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Effects of physical activity on menopausal symptoms, psychosomatic factors and well-being among working women in England: A path analysis

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Abstract

Background: Research to date suggests that physical activity (PA) can buffer menopausal symptoms and support well-being, but there is limited evidence on the link between PA and menopausal symptoms in the United Kingdom, and no study has assessed how PA affects well-being through menopausal symptoms and three psychosomatic factors (i.e. depression, anxiety and stress).

Objectives: This study investigated whether PA affects well-being through menopausal symptoms and psychosomatic factors. This study focuses on how PA influences working women with menopause.

Design: A cross-sectional design based on the STROBE (i.e. Strengthening the Reporting of Observational Studies in Epidemiology) checklist was adopted.

Methods: The participants were 324 working women in England. An online self-reported questionnaire was utilised to gather data through Qualtrics. The data were analysed with path analysis through structural equation modelling, and sensitivity analyses were performed to avoid or reduce statistical bias.

Results: PA had a negative effect on menopausal symptoms ($\beta = -0.21$; $p < 0.001$) but a positive effect on well-being ($\beta = 0.19$; $p < 0.001$). Menopausal symptoms had a negative indirect effect on well-being, but PA had a positive indirect effect on well-being through menopausal symptoms and the three psychosomatic factors.

Conclusion: PA was positively associated with well-being but negatively associated with menopausal symptoms. Menopausal symptoms may lower well-being through anxiety, depression and stress, but PA can be associated with better well-being through depression, anxiety and stress.

Plain language summary

The influence of physical activity on well-being through menopausal symptoms, depression, anxiety, and stress

Why was the study done? Studies have assessed the potential influence of physical activity on menopausal symptoms among women, but no study in the United Kingdom has examined this relationship. Although the positive effect of physical activity on well-being is well researched and documented, no study has explored how it is mediated by menopausal symptoms and psychosomatic factors (i.e. stress, anxiety, and depression). Evaluation of this potential mediation is needed to improve stakeholders' understanding of the best ways to manage menopause at work. What

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did the researchers do? The researchers designed an online survey and used Qualtrics to distribute it among 324 working women with menopause in England. They used the appropriate statistical analysis technique to ascertain how the effect of physical activity on well-being is mediated by menopausal symptoms and the psychosomatic factors. What did the researchers find? Women who reported higher physical activity experienced fewer menopausal symptoms. Women with higher physical activity reported better well-being through fewer menopausal symptoms and lower stress, anxiety, and depression. Physical activity may help to improve well-being among working menopausal women by lowering menopausal symptoms, stress, anxiety, and depression. What do the findings mean? Working women can maintain well-being and experience less menopausal symptoms, stress, anxiety, and depression if they participate in physical activities. Organizations can manage menopause by rolling out workplace programmes encouraging employees to regularly participate in physical activities.

Keywords
physical activity, menopause, stress, depression, anxiety, physical well-being, women

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Introduction

Menopause is a stage of life when women stop menstruating and is characterised by symptoms such as hot flashes, night sweats, difficulty sleeping and reduced sex drive.[1,2] Working women are a major segment of the population experiencing menopause globally. In the United Kingdom, an increasing proportion of working women experience menopause, which is of concern to stakeholders.[3,4] Research has found that menopause is associated with psychosomatic symptoms such as depression, anxiety and stress,[5–9] which are key factors reducing well-being among working women. Secondly, women experiencing menopause are more likely to leave their jobs owing to the foregoing psychosomatic factors and poor well-being.[10–12] Stakeholders, including the British Menopause Society,[4] have therefore called for research and interventions to improve well-being among working women experiencing menopause.

Research has shown that physical activity (PA) can buffer menopausal symptoms and possibly its adverse effect on well-being.[13–16] PA has been defined as any bodily movement produced by skeletal muscles which requires energy expenditure above 1.5 basal metabolic rate.[17] PA has been measured in terms of either hours spent in physical activities or the frequency of performing these activities over a defined period.[18–20] In this study, the latter approach is adopted to measure PA since it better suited our data collection plan and was more convenient to the participants. Thus, PA was measured as how often the individual performed moderate (e.g. walking and gardening) and vigorous (e.g. running and bicycling) physical activities.[20]

PA can reduce or offset the adverse effect of menopausal symptoms on psychosomatic disorders,[21–27] which signifies a nexus between PA, menopausal symptoms, psychosomatic factors and well-being. In the context of this relationship, PA can enhance well-being in working women by buffering menopause symptoms and their influence on the psychosomatic factors. Empirically testing this nexus simultaneously can improve an understanding of the role of PA in managing menopause at work. There have been recent calls[4,28] for research improving stakeholders' understanding of the role of PA in managing menopause at work, and this study responds to these calls by concurrently testing, for the first time, a multivariate model incorporating PA, menopausal symptoms, the above psychosomatic factors and well-being.

Testing the above multivariate model is novel for some reasons. Firstly, the test is based on a path analysis instead of a traditional structural equation modelling (SEM). A traditional SEM, by default, would provide a single estimate of the total effect of PA on well-being through menopausal symptoms and psychosomatic factors. The total effect alone does not provide information about the indirect effects of PA on well-being through individual mediating variables (i.e. menopausal symptoms and psychosomatic factors). With a path analysis, these indirect effects are estimated and interpreted. Secondly, a path analysis enables us to identify and understand implications of the indirect effects on well-being for practice. The psychosomatic factors are among the most likely experiences of menopausal women that often affect well-being and job satisfaction.[12,29] To enhance the evidence for informing workplace management of menopause, it is necessary to ascertain whether their relationship with menopausal symptoms and well-being can be affected by PA.

This study fills major literature gaps, which include the non-availability of research testing a model incorporating PA, menopausal symptoms, psychosomatic factors and well-being concurrently. Most of the empirical evidence linking PA to menopause comes from the United States,[13,14] and no study has tested the link between PA, menopausal symptoms and well-being in a British sample. A study analysing this relationship in a British sample is needed because lifestyle and culture in the United Kingdom may be different from other countries studied. Differences in ethnicity and culture in the United Kingdom may influence PA and menopausal symptoms. Studies have suggested that menopausal symptoms are associated with poor well-being,[13,14,30] but the influence of PA on this relationship has

not been assessed in a British sample. In the United States, PA was found to be negatively associated with menopausal symptoms,[13,14] but the United Kingdom may present a different result owing to its unique culture. This study builds upon this evidence and provides additional information for practitioners. Finally, no study testing models like ours has utilised a sample from the general female workforce in England. Thus, this study provides more elaborate evidence based on a sample of women from the general English female workforce.

This study builds upon our programme of research that has produced key evidence from different publications. Noteworthy is our qualitative study[31] utilising data from five countries (i.e. England, Finland, Denmark, New Zealand, Australia and United States) where women with menopause reported a need for organisational interventions aimed at alleviating the symptoms of menopause. In another study,[32] working women in the United Kingdom reported a need for similar interventions, highlighting the significance of programmes aimed at encouraging PA among menopausal women. The evidence revealed a need for stakeholders to better understand the role of PA in the management of menopause and its symptoms. The current study provides part of this understanding and the evidence needed to support menopausal women. The above contributions are made with three research questions: (1) Does PA have a direct effect on menopausal symptoms? (2) Do menopausal symptoms have a direct effect on well-being? and (3) Does PA have an indirect effect on well-being through menopausal symptoms and the psychosomatic factors?

Methods

Design

A cross-sectional design consistent with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was adopted.[33] This design involved sensitivity analysis against confounding and measures against common methods bias (CMB). Figure 1 is a flowchart of the study design.

Participants and selection

The participants were working women experiencing menopause in England with the ability to complete the survey in English. We targeted eligible women who were members of various working groups in England. To recruit the participants, a participant information sheet with the above inclusion criteria was distributed across the groups to invite eligible individuals to participate in the study. The women participated in the study voluntarily. We calculated the minimum sample size needed for the study using relevant statistics (i.e. effect size = 0.2, power = 0.8 and significance level = 0.05) recommended.[34,35] The sample size reached with the G*Power software on a maximum of 14 predictors was 105. To maximise the power of our tests, we aimed to collect data from more than 105 women.

Measures

We measured menopausal symptoms with the 11-item menopause rating scale adopted in whole from previous research[36,37] with its 5 descriptive anchors (i.e. none – 1; mild – 2; moderate – 3; severe – 4; very severe – 5). This scale measures psychosomatic, physical and health-related symptoms of menopause. It produced a satisfactory Cronbach's $\alpha = 0.87$, which signifies its internal consistency. PA was measured with the PA behaviour domain of the health-promoting behaviour scale adopted as a whole.[20] This tool, which is based on a 5-point descriptive anchor (i.e. never – 1; sometimes – 2; about half the time – 3; most of the time – 4 and always), measures how often the individual had performed moderate and vigorous PA in the last 30 days. This was preferred to other measures because it best supported our online data collection method. It produced a satisfactory Cronbach's $\alpha = 0.77$ in the current study.

Well-being was measured with the unidimensional 5-item World Health Organisation well-being index,[38] which accompanies 5 descriptive anchors (i.e. never – 1; sometimes – 2; often – 3; very often and always). This scale measures perceived physical and mental well-being in the general population and produced an acceptable Cronbach's $\alpha = 0.88$. Stress was measured with a 10-item scale with 4 descriptive anchors (i.e. 1 – never, 2 – sometimes; often – 3 and very often – 4) wholly taken from the literature.[39] This tool measures general stress in employees and was internally consistent at Cronbach's $\alpha = 0.91$. We measured depression with the 9-item Patient Health Questionnaire with its original anchors (i.e. Not at all sure – 0, several days – 1, over half the days – 2, nearly every day – 3). This tool came from a previous study[28] and produced satisfactory Cronbach's $\alpha = 0.84$. Anxiety was measured with the 7-item General Anxiety Disorder scale with four descriptive anchors (i.e. not at all – 1; several days – 2; over half the day – 3; and nearly every day – 4) taken from the literature.[28] In the current study, it produced a Cronbach's $\alpha = 0.90$. Supplemental Appendix A shows scales used to measure the above variables. All negative items within the scales were reverse coded to properly align them with the rest of the items. Items of the above Likert scales were added to create a composite (total) score.

Nine variables were measured as potential covariates. One of these was marital status measured as a categorical variable with two groups (i.e. married – 1, and not married – 2). Smoking status (i.e. never smoked – 1, ex-smoker – 2 and smoker – 3), employment type (i.e. part-time – 1, full-time – 2 and both full-time and part-time – 3), whether one had multiple jobs (i.e. no – 1, maybe – 2, and 3 – yes), whether one had flexible job hours (i.e. no – 1, and yes – 2)

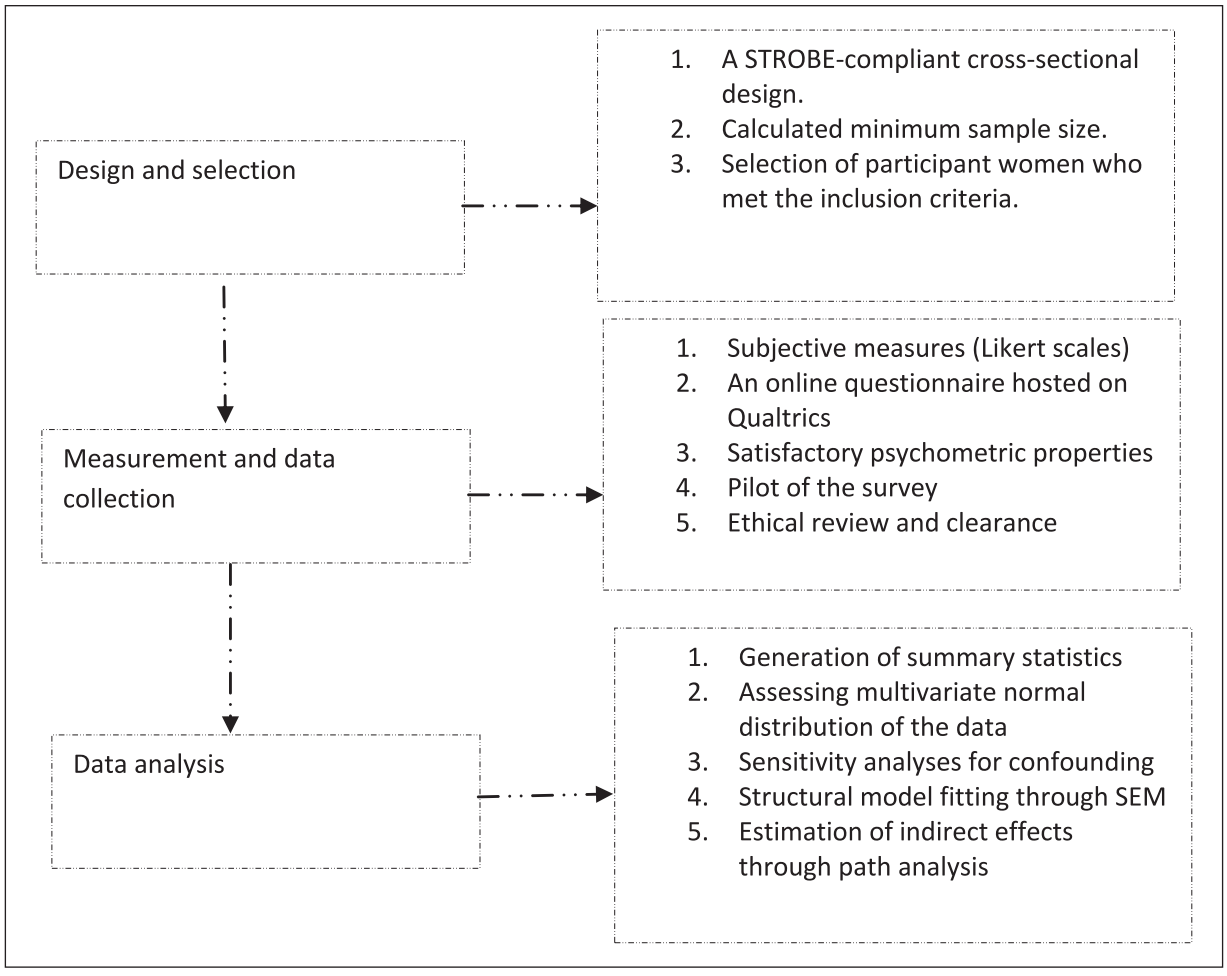

Figure 1. A flowchart of the study design.
STROBE: Strengthening The Reporting of Observational Studies in Epidemiology; SEM: structural equation modelling.

and self-reported health (i.e. poor – 1, and good – 2) were also measured as categorical variables. All categorical variables were coded into dummy-type variables to support our statistical analyses. Age, job tenure and education were measured as discrete variables. Age was the individual's chronological age whereas job tenure was how long (in years) the individual had worked. Education was the participant's years of schooling. The online survey used is attached as a Supplemental Appendix B.

Steps against CMB and confounding

An online self-reported questionnaire with two main parts was used to collect data. The first section of the survey presented scales or items on the main study variables (i.e. PA, menopausal symptoms, well-being and psychosomatic factors) whereas the second part captured the demographic variables. We followed previous procedures to avoid or minimise CMB.[35,40] Scales were randomly presented in blocks separated by preambles, which included instructions for completing each section. We then applied Herman's one-factor method by assessing the factor structure of each scale through exploratory factor analysis (EFA) with maximum likelihood estimation. The EFA produced a variance $<40\%$ on the first factor (for scales with two or more factors) or on the entire scale (for scales with a unidimensional factor structure). These results signified the absence of CMB.

Survey validation

We followed previous research[41,42] to ensure our online survey generated useful data. We made sure the survey was not excessively long and could be completed within 15 min. Clear instructions were provided for completing the survey, and Likert scales and multiple-choice questions were used to make it easier for participants to respond. Two experts reviewed the survey to correct typographical and wording errors. Finally, we piloted the online survey with 17 participants from the sample. Responses in the pilot survey produced Cronbach's $\alpha = 0.78–0.94$ for all scales, signifying the appropriateness of the measures. Participants had no concerns about the survey at the pilot phase of the study.

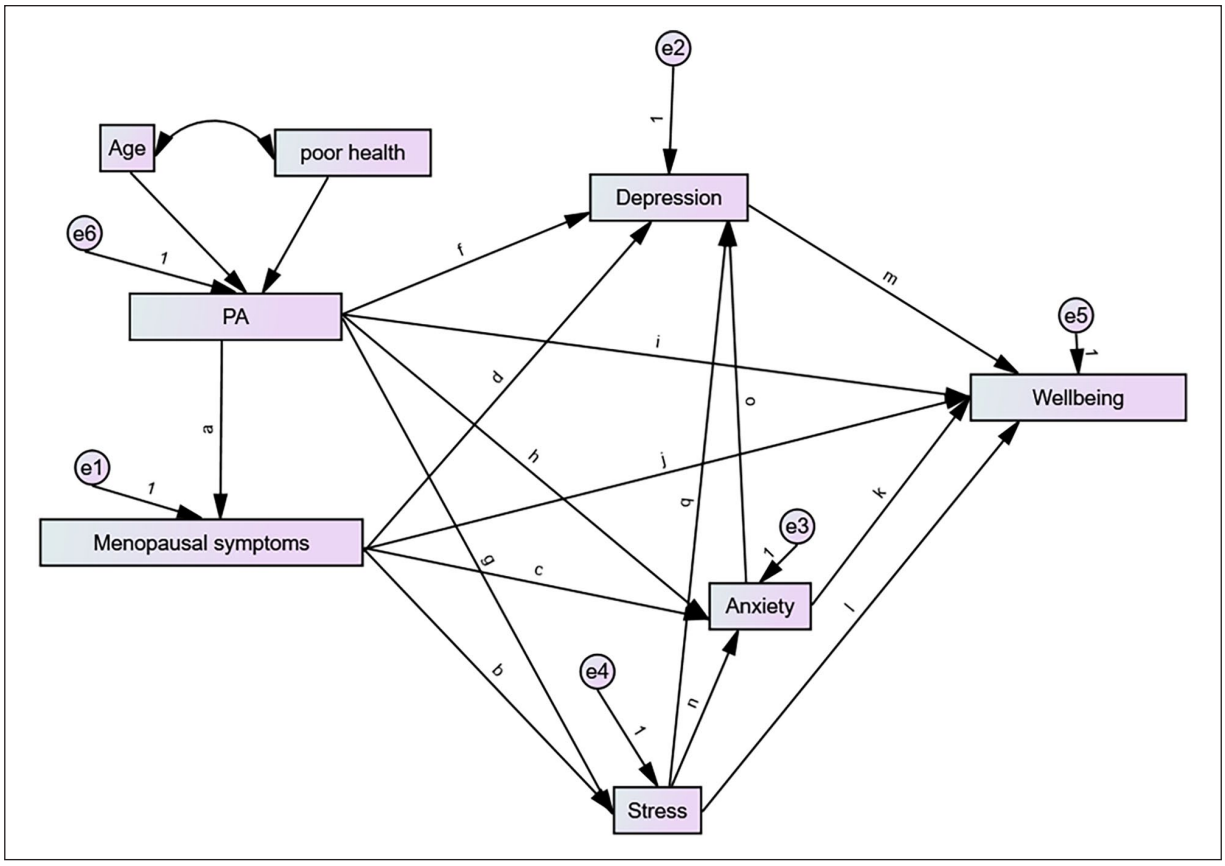

Figure 2. The statistical (ultimate) model tested.
PA, physical activity.

Data collection and ethics

Data were collected with the Qualtrics software, which was more convenient for the participants and researchers. Written informed consent was also provided online. A link of the consent form was part of the survey, and participants could only complete the survey after they had read the participant information sheet and consented to participate in the study. Coordinators of data collection distributed a link to the online survey across groups of working women experiencing menopause. Each week, the coordinators reminded members of the group about the study to encourage those who had not completed the survey to do so. Data were gathered between 15 June and 31 July 2023. A total of 351 surveys were returned by the participants, but 27 of the returned questionnaires were filled halfway and were, therefore, removed. Thus, 324 questionnaires were analysed.

Statistical analysis

Data were analysed with SPSS 28 (IBM Inc., New York, United States) and Amos; SPSS was utilised to summarise the data and perform sensitivity analyses for the ultimate confounders, whereas Amos was used to perform path analysis. Two phases of data analysis were followed. In the first phase, descriptive statistics were used to summarise the data and the hierarchical linear regression analysis was used to screen for the ultimate confounders. The goal of the sensitivity analysis, which was adopted from previous research,[35] was to identify measured covariates that are more likely to affect the primary relationships assessed. Thus, it enabled us to avoid incorporating covariates that would not confound our relationships into our multivariate model. Age and self-reported health were the two ultimate covariates identified through this analysis and incorporated into the multivariate model (i.e. ultimate model). Supplemental Appendix C1 shows the steps followed in this analysis. Only four categorical variables (i.e. smoking status, employment type, having multiple jobs and flexible work hours availability) had missing data, but none of them had up to 10% missing data. Hence, we performed the sensitivity analysis with the missing data following previous research.[35,43]

In the second stage, we fitted two multivariate structural models, namely the baseline (non-adjusted) and ultimate (adjusted) models. The ultimate model incorporated the ultimate covariates, unlike the baseline model. Figure 2 shows

the statistical (ultimate) model tested with path analysis. There were no missing items in the data used at this stage, so our analysis was based on 2,000 bias-corrected sampling iterations through maximum likelihood estimation (at 95% confidence interval). These options enabled us to estimate indirect effect sizes along paths relevant to our research questions. The estimation was done with the 'user-defined estimands' option in Amos. Supplemental Appendix C2 shows the formulae used in the estimation. In a second sensitivity analysis, we compared the effect sizes between the baseline and ultimate models. We confirmed the multivariate normal distribution of the data, which is necessary for SEM,[44] with the Mahalanobis distance test at probability values $\geqslant 0.182$ as recommended in the literature.[45] The statistical significance of the tests was detected at a minimum of $p < 0.05$.

Results

Table 1 shows summary statistics on the study variables. About 65% ($n = 209$) of the participants were married, whereas 64% ($n = 206$) were full-time workers. The average age of the participants was about 60 years (mean = 59.67; SD = 7.2) and the average menopausal symptoms (i.e. total score from all 11 items of the menopausal rating scale) was about 25 (mean = 24.76; SD = 8.21). Table 2 shows the direct effects of the adjusted and non-adjusted models. In the adjusted model, PA had a significant negative effect on menopausal symptoms ($\beta = -0.212$; critical ratio = −3.89; $p < 0.001$) and depression ($\beta = -0.17$; critical ratio = −5.147; $p < 0.001$) but a positive effect on well-being ($\beta = 0.19$; critical ration = 4.21; $p < 0.001$). This result suggests that higher PA was associated with lower menopausal symptoms and depression but higher well-being.

In the adjusted model of Table 2, menopausal symptoms were positively associated with stress ($\beta = 0.57$; critical ratio = 12.14; $p < 0.001$), anxiety ($\beta = 0.43$; critical ratio = 9.07; $p < 0.001$) and depression ($\beta = 0.46$; critical ratio = 10.4; $p < 0.001$), but negatively associated with well-being ($\beta = -0.15$; critical ratio = −2.21; $p < 0.05$). Thus, higher menopausal symptoms were associated with higher stress, anxiety and depression, but lower well-being. Table 3 shows the indirect total effects from the adjusted and baseline models. PA had a positive indirect effect on well-being ($\beta = 0.13$; $p < 0.001$) whereas menopausal symptoms ($\beta = -0.35$; $p < 0.001$), stress ($\beta = -0.12$; $p < 0.001$) and anxiety ($\beta = -0.08$; $p < 0.05$) had negative indirect effects on well-being.

Table 4 (i.e. adjusted model) shows the indirect effects; PA had a positive indirect effect on well-being through depression ($\beta = 0.029$; $p < 0.001$). PA had a positive indirect effect on well-being through menopausal symptoms and depression ($\beta = 0.017$; $p < 0.001$) and a positive indirect effect on well-being through menopausal symptoms and anxiety ($\beta = 0.012$; $p < 0.05$). Finally, PA had a positive indirect effect on well-being through menopausal symptoms and the three psychosomatic factors (i.e. stress, anxiety and depression). Figure 3 shows the fitted statistical model with standardised coefficients or effect sizes. As the footnote to Table 2 suggests, both models produced satisfactory fit statistics.

Table 1. Summary of demographic characteristics ($n = 324$).

Variable	Group	*n*/mean	%/SD
Categorical variable			
Marital status	Married	209	64.51
	Not married	115	35.49
Smoking status	Never smoked	211	65.12
	Ex-smoker	101	31.17
	Smoker	9	2.78
	Missing	3	0.93
Employment type	Part-time	109	33.64
	Full-time	206	63.58
	Both	6	1.85
	Missing	3	0.93
Having multiple jobs	No	283	87.35
	Maybe	6	1.85
	Yes	32	9.88
	Missing	3	0.93
Flexible hours available	No	90	27.78
	Yes	231	71.3
	Missing	3	0.93
Self-reported health	Poor	59	18.21
	Good	261	80.56
	Missing	4	1.23
	Total	324	100
Continuous/discrete variable			
Depression	—	16.31	5.20
Anxiety	—	12.87	4.94
Menopausal symptoms	—	24.76	8.21
Stress	—	16.47	4.99
Physical activity	—	12.82	4.96
Well-being	—	11.92	3.58
Age	—	49.67	7.20
Job tenure (years)	—	15.16	46.29
Education (years)	—	14.77	7.14

n and % apply to categorical variables whereas mean and SD apply to discrete or continuous variables. *n*: frequency; SD: standard deviation.

Discussion

This study aimed to test the effects of PA on well-being through menopausal symptoms and three psychosomatic factors (i.e. anxiety, depression and stress). Relevant direct and indirect effects were estimated with a path analysis.

This study found a negative effect of PA on menopausal symptoms, which suggests that working women who reported a higher frequency of PA reported lower symptoms of menopause. This negative relationship might have been explained by the cumulative effect of metabolic

Table 2. Direct effects from the adjusted and baseline models ($n = 324$).

DV	Path	IV	Baseline model			Adjusted model		
			Standardised (β)	Critical ratio	*p*	Standardised (β)	Critical ratio	*p*
MRS	←	PA	−0.212	−3.892	***	−0.212	−3.892	***
Stress	←	PA	0.004	0.087	0.931	0.004	0.087	0.931
Anxiety	←	PA	0.071	1.824	0.068	0.071	1.824	0.068
Depression	←	PA	−0.170	−5.147	***	−0.170	−5.147	***
Well-being	←	PA	0.190	4.206	***	0.190	4.206	***
Stress	←	MRS	0.569	12.139	***	0.569	12.139	***
Anxiety	←	MRS	0.429	9.068	***	0.429	9.068	***
Anxiety	←	Stress	0.402	8.634	***	0.402	8.634	***
Depression	←	MRS	0.463	10.396	***	0.463	10.396	***
Depression	←	Anxiety	0.342	7.320	***	0.342	7.320	***
Depression	←	Stress	0.057	1.324	0.185	0.057	1.324	0.185
Well-being	←	Anxiety	−0.176	−2.649	0.008	−0.176	−2.649	0.008
Well-being	←	Stress	−0.117	−2.042	0.041	−0.117	−2.042	0.041
Well-being	←	MRS	−0.149	−2.211	0.027	−0.149	−2.211	0.027
Well-being	←	Depression	−0.234	−3.199	0.001	−0.234	−3.199	0.001
PA	←	Age	—	—	—	−0.052	−0.957	0.339
PA	←	poor	—	—	—	−0.239	−4.426	***

Fit statistics for the baseline model include chi-square = 2.33 ($p = 0.132$); GFI = 0.95, TLI = 0.97 and RMSEA = 0.041. Fit statistics for the adjusted model include chi-square = 2.09 ($p = 0.243$); GFI = 0.98, TLI = 0.99 and RMSEA = 0.023. MRS: menopausal symptoms; PA: physical activity; DV: dependent variable; IV: independent variable; GFI: goodness-of-fit index; TLI: Tucker-Lewis Index; RMSEA: root mean square error of approximation.
***$p < 0.001$.

Table 3. Indirect effects of physical activity, menopausal symptoms, stress and anxiety on well-being ($n = 324$).

Dependent variable	Independent variable			
	PA	MRS	Stress	Anxiety
Indirect β: Baseline				
MRS	—	—	—	—
Stress	−0.120**	—	—	—
Anxiety	−0.137**	0.229**	—	—
Depression	−0.127*	0.258**	0.138**	—
Well-being	0.126**	−0.350**	−0.116**	−0.08*
Indirect β: Adjusted				
MRS	—	—	—	—
Stress	−0.120**	—	—	—
Anxiety	−0.137**	0.229**	—	—
Depression	−0.127*	0.258**	0.138**	—
Well-being	0.126**	−0.350**	−0.116**	−0.080**

—: Not applicable; MRS: menopausal symptoms; PA: physical activity.
*$p < 0.05$. **$p < 0.001$.

syndrome, bone mineral density and menopausal symptom severity.[46–48] Our result suggests that menopausal symptoms would be fewer as the frequency of PA increases, but this phenomenon is less likely among those experiencing extremely severe menopause. It could be attributed to PA influencing hormonal, brain and nerve function in ways that lower menopausal symptoms in women experiencing menopause. Experts suggest that menopausal symptoms are due to a distortion of hormonal function by ageing of the reproductive system.[49] If so, our result may have been influenced by the way PA impacted hormones.

The above result is consistent with several studies conducted around the world. In Turkey, for instance, PA was found in a cross-sectional study to be associated with lower menopausal symptoms.[50] Several studies[13–15] in the United States, including randomised controlled trials,[51] have confirmed that PA buffers symptoms of menopause. Our evidence is, thus, consistent with previous research. Even so, it occupies an important place in the literature since this study is the first to investigate and confirm a relationship between PA and menopausal symptoms in a British sample of women from the general working population. The above result supports studies and reports[51,52] recognising PA as one of the ways to manage menopause at work.

This study further found a negative effect of menopausal symptoms on well-being among working women, which means that higher menopausal symptoms were associated with poorer well-being. This result is supported by previous researchers[3,4,53] who have acknowledged that poor well-being can be a consequence of menopausal symptoms experienced by women, although the literature has reported mixed findings on the link between well-being and menopausal symptoms.[3,53,54] Noteworthy is the direct positive effect of PA on menopausal symptoms, which signifies that higher PA was associated with higher

Table 4. Indirect path coefficients (effects) from user-defined estimands ($n = 324$).

Parameter	Baseline model		Adjusted model	
	β	95% CI	β	95% CI
PA_Dep_Well	0.029**	±0.037	0.029**	±0.037
PA_Anx_Well	−0.009	±0.027	−0.009	±0.027
PA_Stress_Well	0.000	±0.022	0.000	±0.022
PA_Stress_Dep_Well	0.000	±0.003	0.000	±0.003
PA_Stress_Anx_Dep_Well	0.000	±0.004	0.000	±0.004
PA_Stress_Anx_Well	0.000	±0.011	0.000	±0.011
PA_MRS_Dep_Well	0.017**	±0.025	0.017**	±0.025
PA_MRS_Anx_Well	0.012*	±0.025	0.012*	±0.025
PA_MRS_Stress_Well	0.010	±0.032	0.010	±0.032
PA_MRS_Stress_Dep_Well	0.001	±0.005	0.001	±0.005
PA_MRS_Stress_Anx_Dep_Well	0.003**	±0.005	0.003**	±0.005
PA_MRS_Stress_Anx_Well	0.006	±0.012	0.006	±0.012

MRS: menopausal symptoms; PA: physical activity; Dep: depression; Well: well-being; Anx: anxiety; CI: confidence interval (based on 2,000 bias-corrected sampling iterations); β: regression weight.
*$p < 0.05$. **$p < 0.001$.

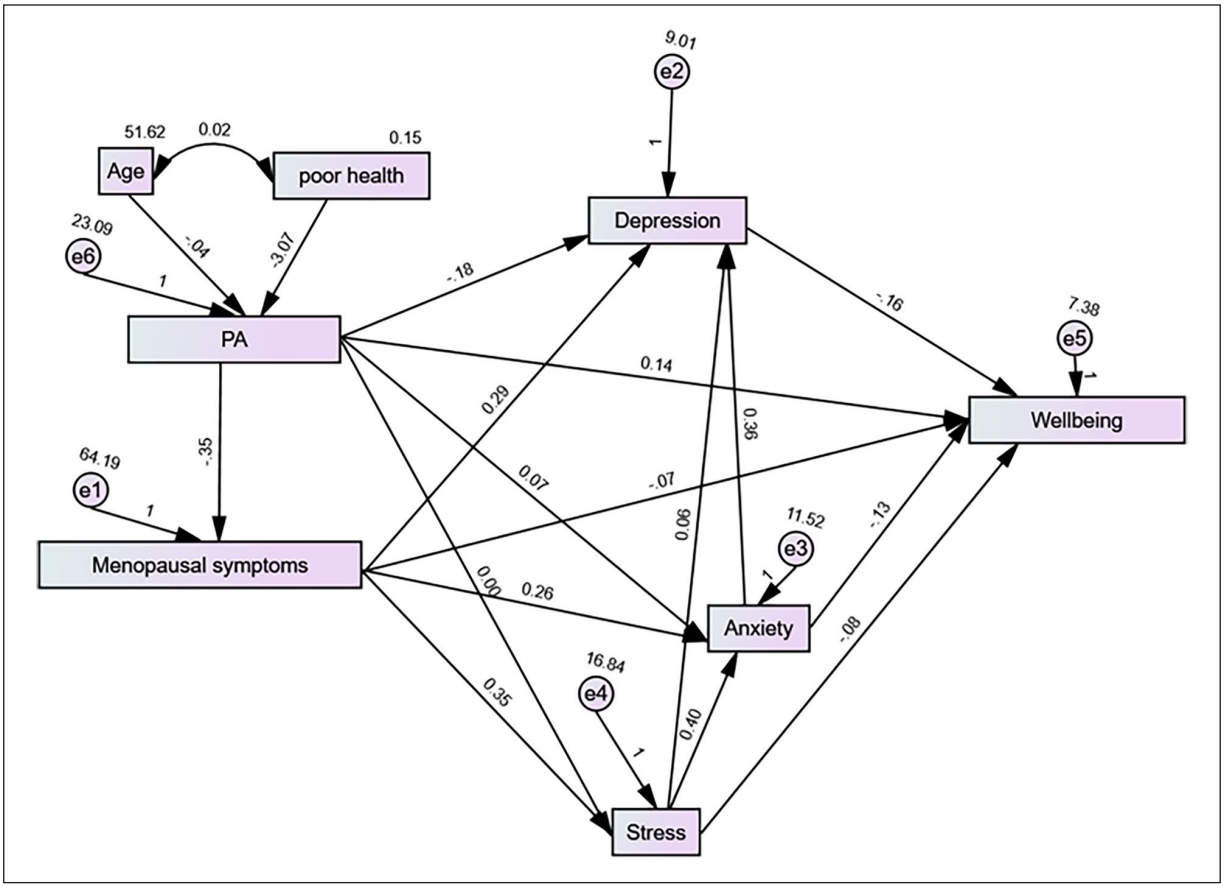

Figure 3. Path model with standardised regression weights.
PA, physical activity.

well-being. This outcome forms the basis of the indirect positive effect of PA on well-being through menopausal symptoms (see Table 3, adjusted model). In other words, menopausal symptoms mediated the relationship between PA and well-being. Based on this result, it can be inferred that women experiencing menopausal symptoms who maintain sufficient PA may experience better well-being, compared with their counterparts with no or less PA.

All three psychosomatic factors (i.e. anxiety, stress and depression) have a negative effect on well-being. Menopausal symptoms also have a positive effect on each of these factors, which suggests that women with higher symptoms of menopause reported higher stress, anxiety and depression. This evidence is consistent with previous research[21–27] that have reported a negative association between these psychosomatic factors and menopausal symptoms, but this study extends the evidence to date by confirming new indirect effects of PA on well-being through menopausal symptoms and the psychosomatic factors. The first example is the indirect effect of PA on well-being through menopausal symptoms and depression (see Table 4). Another example is the positive indirect effect of PA on well-being through menopausal symptoms and anxiety (i.e. see Table 4). More compelling is the positive indirect effect of PA on well-being through menopausal symptoms and all the psychosomatic factors (see Table 4). These indirect effects of PA signify that PA can have a net positive effect on well-being, though depression and anxiety experienced by the women individually have a negative effect on well-being.

Though the foregoing indirect effects are unique to this study, they extend the scope of the evidence regarding the commonly reported role of PA in the management of menopause among working women.[13,53] These effects suggest that PA may not only be associated with lower symptoms of menopause but may also predict well-being among women experiencing stress, anxiety and depression attributable to menopausal symptoms. Depending on the consistency of our evidence with future research, especially experimental studies establishing causation between the variables, organisations and employers may consider interventions encouraging PA among working women as programmes that would not only buffer menopausal symptoms and their influence on stress, anxiety and depression but would also preserve well-being. Interventions in the United States[13,51,55] have proven to be effective in buffering menopausal symptoms and enhancing health-related quality of life, but none have been rolled out in the United Kingdom and most countries. We, therefore, call for more interventions and research, especially studies that can enable stakeholders to assess the effectiveness of PA in reducing menopausal symptoms and preserving well-being.

Worth mentioning is the negligible influence of measured confounders or covariates (e.g. age and education) on our multivariate model as suggested by our comparison of the baseline and ultimate models. The regression weights in both models are not different, and none of the effects was confounded. This result indicates that the direct and indirect effects of PA on well-being through menopausal symptoms and the psychosomatic factors are likely not due to the variables included in this study as covariates. Yet, our cross-sectional design could not have eliminated potential confounding,[56] so future studies incorporating more relevant covariates are needed.

Of interest are the relatively large regression weights between menopausal symptoms and the psychosomatic factors, particularly stress and anxiety. This outcome was expected since menopausal symptoms as a measure include psychosomatic indicators of stress and anxiety. The regression weights ultimately represent correlations, which imply that higher symptoms of menopause are associated with higher stress and anxiety. This evidence supports previous studies[5,6,8,9,57] in which working women attributed their high stress and anxiety levels to menopause or reported higher stress and anxiety against higher menopausal symptoms. If women felt that their stress and anxiety were due to menopause, they may value any workplace interventions that buffer their menopausal symptoms. Further to this, this study suggests that interventions enabling employees to regularly perform PA may be valued by working women with menopause and can be effective at managing menopause in workplaces.

This study has some limitations. Our cross-sectional design could not establish causation between the variables, which means our effect sizes are ideally estimates of the association between the variables. Where possible, future researchers should employ randomised controlled trials to be able to establish causation. We did not have the chance to use a probability sampling method, and our findings may not be generalised due to our non-probability sampling method. We, therefore, call for future studies utilising probabilistic representative samples. Our study was not necessarily free of response bias since it employed only subjective or self-reported measures. Future researchers are encouraged to use objective measures where appropriate and possible. PA was measured as the frequency of physical activities performed but not as duration, miles per hour, number of steps, heaviness of weights and number of repetitions. Consequently, there may be variations in the actual effort expended in exercise. Over-estimation of whether exercise was moderate or vigorous was also possible. Our definition of PA and the use of the term 'basal metabolic rate' earlier does not mean that the activities women reported reflect exercise. Unlike some studies,[58] this study did not consider the duration of symptoms in measuring menopausal symptoms. This shortcoming of the study may have affected scores of menopausal symptoms reported.

This study was the first to test a multivariate model incorporating PA, menopausal symptoms, psychosomatic factors and well-being. Previous studies had assessed this association in parts, which narrowed the evidence. It is the first in the United Kingdom to investigate whether PA can have indirect effects on well-being through menopausal symptoms and psychosomatic factors. Its cross-sectional design is robust as it includes measures against confounding and CMB. Our sensitivity analyses for the ultimate confounding enabled us to avoid or minimise statistical bias and constitute a model for future research. Finally, the study followed the STROBE checklist,[59] which means it met relevant quality

criteria that might be of interest to practitioners and future researchers. Supplemental Appendix D is the completed STROBE checklist.

Conclusion

Higher menopausal symptoms were associated with higher psychosomatic symptoms in the form of higher stress, anxiety and depression. Higher menopausal symptoms were associated with poorer well-being. PA buffered menopausal symptoms, was associated with higher well-being and had an indirect positive effect on well-being through psychosomatic factors. It is concluded that menopausal symptoms had a negative direct and indirect effects on well-being among the working women but were directly and indirectly (through the psychosomatic factors) buffered by PA. Thus, PA may enable working women to maintain well-being despite experiencing menopausal symptoms and their associated psychosomatic symptoms. Workplace interventions aimed at encouraging PA may help manage menopause among working women.

Declarations

Ethical approval and consent to participate

This study received ethics review and clearance from the University of Essex ethics committee (number: ETH2223-1102) after the research protocol and ethical considerations were reviewed by the committee. All participants provided written informed consent before participating in the study.

Consent for publication

The participants provided written informed consent.

Author contribution(s)

Nestor Asiamah performed statistical analysis and wrote the manuscript. **Olajumoke B Aladenola** coordinated data collection and was part of study conceptualisation. **Camille Cronin** supervised the study and was part of study conceptualisation. **Leeni Sepp** coordinated data collection at Colchester City Council whereas Kirsty O'Callaghan coordinated data collection at the NHS. All authors read and approved the manuscript.

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Competing interests

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Availability of data and materials

Data used for this study will be made available upon request.

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Supplemental material

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