeism was assessed by using 4-knot-restricted cubic spline regression. Models included age, gender, marital and working status, educational years, smoking, BMI and comorbid diseases as covariates. The bootstrap method was used when the theoretical distribution of the test statistics was unknown or in the case of violation of the assumptions (e.g. non-normality). Correlation coefficients with 95% confidence intervals (CI) were calculated by using the Pearson method. The normality of variables was evaluated using graphically and the Shapiro–Wilk W test. All analyses were performed using STATA 16.0.

Results:

Table 1 shows the socio-demographic and clinical characteristics of study population. Participants with clinical depression lived less often in relationship, had less educational years, were more often unemployed or retired, smoked more and their BMI were higher than depressive participants without depression diagnosis. Among depression diagnosed participants the prevalence of diabetes, musculoskeletal disorders and lung diseases were higher than among depressive participants without depression diagnosis. The number of subjects with enough sleep were significantly lower among participants with depression diagnosis and their health-related quality of life were poorer than depressive participants without depression diagnosis. In addition, perceived pain (intensity and

interference) was significantly more severe within depression diagnosed participants compared to those without depression (Table 1).

Mean home presenteeism was lower among those without depression (18.8, SD 25.2) compared to those with depression diagnosis (51.5, SD 29.3) ($p=0.002$).

Depressive participants without clinical depression were more physically active than those with depression diagnosis. Among participants without depression 28% of subjects had low, 35% moderate and 37% high IPAQ grade while participants with depression had 42%, 30% and 28% respectively. Mean sum of IPAQ score were higher in those without depression (43.8, SD 44.8) compared to those with depression (35.4, SD 44.1) indicating lower PA among those with depression ($p=0.046$). In the whole study population PA level was linearly related to home presenteeism (p for linearity <0.001). Mean home presenteeism scores by PA level were in low 37.7 (SD 32.7), in moderate 21.4 (SD 25.6) and in high 15.8 (SD 23.4).

Figure 1 shows that higher PA levels were related to lower home presenteeism score in both groups; among those without depression ($p<0.001$) and with depression ($p=0.021$) after adjusting the results for age, gender, marital and working status, educational years, smoking, BMI and comorbid diseases. Home presenteeism score were higher among participants with depression compared to those without depression in all PA levels ($p<0.001$). Instead there was no interaction between IPAQ grade and depression status with respect to home presenteeism ($p=0.47$).

In addition, subgroups analysis (Fig. 2) revealed that BDI scores correlate with PHP ($r=0.60$, 95% CI: 0.56 to 0.65) after adjusting the results for age, gender, marital and working status, educational years, smoking, BMI and comorbid diseases. The higher the BDI score was, the higher the PHP was as well. The same tendency in correlations between BDI scores and PHP is seen also in all PA levels; low ($r=0.60$, 95% CI: 0.50 to 0.68), moderate ($r=0.49$, 95% CI: 0.39 to 0.58) and high ($r=0.63$, 95% CI: 0.54 to 0.70). Also, higher the PA level was, lower the mean PHP score was respectively (Fig. 2).

Discussion:

Main findings and study implications

The study results showed that PA was inversely associated with PHP among depressive participants with and without clinical depression. Those participants with higher PA level had less difficulties and

coped better with their necessary daily housework and household chores than those patients with lower PA activity. Also, depression diagnosis and severity of depressive symptoms were the factors to predict higher discomfort and difficulties to cope with daily tasks.

Our study results indicate, as in line with previous studies ⁶⁻⁸, that clinically diagnosed depression was related to greater BMI as well as other comorbid diseases, poorer quality of life, increased perceived pain and insufficient sleep. Also, depression diagnosed participants' socioeconomic factors and health behavior were poorer than those participants without depression diagnosis. These facts may form significant risk for persons health in the future as well as increase depressions' societal burden ⁵. For example, depression alongside with obesity has found to increase health care utilization and health care-related costs ³⁶.

Depression can also cause huge productivity loss in work ¹⁷⁻¹⁹ and according to this study it is obvious at home environment as well. Among our study population, managing with daily home tasks were harder with depression diagnosed participants as well as along participants with higher severity of DS. We also know that depression can lower persons quality of life ⁷ and this association was found in our study as well. One important finding in our study was that participants who were more physically active suffered less discomfort from diseases and symptoms and they managed better with their housework and household chores than in-active ones in both groups (among those with and without depression diagnosis). Physical activity can affect positively to person's psychological well-being such as sense of coherence and social integration ³⁷ which again is related to better coping with common daily activities ³⁸. Thus, physically active people may have more self-confidence, and this may protect for example from social isolation and lead to better self-care and help seeking in addition with better management with common daily tasks. This is important especially among people suffering from depressive disorders and who are at home (living alone, unemployed or retirement) because their social network may have shrunken, and they are in greater danger to social isolation.

As we know from previous studies, PA and exercise is effective and beneficial for preventing depression as well as reducing DS and that association between PA and depression is bidirectional ¹⁰⁻¹². PA may not decrease health care utilization directly (at least not in a short term) among depressive patients ³⁹, but on other hand promoting lifetime PA may mean reduced risk for depression and somatic diseases in older age ⁴⁰. Our study results indicates also that, as a same way as PA has positive relation to employee's psychosocial health ⁴¹ and can reduce health related presenteeism at work ²⁰⁻²², it can be beneficial reducing home presenteeism as well. In this scope and according to

our study results, it seems clear that PA can have an important role to improve person's health, quality of life and help to manage everyday tasks at home environment among depressive patients.

When interpreting the results, it is important to note that concept of presenteeism in literature is ambiguous. In general, presenteeism can refer either to working longer than necessary e.g. to show high commitment⁴² or it can refer to attending and going to work sick or injured^{13,42}. In depth, for example, in his review, Johns¹³, has identified nine different definitions for presenteeism: 1) attending work, as opposed to being absent; 2) exhibiting excellent attendance; 3) working elevated hours even when unfit; 4) being reluctant to work part time rather than full time; 5) being unhealthy but exhibiting no sickness absenteeism; 6) going to work despite feeling unhealthy; 7) going to work despite feeling unhealthy or experiencing other events that normally compel absence; 8) reduced productivity at work due to health problems; 9) reduced productivity at work due to health problems or other events that distract one from full productivity. Therefore, the term presenteeism can consider to be health related or not, and it can vary depending on point of view or study approach.

As most of recent studies are focused on work related presenteeism it is important to illuminate illnesses impact on household chores and daily activities as well. Moreover, concept of presenteeism needs more clarified definition for the future and should also include home presenteeism as well. Our study is one of the first of kind to study and measure home presenteeism in association with PA and illness.

Strengths and limitations

Novelty of this study is the study design and approach to explore associations between PA, depression and home presenteeism. The main strength of this study is the use of diagnostic interview (M.I.N.I.) to confirm depression and use of IPAQ method to assess participants PA. IPAQ is widely used and accepted, valid and reliable proof method for evaluating PA in cross-sectional studies²⁸. Another strength of this study is national representative study population with catchment area of 274 000 inhabitants. The main limitation lies on generalizability. Because the study population was enrolled with patients 35 years or older the generalizability to younger persons are questionable. Also, different health care infrastructures (such as accessibility, screening and prevention methods or funding of health care etc.) between countries must take account when interpret these study findings in wider international context.

Although VAS has found to be valid and reliable measurement in cross sectional studies, some caution must also be made when using self-administered VAS questionnaire. In literature, some limitations when using VAS have raised. For example, VAS may be difficult to fulfill among patients with perceptual-motor problems or cognitive limitations and among elderly ⁴³. VAS may also be prone to spreading (meaning that respondents use all areas on the valuation scale, especially when there are multiple health states that are value on the same scale) as well as to context effects (average rating for items is influenced by the level of other items being valued) and endpoint bias (health states at the top and bottom of the scale are placed further apart on the scale than would be suggested by a direct comparison of differences) ⁴⁴. Again, the concept “worst imaginable” may be difficult to understand what it actually means, as the respondent can never know whether the present experience is the “worst” ⁴⁵.

Furthermore, as Despiegel et al ⁴⁶ pointed out in their review, the recommendations for presenteeism tool (such as VAS based) must be consider by instrument properties such as easy use and monetization ability as well as study type ⁴⁶. Also, the responsiveness of the tool and impact of mood disorders on self-reported assessment must be take account ⁴⁶

Conclusion(s):

According to this study, physical activity is associated with predicted home presenteeism among patients with depressive symptoms with and without clinical depression in Finnish adult population. Higher physical activity seems to help coping better with daily activities at home despite of depression or depressive symptoms. On the contrary, those participants with higher depressive symptoms had more difficulties and coped worse with their necessary household chores than those with lower DS level. These findings outline the importance of being physically active regarding independency of daily activities and thus should be consider in clinical practices when treating depressive patients.

Table 1. Socio-demographic and clinical characteristics of study population at follow up; patients with depression symptoms without depression diagnosis and with a depression diagnosis.

| Variables | No depression N=636 | Depression N=124 | P value |
|--|------------------------|---------------------|---------|
| Female, n (%) | 434(68) | 80(65) | 0.42 |
| Age, mean (SD) | 59(10) | 60(10) | 0.91 |
| Living in relationship, n (%) | 424(67) | 66(53) | 0.004 |
| Working status, n (%) | | | <0.001 |
| Working | 300(47) | 34(27) | |
| Unemployed | 66(10) | 20(16) | |
| Retired | 270(42) | 70(56) | |
| Education years, mean (SD) | 11.7(3.3) | 10.5(3.0) | <0.001 |
| Body Mass Index (kg/m ²), mean (SD) | 27.3(5.0) | 29.0(6.0) | <0.001 |
| Smoking, n (%) | 94(15) | 35(28) | <0.001 |
| Drinking habits (AUDIT-C), mean (SD) | 2.6(2.4) | 2.9(3.2) | 0.23 |
| Chronic conditions, n (%) | | | |
| Hypertension | 207(33) | 50(40) | 0.094 |
| Cardiovascular disease | 58(9) | 12(10) | 0.84 |
| Diabetes mellitus | 65(10) | 26(21) | <0.001 |
| Musculoskeletal disorder | 241(38) | 71(57) | <0.001 |
| Lung disease | 77(12) | 26(21) | 0.008 |
| Migraine | 79(12) | 18(15) | 0.52 |
| Sufficient sleep, n (%) | 458(72) | 32(26) | <0.001 |
| Health-related quality of life (EQ5D), mean (SD) | 0.805(0.188) | 0.565(0.254) | <0.001 |
| Pain, mean (SD) | | | |
| Intensity | 3.0(2.4) | 5.2(2.4) | <0.001 |
| Interference | 2.6(2.6) | 5.2(2.9) | <0.001 |

AUDIT-C: alcohol use disorders identification test (three question screening version); EQ5D: European quality of life five dimensions questionnaire; SD: standard deviation

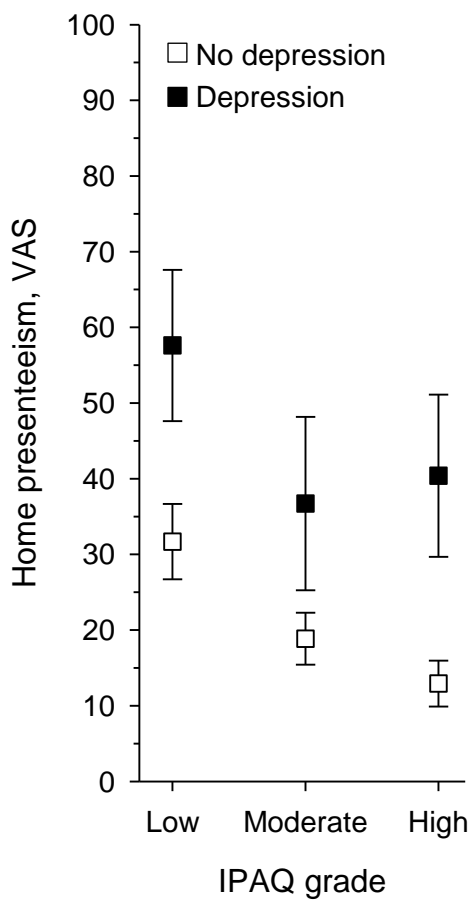


Fig. 1. Mean home presenteeism (with 95% confidence intervals) according to physical activity level (IPAQ grade) and depression status (depression vs. no depression). Adjusted for age, gender, marital and working status, educational years, smoking, BMI and comorbid diseases.

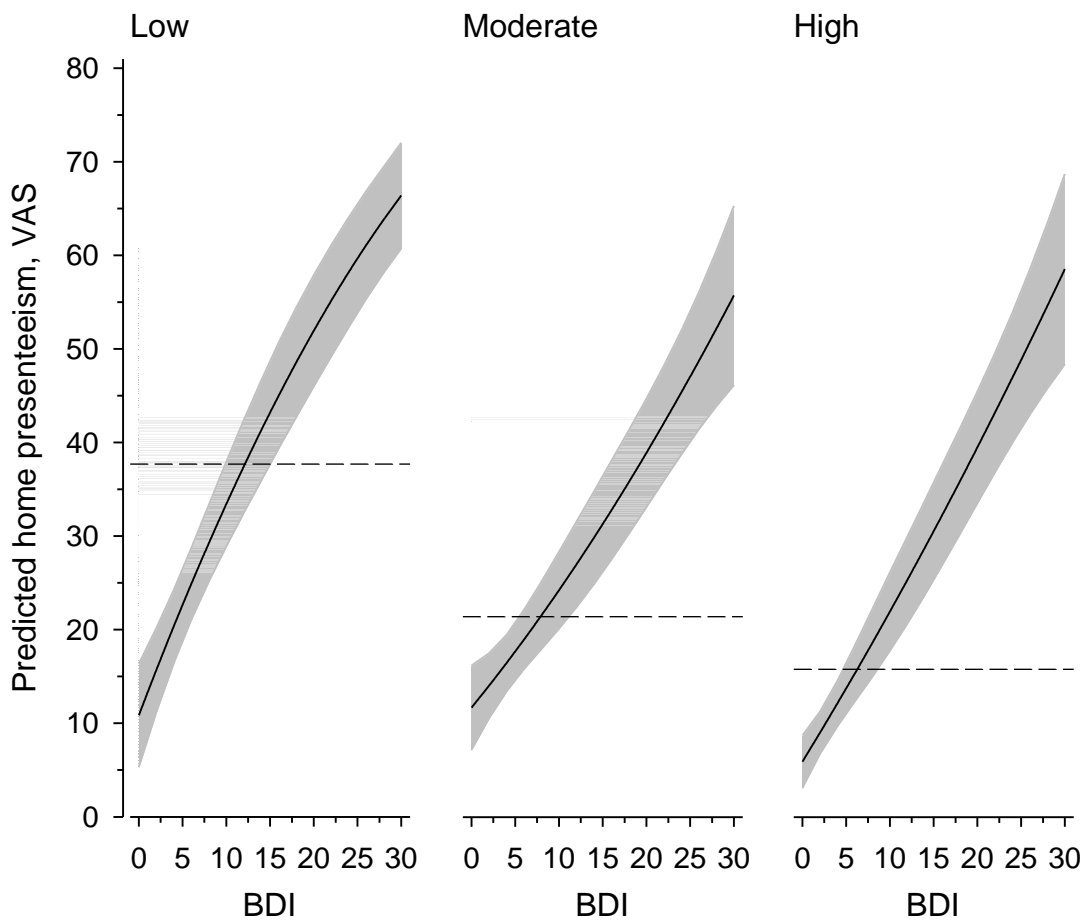


Fig. 2.

Relationships of home presenteeism as the function of the BDI in PA levels (low, moderate, high). The curves were derived from a 4-knot restricted cubic splines regression models. The models were adjusted for age, gender, marital and working status, educational years, smoking, BMI and comorbid diseases. Gray area represents 95% confidence intervals.

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Ethical considerations

The study protocol was approved on the 17th of April 2007 by the Ethics Committee of Central Finland Central Hospital.

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Conflict of interest

The authors declare that they have no conflict of interest.

References

1. Vos T, Abajobir AA, Abate KH, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet*. 2017;390(10100):1211-1259. doi:10.1016/S0140-6736(17)32154-2
2. Mathers CD, Loncar D. Projections of Global Mortality and Burden of Disease from 2002 to 2030. Samet J, ed. *PLoS Med*. 2006;3(11):e442. doi:10.1371/journal.pmed.0030442
3. Kela. Kelasto - Sickness allowance: Number of recipients and allowances paid out. http://raportit.kela.fi/ibi_apps/WFServlet?IBIF_ex=NIT098AL&YKIELI=E. Published 2019. Accessed March 24, 2019.
4. Finnish Centre for Pensions. Statistical Database. https://tilastot.etk.fi/pxweb/en/ETK/ETK__110kaikki_elakkeensaajat__30elakkeelle_siirtyneiden_lkm/elsi_k10_tk_diag.Px/?rxid=9e2f2dab-4dfb-4913-928c-4a121a6b46d9. Published 2017. Accessed March 24, 2019.
5. Sobocki P, Jonsson B, Angst J, Rehnberg C. Cost of depression in Europe. *J Ment Health Policy Econ*. 2006;9(2):87-98. <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed7&NEWS=N&AN=2006325880>.
6. Kessler RC, Berglund P, Demler O, et al. The Epidemiology of Major Depressive Disorder. *JAMA*. 2003;289(23):3095. doi:10.1001/jama.289.23.3095
7. Bair MJ, Wu J, Damush TM, Sutherland JM, Kroenke K. Association of depression and anxiety alone and in combination with chronic musculoskeletal pain in primary care patients. *Psychosom Med*. 2008;70(8):890-897. doi:10.1097/PSY.0b013e318185c510
8. Penninx BWJH, Milaneschi Y, Lamers F, Vogelzangs N. Understanding the somatic consequences of depression: Biological mechanisms and the role of depression symptom profile. *BMC Med*. 2013;11(1):129. doi:10.1186/1741-7015-11-129
9. Hämäläinen J, Isometsä E, Sihvo S, Pirkola S, Kiviruusu O. Use of health services for major depressive and anxiety disorders in Finland. *Depress Anxiety*. 2008;25(1):27-37. doi:10.1002/da.20256
10. Sieverdes JC, Ray BM, Sui X, et al. Association between leisure time physical activity and depressive symptoms in men. *Med Sci Sports Exerc*. 2012;44(2):260-265. doi:10.1249/MSS.0b013e31822e00a6

11. Mammen G, Faulkner G. Physical Activity and the Prevention of Depression: A Systematic Review of Prospective Studies. *Am J Prev Med*. 2013;45(5):649-657. doi:10.1016/J.AMEPRE.2013.08.001
12. Kvam S, Kleppe CL, Nordhus IH, Hovland A. Exercise as a treatment for depression: A meta-analysis. *J Affect Disord*. 2016;202:67-86. doi:10.1016/j.jad.2016.03.063
13. Johns G. Presenteeism in the workplace: A review and research agenda. *J Organ Behav*. 2009;31(4):519-542. doi:10.1002/job.630
14. Soliman AM, Coyne KS, Gries KS, Castelli-Haley J, Snabes MC, Surrey ES. The Effect of Endometriosis Symptoms on Absenteeism and Presenteeism in the Workplace and at Home. *J Manag Care Spec Pharm*. 2017;23(7):745-754. doi:10.18553/jmcp.2017.23.7.745
15. Kumar RN, Hass SL, Li JZ, Nickens DJ, Daenzer CL, Wathen LK. Validation of the Health-Related Productivity Questionnaire Diary (HRPQ-D) on a sample of patients with infectious mononucleosis: Results from a phase 1 multicenter clinical trial. *J Occup Environ Med*. 2003;45(8):899-907. doi:10.1097/01.jom.0000083039.56116.79
16. Lohaus D, Habermann W. Presenteeism: A review and research directions. *Hum Resour Manag Rev*. 2019;29(1):43-58. doi:10.1016/J.HRMR.2018.02.010
17. Lépine J-P, Briley M. The increasing burden of depression. *Neuropsychiatr Dis Treat*. 2011;7(Suppl 1):3-7. doi:10.2147/NDT.S19617
18. Evans-Lacko S, Knapp M. Global patterns of workplace productivity for people with depression: absenteeism and presenteeism costs across eight diverse countries. *Soc Psychiatry Psychiatr Epidemiol*. 2016;51(11):1525-1537. doi:10.1007/s00127-016-1278-4
19. Allen D, Hines EW, Pazdernik V, Konecny LT, Breitenbach E. Four-year review of presenteeism data among employees of a large United States health care system: A retrospective prevalence study. *Hum Resour Health*. 2018;16(1). doi:10.1186/s12960-018-0321-9
20. Walker TJ, Tullar JM, Diamond PM, Kohl HW, Amick BC. The longitudinal relation between self-reported physical activity and presenteeism. *Prev Med (Baltim)*. 2017;102:120-126. doi:10.1016/j.ypmed.2017.07.003
21. Walker TJ, Tullar JM, Diamond PM, Kohl HW, Amick BC. Association of Self-Reported Aerobic Physical Activity, Muscle-Strengthening Physical Activity, and Stretching Behavior With Presenteeism. *J Occup Environ Med*. 2017;59(5):474-479. doi:10.1097/JOM.0000000000000978
22. Justesen JB, Sjøgaard K, Dalager T, Christensen JR, Sjøgaard G. The Effect of Intelligent Physical Exercise Training on Sickness Presenteeism and Absenteeism Among Office

Workers. *J Occup Environ Med.* 2017;59(10):942-948.

doi:10.1097/JOM.0000000000001101

23. Luppá M, Heinrich S, Angermeyer MC, König H-H, Riedel-Heller SG. Cost-of-illness studies of depression: A systematic review. *J Affect Disord.* 2007;98(1-2):29-43. doi:10.1016/J.JAD.2006.07.017
24. Koponen H, Kautiainen H, Leppänen E, Mäntyselkä P, Vanhala M. Cardiometabolic risk factors in patients referred to depression nurse case managers. *Nord J Psychiatry.* 2015;69(4):262-267. doi:10.3109/08039488.2014.972451
25. Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. *Arch Gen Psychiatry.* 1961;4:561-571. doi:10.1001/archpsyc.1961.01710120031004
26. Sheehan D, Lecrubier Y, Harnett-Sheehan K, et al. The Mini International Neuropsychiatric Interview (M.I.N.I.): The Development and Validation of a Structured Diagnostic Psychiatric Interview. In: *Journal of Clinical Psychiatry.* Vol 59. ; 1998:22-23. doi:10.1016/S0924-9338(99)80239-9
27. Booth M. Assessment of physical activity: An international perspective. *Res Q Exerc Sport.* 2000;71:114-120. doi:10.1080/02701367.2000.11082794
28. Craig CL, Marshall AL, Sjöström M, et al. International physical activity questionnaire: 12-Country reliability and validity. *Med Sci Sports Exerc.* 2003. doi:10.1249/01.MSS.0000078924.61453.FB
29. Grupo IPAQ. IPAQ scoring protocol - International Physical Activity Questionnaire. 2005. <https://sites.google.com/site/theipaq/scoring-protocol>. Published 2016. Accessed March 16, 2019.
30. World Health Organization. Obesity and overweight. <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>. Published 2018. Accessed March 16, 2019.
31. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. *The Alcohol Use Disorders Identification Test Guidelines for Use in Primary Care.*; 2001. https://apps.who.int/iris/bitstream/handle/10665/67205/WHO_MSD_MSB_01.6a.pdf;jsessionid=758E5FE56C8421DABA78F76CE66863D7?sequence=1. Accessed March 16, 2019.
32. Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA. The AUDIT Alcohol Consumption Questions (AUDIT-C) An Effective Brief Screening Test for Problem Drinking</sub> Arch Intern Med. 1998;158(16):1789. doi:10.1001/archinte.158.16.1789
33. EuroQol Group. EuroQol - a new facility for the measurement of health-related quality of

- life. *Health Policy (New York)*. 1990;16(3):199-208. doi:10.1016/0168-8510(90)90421-9
34. EuroQol Group. EQ-5D-3L User Guide. EuroQol Research Foundation.
<https://euroqol.org/publications/user-guides/>. Published 2018. Accessed March 17, 2019.
35. Gerhards SAH, Huibers MJH, Theunissen KATM, de Graaf LE, Widdershoven GAM, Evers SMAA. The Responsiveness of Quality of Life Utilities to Change in Depression: A Comparison of Instruments (SF-6D, EQ-5D, and DFD). *Value Heal*. 2011;14(5):732-739. doi:10.1016/J.JVAL.2010.12.004
36. Penninx BWJH, Nigatu YT, Bültmann U, et al. Does obesity along with major depression or anxiety lead to higher use of health care and costs? A 6-year follow-up study. *Eur J Public Health*. 2017;27(6):965-971. doi:10.1093/eurpub/ckx126
37. Hassmén P, Koivula N, Uutela A. Physical Exercise and Psychological Well-Being: A Population Study in Finland. *Prev Med (Baltim)*. 2000;30(1):17-25. doi:10.1006/PMED.1999.0597
38. Portegijs E, Read S, Pakkala I, et al. Sense of Coherence: Effect on Adherence and Response to Resistance Training in Older People with Hip Fracture History. *J Aging Phys Act*. 2014;22(1):138-145. doi:10.1123/japa.2012-0229
39. Raatikainen I, Vanhala M, Mäntyselkä P, et al. Does level of leisure time physical activity, in a sample of patients with depression, predict health care utilization over a subsequent 5-year period? Findings from a Finnish cohort study. *Ment Health Phys Act*. 2018;15(June):40-44. doi:10.1016/j.mhpa.2018.06.007
40. Korniloff K, Vanhala M, Kautiainen H, et al. Lifetime leisure-time physical activity and the risk of depressive symptoms at the ages of 65–74 years: The FIN-D2D survey. *Prev Med (Baltim)*. 2012;54(5):313-315. doi:10.1016/J.YPMED.2012.02.008
41. Brown HE, Gilson ND, Burton NW, Brown WJ. Does Physical Activity Impact on Presenteeism and Other Indicators of Workplace Well-Being? *Sport Med*. 2011;41(3):249-262. doi:10.2165/11539180-000000000-00000
42. Lowe G. Here in body, absent in productivity: Presenteeism hurts output, quality of work-life and employee health. Canadian HR Reporter. The National journal of human resource management. https://grahamlowe.ca/wp-content/uploads/import_docs/2002-12-02-Lowe.pdf. Published 2012. Accessed November 29, 2020.
43. Lazaridou A, Elbaridi N, Edwards RR, Berde CB. Pain Assessment. In: *Essentials of Pain Medicine*. Elsevier; 2018:39-46.e1. doi:10.1016/B978-0-323-40196-8.00005-X
44. Brazier J, Ratcliffe J. Measurement and Valuation of Health for Economic Evaluation. In: *International Encyclopedia of Public Health*. Elsevier Inc.; 2016:586-593.

doi:10.1016/B978-0-12-803678-5.00457-4

45. Correll DJ. The Measurement of Pain: Objectifying the Subjective. In: *Pain Management*. Vol 1. Elsevier Inc.; 2006:197-211. doi:10.1016/B978-0-7216-0334-6.50022-4
46. Despiégel N, Danchenko N, François C, Lensberg B, Drummond MF. The use and performance of productivity scales to evaluate presenteeism in mood disorders. *Value Heal*. 2012;15(8):1148-1161. doi:10.1016/j.jval.2012.08.2206

Supplementary material

European Quality of life five dimension (three level version) (EQ-5D-3L):

The questions dimensions and response options were as follows (in each participant was asked to mark the option which best describes participants health today):

Mobility (1= I have no problems in walking about; 2= I have some problems in walking about; 3= I am confined to bed);

Self-care (1= I have no problems with self-care; 2= I have some problems washing or dressing myself; 3= I am unable to wash or dress myself);

Usual activities (e.g. work, study, housework, family or leisure activities) (1= I have no problems with performing my usual activities; 2= I have some problems with performing my usual activities; 3= I am unable to perform my usual activities);

Pain/Discomfort (1= I have no pain or discomfort; 2= I have moderate pain or discomfort; 3= I have extreme pain or discomfort);

Anxiety/Depression (1= I am not anxious or depressed; 2= I am moderately anxious or depressed; 3= I am extremely anxious or depressed).