Moderating effects of age on associations between exercise self-efficacy and physical activity in women with psychosis in Hong Kong

Yuen Ting Connie Leung*, Yi Nam Suen*, Lik Hang Lincoln Lo, Ho Ming Edwin Lee, Lai Ming Christy Hui, Kit Wa Sherry Chan, Eric Yu Hai Chen

* Contributed equally

Abstract

Background: Physical activity (PA) can improve the clinical symptoms, physical health, and functional outcomes of patients with psychosis. This study aimed to investigate the moderating effects of age on the associations between exercise self-efficacy (ESE) and PA in women with psychosis.

Methods: Data from 38 women with psychosis (mean age, 37.5±13.2 years) who participated in a community mental health project in Hong Kong were analysed. Psychotic symptoms were evaluated using the Scale for the Assessment of Positive Symptoms and the Scale for the Assessment of Negative Symptoms. Levels of PA were determined using the self-report International Physical Activity Questionnaire-Long Form. ESE was assessed using a self-report instrument. The moderating effects of age on associations between ESE domains and physical activity levels were assessed.

Results: Age was correlated with moderate-intensity PA (r = 0.51, p = 0.007) and total PA (r = 0.52, p = 0.002). The ESE 'must exercise alone' domain was correlated with moderate-intensity PA (r = 0.17, p = 0.009) and total PA (r = 0.15, p = 0.04). The ESE 'resistance from others' domain was correlated with moderate-intensity PA (r = 0.0003, p = 0.03). No significant correlations were observed between other PA variables and other ESE domains. Among women with psychosis, age was a moderating factor in the association between moderate-intensity PA and ESE, particularly in domains of 'must exercise alone', 'inconvenience to exercise', and 'resistance from others'.

Conclusion: Among women with psychosis, ESE domains of 'must exercise alone', 'inconvenience to exercise', and 'resistance from others' as well as overall ESE were significantly associated with moderate-intensity PA in older age group only. Age-specific strategies should be applied when designing interventions to increase PA levels in this population.

Key words: *Exercise; Psychotic disorders; Self efficacy; Women*

Yuen Ting Connie Leung, Department of Psychiatry, School of Clinical Medicine, LKS Faculty of Medicine, University of Hong Kong, Hong Kong SAR, China
Yi Nam Suen, School of Nursing, LKS Faculty of Medicine, University of Hong Kong, Hong Kong SAR, China
Lik Hang Lincoln Lo, Department of Psychiatry, School of Clinical Medicine, LKS Faculty of Medicine, University of Hong Kong, Hong Kong SAR, China
Ho Ming Edwin Lee, Department of Psychiatry, School of Clinical Medicine, LKS Faculty of Medicine, University of Hong Kong, Hong Kong SAR, China
Lai Ming Christy Hui, Department of Psychiatry, School of Clinical Medicine, LKS Faculty of Medicine, University of Hong Kong, Hong Kong SAR, China
Kit Wa Sherry Chan, Department of Psychiatry, School of Clinical Medicine, LKS Faculty of Medicine, University of Hong Kong, Hong Kong SAR, China
Eric Yu Hai Chen, Department of Psychiatry, School of Clinical Medicine, LKS Faculty of Medicine, University of Hong Kong, Hong Kong SAR, China

Address for correspondence: *Dr Yi Nam Suen, 5/F, Academic Building, 3 Sassoon Road, Pokfulam, Hong Kong SAR, China. Email: suenyn@hku.hk*

Submitted: *5 May 2024;* **Accepted:** *27 June 2024*

Introduction

Psychotic disorders can result in unfavourable functional outcomes and increased global burden of disease.[1,2] They are also associated with a reduced life expectancy of up to 20 years,[3] and the mortality gap has increased over the past 3 decades.[4] Early intervention can improve and maintain early outcomes and long-term prognosis.[5,6] However, a large proportion of patients still experience poor functioning despite receiving early intervention services.[7] Poor outcomes are associated with physical inactivity, residual psychotic symptoms, and impaired cognitive function.[8] Although antipsychotic medications can alleviate psychotic symptoms, their efficacy for functioning is limited, and they can cause adverse metabolic effects.[9]

Exercise and non-pharmacological interventions are increasingly used to improve outcomes.[10] Exercise interventions, in particular, have transdiagnostic efficacy and cost-effectiveness for various psychiatric conditions.[11,12] They are effective in improving cognitive, functional, and symptomatic outcomes as well as reversing some neurobiological changes, such as hippocampal volume, in psychotic disorders.[13] Combining an exercise intervention with cognitive training can effectively enhance the thickness of the fronto-cingulate cortex, thereby reducing

the progressive neural degeneration that occurs in the early stages of schizophrenia.[14] Additionally, aerobic fitness is positively correlated with volumes of grey matter and white matter in the right hippocampus, parahippocampal region, and other cerebellar regions in individuals with a first episode of psychosis.[15] The benefits of exercise interventions have also been observed in Asian populations.[16,17] However, self-efficacy (motivation and sustainability) in engaging exercise is a challenge for psychiatric patients.[18,19]

Self-efficacy in exercise refers to one's belief in their ability to perform exercise.[20] It is a key factor in determining the level of physical activity (PA) in individuals with psychosis.[18,19] Age is associated with self-efficacy and exercise levels in obese adults.[21] Middle-aged and older adults exhibit higher levels of exercise self-efficacy (ESE) but lower levels of exercise, compared with younger adults.[22] Thus, age-specific levels of self-efficacy should be considered when developing interventions to encourage PA.[22] By determining the role of age in noncompliance with PA, therapists can better understand patient needs so as to implement targeted behavioural techniques and enhance PA habits.

Women's participation in exercise depends on self-efficacy.[23] In patients with psychosis, women tend to have a later onset age, and their aetiology has a stronger association with dysregulation in psychosocial factors. Women commonly take on caregiving responsibilities within their families; their well-being may affect the health of care recipients. The findings of this study may help healthcare providers to develop more personalised interventions and strategies that encourage regular PA and improve overall well-being and health outcomes among women with psychosis. In this study, we aimed to determine whether age is associated with ESE and PA level among women with psychosis.

Methods

The present study was part of the Jockey Club Mental Wellness Project for Women.[16,24] The project's goal is to implement early detection and intervention for mental disorders to improve clinical outcomes, particularly for women with psychosis. Women aged 18 to 64 years with a diagnosis of non-affective psychotic disorder (based on DSM-5) who were suitable for exercises were recruited from a psychiatric outpatient clinic at a public hospital in Hong Kong or were referred by community workers. Data from 38 women with psychosis (mean age, 37.5±13.2 years) were analysed.

Psychotic symptoms were evaluated using the Scale for the Assessment of Positive Symptoms[25] (SAPS) and the Scale for the Assessment of Negative Symptoms[26] (SANS). The SAPS has 30 items in four domains: hallucinations (α = 0.75), delusions (α = 0.67), bizarre behaviour (α = 0.31), and positive formal thought disorder (α = 0.86), whereas the SANS has 20 items in five domains: affective flattening or blunting (α = 0.83), alogia (α = 0.80), avolition-apathy (α = 0.27), anhedonia-asociality (α = 0.77), and attention disturbance (α = 0.47). Each item on both scales is measured using a 6-point Likert scale from 0 (none) to 5 (severe); higher scores indicate more severe levels of positive or negative symptoms.

Levels of PA were determined using the self-report International Physical Activity Questionnaire-Long Form[27] (IPAQ-L) in terms of employment, transportation, household chores and gardening, and recreational PA; intensity is categorised into light (such as walking), moderate, and vigorous, based on metabolic equivalent of task (MET) minutes per week (min/week). For instance, 1

Table 1. Participant characteristics, clinical presentations, physical activity levels, and exercise self-efficacy (n = 38)

Characteristics	Value*
Age, y	37.53 ± 13.19
Education, y	13.32 ± 2.61
Clinical presentation	
Duration of psychosis, m	5.95 (0-48)
History of hospitalisation	26 (68.4)
Diagnosis of schizophrenia according to DSM-5	24 (63.2)
Scale for the Assessment of Positive Symptoms	9.45 ± 13.38
Hallucination	2.00 ± 4.61
Delusion	4.18 ± 6.06
Bizarre behaviour	0.88 ± 2.06
Positive formal thought disorder	2.39 ± 4.93
Scale for the Assessment of Negative Symptoms	11.15 ± 12.36
Affective flattening or blunting	4.09 ± 5.69
Alogia	1.52 ± 3.33
Avolition/Apathy	1.67 ± 2.34
Anhedonia	3.15 ± 4.74
Attention disturbance	0.73 ± 1.64
Physical activity, metabolic equivalent of task min/week	3228.59 ± 2794.90
Light	1201.93 ± 1628.53
Moderate	1386.65 ± 2254.21
Vigorous	640.00 ± 1135.08
Exercise self-efficacy	40.16 ± 12.89
Negative affect	6.79 ± 2.73
Excuse making	5.47 ± 2.39
Must exercise alone	8.21 ± 3.21
Inconvenience to exercise	6.61 ± 2.40
Resistance from others	7.18 ± 2.92
Bad weather conditions	5.89 ± 2.55

* *Data are presented as mean ± standard deviation, median (range), or No. (%) of participants*

minute of light-, moderate-, and vigorous-intensity PA is equal to 3.3, 3-6, and 8 MET, respectively. The frequency and duration of specific activities in the week prior to the assessment were recorded.

ESE was assessed using a self-report instrument,[28] which comprises 18 items in six domains: negative affect (α = 0.90), excuse-making (α = 0.83), must exercise alone (α = 0.95), inconvenient to exercise (α = 0.65), resistance from others (α = 0.87), and bad weather conditions (α = 0.90). Each item is measured using a 5-point Likert scale from 1 (not at all confident) to 5 (completely confident); higher scores indicate greater confidence in dealing with obstacles to exercise.

Statistical analyses were conducted using *R* version 4.3.1. Associations between ESE, age, and PA levels were determined using Spearman correlation analyses. Moderation analyses were performed using the *interaction* package in R. Age was a moderator, whereas PA level variables were regressed on each ESE domain in separate models. Psychotic symptom variables that were associated with PA levels (ie, hallucinations, affective flattening or blunting, and alogia) were added to the regression

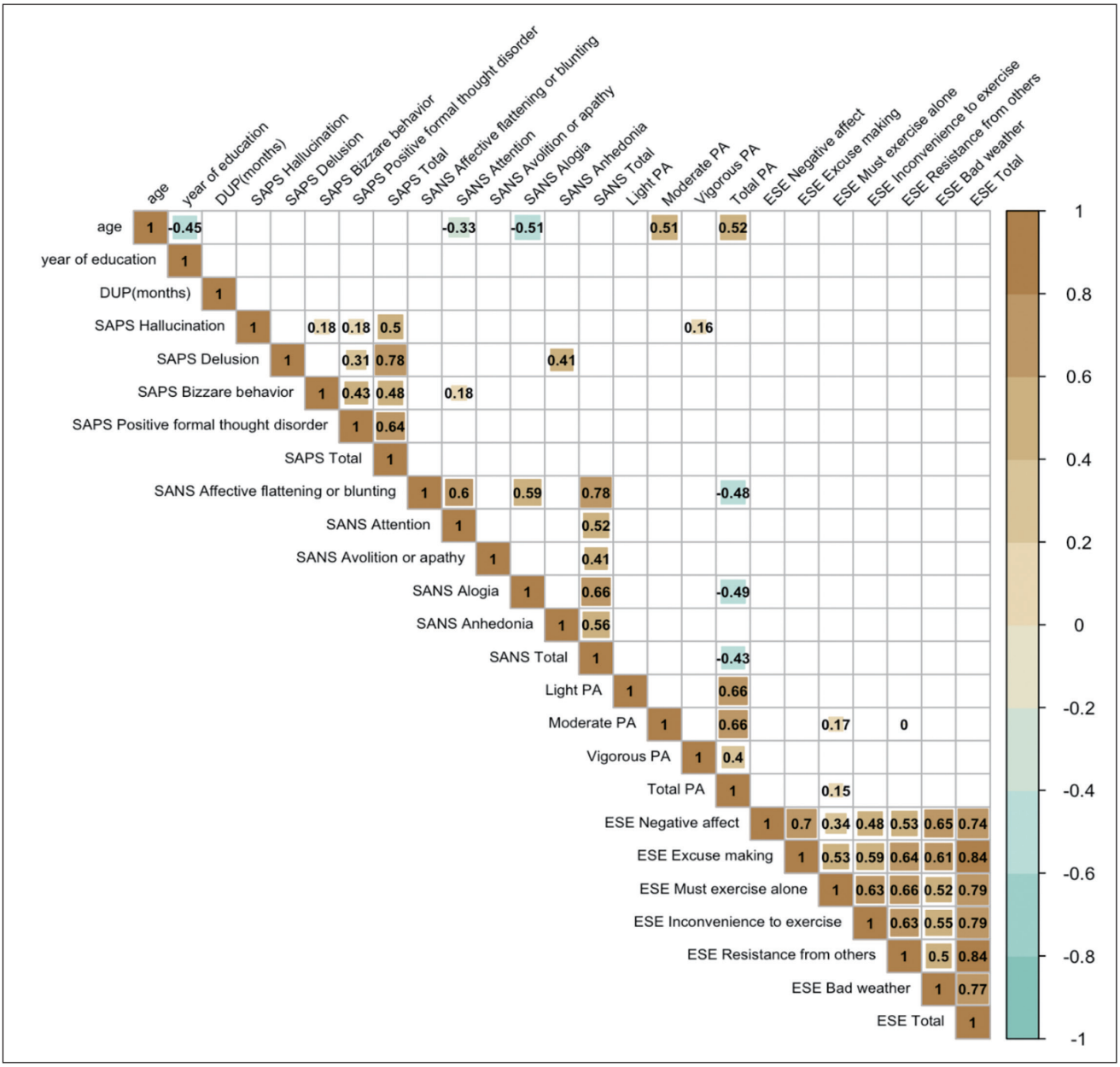

Figure 1. Spearman correlations between variables: duration of psychosis (DUP), Scale for the Assessment of Positive Symptoms (SAPS), Scale for the Assessment of Negative Symptoms (SANS), physical activity (PA), and exercise self-efficacy (ESE)

models as covariates. The *sim_slopes* function was used to analyse and visualise conditional simple slopes in the interaction models. The contribution of the interaction term to the variance explained by the independent variables was examined using hierarchical linear regression.

Results

The 38 women with psychosis exhibited severe delusional symptoms, mild-to-moderate symptoms of hallucination and positive formal thought disorders, and minimal symptoms of bizarre behaviour. They also exhibited severe symptoms of affective flattening or blunting, moderate symptoms of anhedonia-asociality, mild symptoms of alogia and avolition-apathy, and questionable symptoms of attention disturbance.

In the week prior to the assessment, participants reported a mean PA level of 3228.59 MET-min, which included 1201.93 MET-min of light-intensity PA, 1386.65 MET-min of moderate-intensity PA, and 640.00 MET-min of vigorous-intensity PA.

Age was correlated with moderate-intensity PA (r = 0.51, p = 0.007) and total PA (r = 0.52, p = 0.002). The ESE 'must exercise alone' domain was correlated with moderate-intensity PA (r = 0.17, p = 0.009) and total PA (r= 0.15, p = 0.04). The ESE 'resistance from others' domain was correlated with moderate-intensity PA (r = 0.0003, p = 0.03). No significant correlations were observed between other PA variables and other ESE domains.

The 'must exercise alone' domain × age interaction term was significant (estimate = 23.29, standard error [SE] = 6.98, p = 0.002, $\Delta R^2 = 0.168$). The unstandardised simple slope for moderate-intensity PA was -136.34 (SE = 149.12, p = 0.37) among participants aged 1 standard deviation (SD) below the mean age, 166.71 (SE = 90.82, p = 0.08) among participants aged within 1 SD of the mean age, and 469.77 (SE = 103.67, p < 0.001) among participants aged 1 SD above the mean age (Figure 2a). The 'inconvenient to exercise' domain × age interaction term was significant (estimate = 31.53, SE = 11.08, p = 0.008, ΔR2 = 0.149). The unstandardised simple slope for moderate-intensity PA was -251.12 (SE = 215.79, p = 0.25) among participants aged 1 SD below the mean age, 159.15 (SE = 129.68, p = 0.23) among participants aged within 1 SD of the mean age, and 569.41 (SE = 169.25, p < 0.001) among participants aged 1 SD above the mean age (Figure 2b). The 'resistance from others' domain × age interaction term was significant (estimate = 27.18, SE = 8.18, p = 0.002, $\Delta R^2 = 0.179$). The unstandardised simple slope for moderate-intensity PA was -264.26 (SE = 183.77, p = 0.16) among participants aged 1 SD below the mean age, 89.40 (SE = 109.43, p = 0.42) among participants aged within 1 SD of the mean age, and 443.06 (SE = 113.33, p < 0.001) among participants aged 1 SD above the mean age (Figure 2c). The overall ESE × age interaction term was significant (estimate = 4.38, SE = 2.07, p = 0.04, $\Delta R^2 = 0.091$). The unstandardised simple slope for moderate-intensity PA was -27.42 (SE = 42.20, p = 0.52) among participants aged 1 SD below the mean age, 29.56 (SE = 25.74, p = 0.26) among participants aged within 1 SD of the mean age, and 86.55 (SE = 31.52, p = 0.01) among participants aged 1 SD above the mean age (Figure 2d).

Discussion

In the present study, confidence in one's ability to exercise independently ('must exercise alone' domain) and confidence in overcoming resistance from others ('resistance from others' domain) were associated with increased engagement in moderate-intensity PA. These associations were dependent on the participant's age. In addition, confidence in overcoming exercise inconvenience barriers ('inconvenience to exercise' domain) and overall ESE, which were not initially associated with moderate-intensity PA, were associated with the older age group. The association between confidence in one's ability to exercise independently and total PA was not dependent on the participant's age. Indeed, the post-hoc analysis suggested that the association became non-significant after accounting for age and negative symptoms of affective flattening or blunting and alogia. Psychotic symptoms, particularly negative symptoms of affective flattening or blunting and alogia, affect levels of PA.[29] No associations were observed between PA levels and other ESE domains including negative affect, excuse-making, and bad weather conditions. These findings underscore the effects of an individual's beliefs and confidence in PA on PA levels. Targeted strategies can be used to assist women with psychosis to overcome real-life barriers to PA, ultimately leading to improved adherence to exercise.

Self-efficacy is predictor for engagement and continuation of PA among older people (but not younger people).[21,22] Exercise intentions of older people are more influenced by both perceived risk and result expectancies, compared with younger adults.[22] Younger people tend to view themselves as less prone to health problems, but older adults perceive themselves as more susceptible to health problems, thereby having stronger intention and dedication to exercise. Strategies to promote PA among older adults may aim at enhancing self-efficacy. Methods to promote exercise include performing exercises in a safe environment, recalling previous successful performances, and observing others to perform exercise.[30] Controlling expectations regarding the positive effects of exercise can affect health, social interactions, and other desirable results.[31] Individuals who are content with the initial goals are more inclined to maintain a consistent exercise routine.[32]

In women, moderate-intensity PA primarily encompasses housework or work-related tasks (Table 2). This could explain the positive correlation between moderate-intensity PA and age, as older women are generally more involved in housework. Although ESE may not align perfectly with that required for daily chores or work-related activities, ESE was correlated with these work-related tasks, which are typically driven by role-related responsibilities

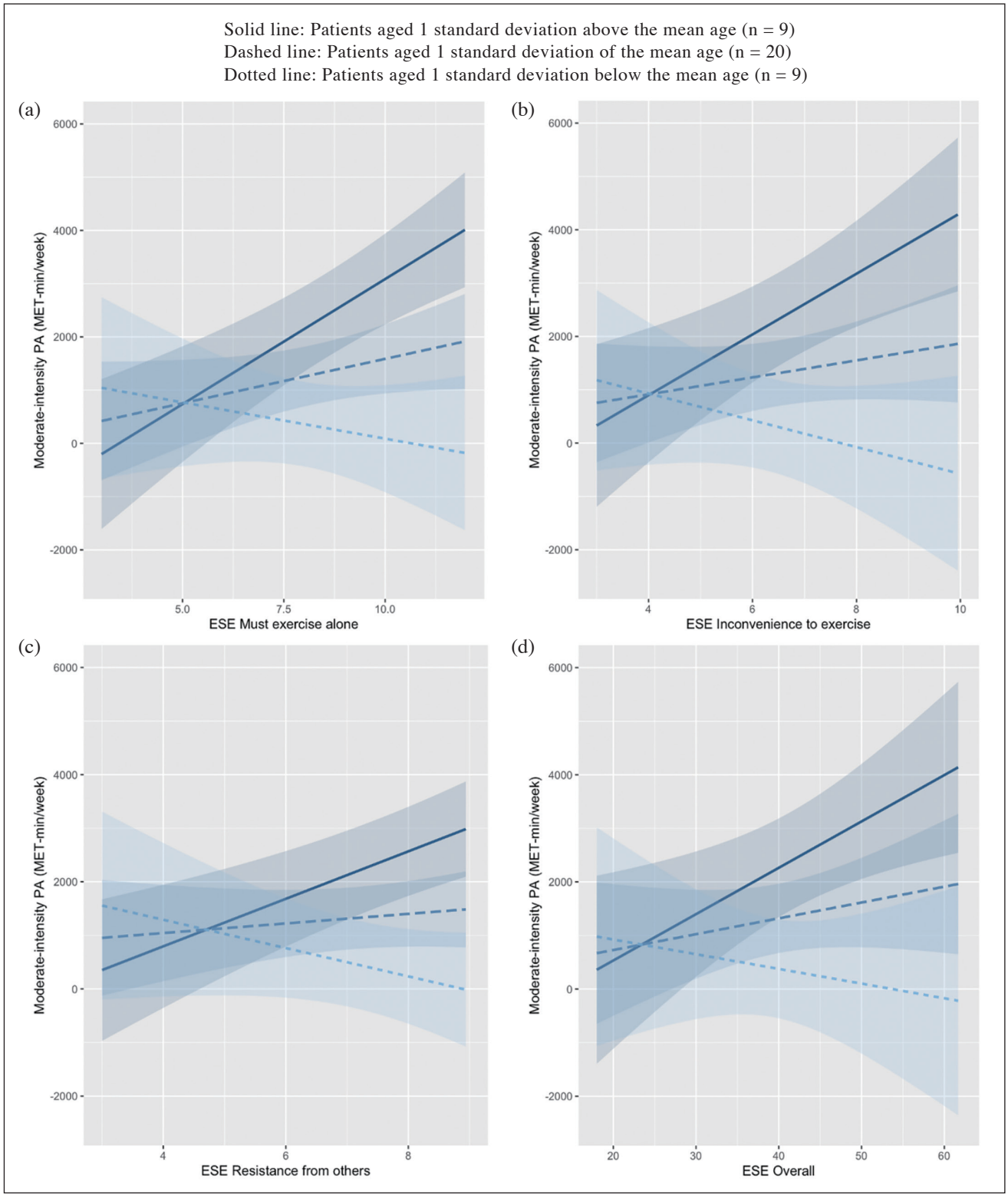

Figure 2. Plot of estimated means for the moderating effect of age on the association between exercise self-efficacy (ESE) domains and physical activity (PA) levels: (a) ESE 'must exercise alone' domain and moderate-intensity PA, (b) ESE 'inconvenience to exercise' domain and moderate-intensity PA, (c) ESE 'resistance from others' domain and moderate-intensity PA, and (d) overall ESE and moderate-intensity PA

Table 2. Associations between age and physical activity levels

Type of physical activity	Correlation with age (n = 38)	Mean ± standard deviation (SD) metabolic equivalent of task min/week		
		Patients aged 1 SD below the mean age (n = 9)	Patients aged within 1 SD of the mean age (n = 20)	Patients aged 1 SD above the mean age (n = 9)
Work	r = 0.04, p = 0.83	3013.0 ± 6987.4	971.7 ± 2236.8	598.0 ± 811.4
Transportation	r = 0.20, p = 0.24	2871.0 ± 7835.0	431.1 ± 292.8	542.7 ± 327.7
Housework	r = 0.45, p = 0.004	346.7 ± 591.0	864.6 ± 1320.5	2065.3 ± 3545.8
Leisure	r = 0.09, p = 0.58	1594.5 ± 2977.7	715.7 ± 879.0	1803.4 ± 1659.4

such as homemaking. Women with higher ESE were more inclined to engage in housework, possibly with increased frequency.

The 'must exercise alone' domain indicates the confidence to participate in PA without a partner. Ageing can lead to physiological and psychological changes in terms of objective and subjective physical health, health behaviours, and psychological influences on health behaviours. Older people generally have more time and make greater efforts to maintain their health as a primary goal,[33] given their perceived vulnerability to illness, compared with younger adults.[34] Their motivation to engage in regular PA to improve health outcomes may surpass the enjoyment of socialising with others. Furthermore, perception of and reaction to a particular situation depend on life experiences and self-regulation capabilities. Self-regulatory ability refers to ability to manage behaviour based on internal goals and limitations, as well as ability to control their thoughts and actions.[35] Self-regulatory ability was developed through various experiences and adopt specific practices. Older people are more able to evaluate their self-efficacy and regulate and implement their thoughts and actions. In contrast, younger adults may lack the necessary experience and self-regulatory skills to execute their intentions, particularly those with psychosis, which are associated with impaired self-regulation.[36] Although self-efficacy is associated with intention to exercise, the actual health behaviours can be influenced by numerous other factors.

Among women with psychosis, age moderated the associations between moderate-intensity PA and ESE, specifically the domains of 'resistance from others' and 'inconvenience to exercise'. Resistance from others can be viewed as a social force that either promotes or inhibits exercise habits, particularly when it originates from someone who is significant in their life. Three issues are covered in this domain: (1) my friend does not want me to exercise; (2) my significant other does not want me to exercise; and (3) I spend time with friends or family who do not exercise. Older adults may perceive PA as a health-related behaviour that improves their well-being,[37] whereas younger people may consider PA a recreational activity influenced by social factors such as family and friends. Social support plays a crucial role in determining PA behaviour.[38] The health promotion model explains how people interact with their interpersonal and physical environments for favourable health behaviours. This model considers social factors such as family and friends when initiating healthy behaviours. However, the influence of social factors changes throughout people's life. Social networks typically grow during young adulthood, a phase marked by exploration and establishment of new connections to meet emotional needs, and then decrease in size during later stages of adulthood.[39] These changes may affect the utilisation of social resources to attain behavioural changes.

This study has several limitations. A cross-sectional design was used; thus, causality between ESE and PA levels cannot be deduced. Furthermore, the small sample size may lead to insufficient statistical power and a large margin of error. The use of the self-report IPAQ-L for evaluating PA levels may be subject to both systematic and random errors; the IPAQ-L may not accurately capture PA levels in patients with psychosis who have recall bias owing to difficulties in concentration and memory.

Our findings that age had moderating effects on associations between ESE and PA levels underscore the importance of implementing age-specific strategies to optimise PA levels in women with psychosis. Forming positive expectations for exercise, providing targeted support (group exercise) to enhance social connections, and offering family psychoeducation to foster emotional support may help women to overcome real-world challenges and increase their commitment to exercise. Gender affects behaviours because of societal norms and stereotypes. Women are more likely to report that emotions play a significant role in their decision-making process, whereas men are more focused on goals or objectives.[40] Future research should examine how age and sex differences affect social-cognitive factors such as self-confidence, self-control, social support, external influences, outcome expectations, and perceived risk.

Conclusion

Among women with psychosis, ESE domains of 'must exercise alone', 'inconvenience to exercise', and 'resistance from others' as well as overall ESE were significantly associated with moderate-intensity PA in older age group only. Age-specific strategies should be applied when designing interventions to increase PA levels and overall well-being in this population. For younger women with psychosis, interventions should focus on providing exercise opportunities and social support, such as family education and psychoeducation, to overcome emotional barriers. For older women with psychosis, interventions should focus on enhancing ESE.

Contributors

All authors designed the study, acquired the data, analysed the data, drafted the manuscript, and critically revised the manuscript for important intellectual content. All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

As editors of the journal, YNS, HMEL, LMCH, KWS Chan, and EYHC were not involved in the peer review process. Other authors have disclosed no conflicts of interest.

Funding/support

This study was funded by the Hong Kong Jockey Club Charities Trust (grant number: 2017/0104).

Data availability

All data generated or analysed during the present study are available from the corresponding author on reasonable request.

Ethics approval

This study was approved by Kowloon West Cluster Research Ethics Committee (reference: KW/EX-16-041(96-23)). The participants provided written informed consent for all treatments and procedures and for publication.

References

1. Correll CU, Solmi M, Croatto G, et al. Mortality in people with schizophrenia: a systematic review and meta-analysis of relative risk and aggravating or attenuating factors. World Psychiatry 2022;21:248-71. Crossref
2. Solmi M, Seitidis G, Mavridis D, et al. Incidence, prevalence, and global burden of schizophrenia: data, with critical appraisal, from the Global Burden of Disease (GBD) 2019. Mol Psychiatry 2023;28:5319-27. Crossref
3. Laursen TM, Nordentoft M, Mortensen PB. Excess early mortality in schizophrenia. Annu Rev Clin Psychol 2014;10:425-48. Crossref
4. Lee EE, Liu J, Tu X, Palmer BW, Eyler LT, Jeste DV. A widening longevity gap between people with schizophrenia and general population: a literature review and call for action. Schizophr Res 2018;196:9-13. Crossref
5. Chan SKW, Chan SWY, Pang HH, et al. Association of an early intervention service for psychosis with suicide rate among patients with first-episode schizophrenia-spectrum disorders. JAMA Psychiatry 2018;75:458-64. Crossref
6. McGorry PD, Killackey E, Yung A. Early intervention in psychosis: concepts, evidence and future directions. World Psychiatry 2008;7:148-56. Crossref
7. Hui CL, Wong GH, Tang JY, et al. Predicting 1-year risk for relapse in patients who have discontinued or continued quetiapine after remission from first-episode psychosis. Schizophr Res 2013;150:297-302. Crossref
8. Stubbs B, Koyanagi A, Schuch F, et al. Physical activity levels and psychosis: a mediation analysis of factors influencing physical activity target achievement among 204 186 people across 46 low- and middle-income countries. Schizophr Bull 2017;43:536-45. Crossref
9. Goff DC, Falkai P, Fleischhacker WW, et al. The long-term effects of antipsychotic medication on clinical course in schizophrenia. Am J Psychiatry 2017;174:840-9. Crossref
10. Fernández-Abascal B, Suárez-Pinilla P, Cobo-Corrales C, Crespo-Facorro B, Suárez-Pinilla M. In- and outpatient lifestyle interventions on diet and exercise and their effect on physical and psychological health: a systematic review and meta-analysis of randomised controlled trials in patients with schizophrenia spectrum disorders and first episode of psychosis. Neurosci Biobehav Rev 2021;125:535-68. Crossref
11. Dauwan M, Begemann MJH, Slot MIE, Lee EHM, Scheltens P, Sommer IEC. Physical exercise improves quality of life, depressive symptoms, and cognition across chronic brain disorders: a transdiagnostic systematic review and meta-analysis of randomized controlled trials. J Neurol 2021;268:1222-46. Crossref
12. Snowsill TM, Stathi A, Green C, et al. Cost-effectiveness of a physical activity and behaviour maintenance programme on functional mobility decline in older adults: an economic evaluation of the REACT (Retirement in Action) trial. Lancet Public Health 2022;7:e327-e334. Crossref
13. Pajonk FG, Wobrock T, Gruber O, et al. Hippocampal plasticity in response to exercise in schizophrenia. Arch Gen Psychiatry 2010;67:133-43. Crossref
14. McEwen SC, Jarrahi B, Ventura J, et al. A combined exercise and cognitive training intervention induces fronto-cingulate cortical plasticity in first-episode psychosis patients. Schizophr Res 2023;251:12-21. Crossref
15. Maurus I, Röll L, Keeser D, et al. Associations between aerobic fitness, negative symptoms, cognitive deficits and brain structure in schizophrenia: a cross-sectional study. Schizophrenia (Heidelb) 2022;8:63. Crossref
16. Suen YN, Lo LHL, Lee EH, et al. Motivational coaching augmentation of exercise intervention for early psychotic disorders: a randomised controlled trial. Aust N Z J Psychiatry 2022;56:1277-86. Crossref
17. Lo LLH, Lee EHM, Hui CLM, et al. Effect of high-endurance exercise intervention on sleep-dependent procedural memory consolidation in individuals with schizophrenia: a randomized controlled trial. Psychol Med 2023;53:1708-20. Crossref
18. Firth J, Rosenbaum S, Stubbs B, Gorczynski P, Yung AR, Vancampfort D. Motivating factors and barriers towards exercise in severe mental illness: a systematic review and meta-analysis. Psychol Med 2016;46:2869-81. Crossref
19. Vancampfort D, De Hert M, Vansteenkiste M, et al. The importance of self-determined motivation towards physical activity in patients with schizophrenia. Psychiatry Res 2013;210:812-8. Crossref
20. Bandura A. Self-Efficacy: The Exercise of Control. Macmillan; 1997.
21. Annesi JJ. Moderation of age, sex, and ethnicity on psychosocial predictors of increased exercise and improved eating. J Psychol

2013;147:455-68. Crossref
22. Renner B, Spivak Y, Kwon S, Schwarzer R. Does age make a difference? Predicting physical activity of South Koreans. Psychol Aging 2007;22:482-93. Crossref
23. Lloyd KM, Little DE. Keeping women active: an examination of the impacts of self-efficacy, intrinsic motivation, and leadership on women's persistence in physical activity. Women Health 2010;50:652-69. Crossref
24. Suen YN, Yau JY, Wong PS, et al. Effect of brief, personalized feedback derived from momentary data on the mental health of women with risk of common mental disorders in Hong Kong: a randomized clinical trial. Psychiatry Res 2022;317:114880. Crossref
25. Andreasen NC. Scale for the Assessment of Positive Symptoms. University of Iowa; 2000.
26. Andreasen NC. The Scale for the Assessment of Negative Symptoms (SANS): conceptual and theoretical foundations. Br J Psychiatry Suppl 1989;7:49-58. Crossref
27. Craig CL, Marshall AL, Sjöström M, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003;35:1381-95. Crossref
28. Benisovich SV, Rossi JS, Norman GJ, Nigg CR. Development of a multidimensional measure of exercise self-efficacy. Poster presentation at the Society of Behavioral Medicine; 1998.
29. Vancampfort D, De Hert M, Stubbs B, et al. Negative symptoms are associated with lower autonomous motivation towards physical activity in people with schizophrenia. Compr Psychiatry 2015;56:128-32. Crossref
30. French DP, Olander EK, Chisholm A, McSharry J. Which behaviour change techniques are most effective at increasing older adults' self-efficacy and physical activity behaviour? A systematic review. Ann Behav Med 2014;48:225-34. Crossref
31. van Stralen MM, Lechner L, Mudde AN, de Vries H, Bolman C. Determinants of awareness, initiation and maintenance of physical activity among the over-fifties: a Delphi study. Health Educ Res 2010;25:233-47. Crossref
32. Kassavou A, Turner A, Hamborg T, French DP. Predicting maintenance of attendance at walking groups: testing constructs from three leading maintenance theories. Health Psychol 2014;33:752-6. Crossref
33. Hooker K, Kaus CR. Health-related possible selves in young and middle adulthood. Psychol Aging 1994;9:126-33. Crossref
34. Renner B, Knoll N, Schwarzer R. Age and body make a difference in optimistic health beliefs and nutrition behaviors. Int J Behav Med 2000;7:143-59. Crossref
35. Goldberg E, Podell K. Adaptive decision making, ecological validity, and the frontal lobes. J Clin Exp Neuropsychol 2000;22:56-68. Crossref
36. Jovanovski D, Zakzanis KK, Young DA, Campbell Z. Assessing the relationship between insight and everyday executive deficits in schizophrenia: a pilot study. Psychiatry Res 2007;151:47-54. Crossref
37. Schwarzer R, Renner B. Social-cognitive predictors of health behavior: action self-efficacy and coping self-efficacy. Health Psychol 2000;19:487-95. Crossref
38. Soundy A, Freeman P, Stubbs B, Probst M, Vancampfort D. The value of social support to encourage people with schizophrenia to engage in physical activity: an international insight from specialist mental health physiotherapists. J Ment Health 2014;23:256-60. Crossref
39. Wrzus C, Hänel M, Wagner J, Neyer FJ. Social network changes and life events across the life span: a meta-analysis. Psychol Bull 2013;139:53-80. Crossref
40. de Acedo Lizárraga MLS, de Acedo Baquedano MTS, Cardelle-Elawar M. Factors that affect decision making: gender and age differences. Int J Psychol Psychol Ther 2007;7:381-91.