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Original Research

Motivation Matters: Understanding the Antidepressant Mechanism of Physical Activity among Young Adults

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ABSTRACT

International Journal of Exercise Science 17(5): 861-873, 2024. A negative association between physical activity and depressive symptoms is consistently reported within scientific literature and physical self-concept has been suggested to mediate this pathway. However, for whom these associations are strongest remains poorly understood, and little is known about how other psychosocial factors might be implicated. Consequently, we examined how various exercise motivations, specifically appearance, physical health, and mental health, might moderate the indirect effect of physical activity on depressive symptoms through physical self-concept. Canadian young adults (N = 496, $Mage$ = 20.36, SD = 1.87) completed an online questionnaire. Mediation and moderated-mediation models were tested using PROCESS macro in RStudio. A significant indirect effect (ß = -0.18, CI [-0.005, -0.003]) of physical activity on depressive symptoms through physical self-concept was found. Exercise motivations moderated the association between physical activity and physical self-concept, such that the association was stronger when individuals were motivated by physical health. Thus, the effect of physical activity on depressive symptoms varied according to physical self-concept and physical health-exercise motivations. We conclude that motivation should be considered when developing and delivering physical activity prevention efforts for depressive symptoms.

KEY WORDS: Mental health, prevention, depression, well-being

INTRODUCTION

In Canada, 70% of mental health problems begin between ages 15 and 24 (24). In particular, depression is a leading cause of disability and a major contributor to the global disease burden (5, 18). Symptoms, which include, but are not limited to, low mood, lack of interest, and fatigue, are often chronic and persistent, underpinning serious consequences including cardiovascular disease, unemployment, criminality, and suicide (1, 5). While five or more of the nine diagnostic criteria must be present during a two-week period to make a diagnosis of major depressive disorder (1), subclinical presentations also lead to functional impairments and significantly increase the risk of developing major depressive disorder (39). An estimated 15% of individuals are affected by subclinical depressive symptoms in North America (39). Consequently, elucidating prevention methods for these pervasive symptoms is of critical importance. Physical

activity is a cost-effective and accessible intervention with minimal side-effects. Negative associations between physical activity and depressive symptoms are consistently reported in systematic reviews and meta-analyses (e.g., 2, 17). However, the mechanism is often oversimplified, negating the complex pathways that likely involve multiple mediators and moderators. Research exploring how and for whom physical activity is protective against depression could be informative for designing prevention programs and determining to whom to direct them (18). We aim to address this within the present study, focusing on young adults given their developmental vulnerability to depressive symptoms (24).

Positive self-concept, referring to the extent to which individuals perceive themselves positively in various capacities, is associated with increased physical activity (2), and negatively associated with depressive symptoms (4, 7, 33). Indeed, positive self-concept may be an important mediator between physical activity and depressive symptoms (18). For instance, according to the Exercise and Self-Esteem Model (EXSEM; 35, 36), physical activity increases physical self-concept, leading to improved self-esteem associated with reduced depressive symptoms, with several studies supporting this model (8, 13, 23, 31, 38). Yet, under what conditions these associations are strongest remains unclear (18). We explore this within the present study, particularly examining the moderating influence of exercise motivations, including exercising for appearance-, physical health-, and mental health-related reasons.

According to theory and research findings, individuals motivated to exercise for the purpose of altering appearance may be less likely to experience psychological benefits from physical activity. Objectification Theory posits that self-objectification, viewing one's body in terms of how it appears as opposed to how it functions, negatively affects mental health, particularly among young women (11). For example, Homan and Tylka (16) found that when young adult women (N = 321; *Mage* = 19.88, SD = 3.73) more strongly endorsed engaging in physical activity for appearance-related reasons, the positive association between physical activity and physical self-concept was weaker. To add, in a recent meta-analysis, appearance-motivated exercise was associated with poor body image, a facet of physical self-concept (28).

On the contrary, participants who endorse greater physical health-related motives for engaging in physical activity tend to report more positive body image (28). Furthermore, they typically experience less anxiety and greater enjoyment while exercising (27). Such findings may be understood through Self-Determination Theory which proposes that human well-being is optimized when three psychological needs are met: autonomy, competence, and relatedness (32). Autonomy satisfaction, in particular, is promoted when behaviours are intrinsically rewarding or enjoyable and align with an individual's beliefs, as opposed to being externally motivated, for example, by social approval (32). Thus, exercising for physical health purposes may be more intrinsically motivating than pursuing societally imposed body ideals, leading to greater psychological need fulfillment. It remains to be explored whether this effect extends to exercising for mental health or is restricted to physical health-motivated exercise.

Understanding how the antidepressant effect of physical activity occurs and for whom it may be strongest is necessary to further improve its potential for prevention and intervention (18).

Exercise motivation appears to play a role. Consequently, we examined whether appearance-, physical health-, or mental health- motivated exercise moderated the indirect effect of physical activity on depressive symptoms through physical self-concept among a young adult sample. The following is hypothesized: 1. Higher levels of physical activity will be associated with lower levels of depressive symptoms. 2. Physical activity will indirectly affect depressive symptoms via increased physical self-concept. 3. The indirect effect will be moderated such that the physical activity and physical self-concept association will be weaker when: a.) individuals are strongly motivated to exercise to alter their appearance. b.) individuals weakly endorse exercising to improve their physical health. c.) individuals are weakly motivated to exercise to improve their mental health.

METHODS

Participants

An a priori statistical power analysis conducted in RStudio v4.0.2 for MacOS indicated that 239 participants were needed to detect medium effects with 80% power at a 0.05 alpha-level. Participants were recruited through the University of Victoria's undergraduate participant pool, and ads displayed around campus and on social media. To meet inclusion criteria, participants had to reside in Canada and be between the ages of 18 and 25. All participants provided informed consent and all procedures were approved by the University of Victoria's Human Research Ethics Board (protocol number 21-0424). Additionally, all ethical statements issued by the International Journal of Exercise Science were adhered to (26).

Participants (n = 134) were removed for failing to correctly answer both "bot" prevention questions or for missing 100% of data beyond the demographic section (19). If duplicate IP addresses were identified but demographic information was different, both entries were retained. If demographic information was the same for both entries, the original was retained, and the latter was removed (n = 15). Five participants were excluded for failing to complete 80% of two or more scales. The final sample included 496 participants (M_{age} = 20.36 ± 1.87; 81.5% women; 83.3% White; 78.2% full-time students). Additional sample characteristics are presented in Table 1.

Protocol

After providing informed consent, participants completed an open questionnaire via Qualtrics, the usability of which was tested by four lab members. Data collection occurred during January and February of 2022. Two questions were included at the beginning of the questionnaire that were designed to protect against algorithmic scripts (i.e., "bots"; 19). Access to the full questionnaire was withheld if participants did not correctly respond to these items. Thereafter, each measure was presented on subsequent pages that could be navigated with forward and back buttons. Participants were reimbursed with entry into a prize draw for $50 or 0.5 credits to a choice University of Victoria psychology course.

Physical Activity: The Godin-Shephard Leisure-Time Physical Activity Questionnaire assessed participants' level of physical activity. It is widely used, simple to complete, valid within a range

of populations, and correlates with other measures of physical activity such as VO2max (12). Participants reported how many times during an average week they engaged in strenuous, moderate, and mild exercise for durations longer than 15 minutes (12). The reported values for each intensity were multiped by weights of 9, 5, and 3, respectively, and these products were summed to form a composite total leisure score index. Higher scores indicate greater amounts of physical activity (12). Reliability was acceptable among the current sample (α = 0.75).

Table 1. Participant demographics.

	N	%
Gender		
Women	404	81.5
Men	75	15.1
Gender Minorities	16	3.2
Race		
Black	5	1.0
East Asian	40	8.1
First Nations	4	0.8
Inuit	1	0.2
Métis	4	0.8
Middle Eastern	10	2.0
South American	12	2.4
South Asian	31	6.3
Southeast Asian	16	3.2
White	413	83.3
Education		
Some high school	3	0.6
High school diploma	58	11.7
Vocational training	2	0.4
College diploma	19	3.8
Some university	338	68.1
Undergraduate degree	75	15.1
Master's degree	1	0.2
Employment status		
Employed full-time	41	8.3
Employed part-time	180	36.3
Income		
Less than 20,000	379	76.4
20,001 – 48,500	70	14.1
48,501 – 97,000	23	4.6
97,001 plus	22	4.4
Relationship status		
Single	269	54.2
In a relationship	227	45.8
Children		
No children	487	98.2
One or more children	9	1.8
Barriers to Physical Activity		
No barriers	420	84.7
Experiences mental and/or physical barriers	67	13.5

Physical Self-Concept: The Physical Self-Description Questionnaire short version (PSDQ-S), a gold-standard measure, assessed physical self-concept (21). As it only shows a slightly lower reliability than the long version and generalizes across diverse populations, including university students, the short-form was chosen to prevent fatigue (21). The PSDQ-S contains 40 items. Participants indicate how correct each statement is about them (e.g., "I am good at coordinated movements") using a 6-point Likert response format from 1 (false) to 6 (true). Scores were summed and higher scores indicated more positive self-concept (21). The questionnaire demonstrated acceptable reliability ($\alpha = 0.95$).

Depressive Symptoms: The Center for Epidemiologic Studies Depression Scale (CES-D) evaluated depressive symptoms as it is a valid and reliable measure for both clinical and general populations (29). The CES-D presents 20 items representing an array of depressive symptoms (e.g., "I was bothered by things that usually don't bother me") and participants indicated how often within a week they experienced each from 0 (rarely or none of the time) to 3 (most or all of the time). Higher sum scores indicated the presence of more symptoms ($\alpha = 0.92$).

Exercise Motivations: Participants' motivations for engaging in physical activity were evaluated using the 24-item Reasons for Exercise Inventory (REI) which assesses multiple domains of motives (34). For the purposes of this study, these domains were collapsed into three categories: weight control, attractiveness, and tone comprised appearance-related engagement (9 items; $\alpha = 0.88$); fitness and health comprised physical health-related engagement (8 items; $\alpha = 0.89$); and mood and enjoyment comprised mental health-related engagement (7 items; $\alpha = 0.86$). For example, participants were asked "To what extent is each of the following an important reason that you have for exercising?" (e.g., "to improve me muscle tone"; appearance-related) and responded using a 7-point Likert response format ranging from 1 (not at all important) to 7 (extremely important). Scores were averaged for each domain with higher scores indicating stronger identification with a particular motive.

Statistical Analysis

Collected data were cleaned before analyses in Microsoft Excel (version 16.81) and RStudio v4.0.2 for MacOS. To account for any missing items within scales, scores were averaged, and this mean score was used for analyses. If participants failed to complete 80% of a scale, their total score for that scale was marked as missing. Outliers of the leisure score indices were determined using box plots. Fifteen scores above the 75th percentile were identified and marked as missing. Pearson correlation coefficients were computed between all variables of interest with alpha set at 0.05.

All analyses were conducted in RStudio v4.0.2 for MacOS. Given support for a regression-based approach (25), models 4 and 7 of the PROCESS macro v4.0 were used to test the mediation and moderated-mediation models outlined in Hypothesis 1 and 2, and 3a-c, respectively. Model 4 is appropriate for use with single predictors, outcomes, and mediators, while model 7 allows for the inclusion of a single moderator at the *a*-path (15). Following current recommendations, bootstrap confidence intervals (CI) were used for significance testing (14, 25). Effects were considered significant when the bias-corrected 95% CIs based on 5000 iterations did not cross 0.

Significant moderation effects were probed with simple slopes analyses. Age, race (0 = White), income, and presence of barriers to physical activity engagement (0 = no barriers) were entered as covariates in all models. Gender was also included as both the levels of and the associations between physical activity and depressive symptoms are known to vary by gender (23). Gender was dummy coded with "man" as the reference group to compare "woman" and "gender minority." Predictors were mean centered for interpretability.

RESULTS

Descriptive Statistics: Descriptive statistics are detailed in Table 2. Of note, the cut-off composite score for the CES-D is 16, which 339 participants (68.4%) met or exceeded. The average mean score was 1.14 (*SD* = 0.59), equivalent to a composite score of 22.78. Most variables were correlated in the expected directions (Table 2); however, physical activity was not significantly correlated with depressive symptoms.

Table 2. Descriptive statistics and bivariate correlations.

	Mean	SD	1	2	3	4	5	6
1. Physical Activity	50.60	26.29	1					
2. Physical Self-Concept	3.97	0.81	0.43**	1				
3. Appearance-Motivated Exercise	4.51	1.3	-0.05	-0.21**	1			
5. Physical Health-Motivated Exercise	5.49	1.12	0.24**	0.38**	0.04	1		
6. Mental Health-Motivated Exercise	4.88	1.28	0.24**	0.33**	0.09*	0.54**	1	
7. Depressive Symptoms	1.14	0.59	-0.06	-0.40**	0.25**	-0.18**	-.03	1

Note. Mean for variable 1 was calculated using composite scores and means for variables 2-6 were calculated using mean scores; SD = standard deviation; *$p < 0.05$, **$p < 0.01$.

Results of the mediation analysis are detailed in Table 3. The indirect effect of physical activity on depressive symptoms through physical self-concept was significant and negative (*a*: B = 0.012, ß = -0.403, CI [0.010, 0.015]; *b*: B = -0.316, ß = -0.437, CI [-0.386, -0.246] *ab*: B = -0.004, ß = -0.177, CI [-0.005, -0.003]). After controlling for physical self-concept, the direct effect of physical activity on depressive symptoms was significant and positive (c': B = 0.003, ß = 0.144, *SE* = .001, p = 0.002). The total effect of physical activity on depressive symptoms was not significant (c: B = -0.001, ß = -0.032, CI [-0.003, -0.001]). Identifying as a woman or gender minority, having a higher income, and reporting more barriers to engaging in physical activity were all associated with decreased physical activity participation (Table 3).

Table 3. Mediation analysis results.

	B	ß	*SE*	*t*	*p*	LLCI	ULCI
Outcome: Physical Self-Concept							
Constant	3.40		0.39	8.78	0.00	2.64	4.17
PA	0.01	0.40	0.00	9.80	0.00	0.01	0.02
Age (cov)	0.02	0.04	0.02	0.91	0.36	-0.02	0.05
Race (cov)	-0.09	-0.05	0.08	-1.22	0.22	-0.24	0.06
Woman (cov)	-0.34	-0.16	0.09	-3.71	0.00	-0.52	-0.16
Gender Minority (cov)	-0.73	-0.17	0.20	-3.70	0.00	-1.11	-0.34
High Income (cov)	-0.30	-0.10	0.12	-2.54	0.01	-0.53	-0.07
Impairment (cov)	-0.37	-0.16	0.10	-3.90	0.00	-0.56	-0.19
Outcome: Depressive Symptoms							
Constant	2.60		0.32	8.14	0.00	1.974	3.230
Physical Self-Concept	-0.32	-0.44	0.04	-8.85	0.00	-0.39	-0.25
PA	0.00	0.14	0.00	3.05	0.00	0.00	0.01
Age (cov)	-0.02	-0.08	0.01	-1.71	0.09	-0.05	0.00
Race (cov)	-0.02	-0.02	0.06	-0.36	0.72	-0.13	0.09
Woman (cov)	0.11	0.07	0.07	1.55	0.12	-0.03	0.25
Gender Minority (cov)	0.14	0.04	0.15	0.89	0.37	-0.16	0.43
High Income (cov)	-0.13	-0.06	0.09	-1.41	0.16	-0.31	0.05
Impairment (cov)	0.10	0.06	0.07	1.30	0.19	-0.05	0.24
Indirect Effect of PA on Depressive Symptoms Through Physical Self-Concept							
	B	ß	BootSE	BootLLCI	BootULCI		
Physical Self-Concept	-0.0039	-0.177	0.0271	-0.2329	-0.1271		

Note. B = unstandardized coefficient; PA = Physical Activity; cov = covariate; LLCI = 95% lower limit confidence interval; ULCI = 95% upper limit confidence interval.

Regarding the moderated-mediation models, the only significant *a*-path interaction was between physical health-motivated exercise and physical activity (see Figure 1 and Figure 2), such that the strength of the indirect effect of physical activity on depressive symptoms was influenced by the level of physical health-motivated exercise. Simple slope analyses revealed that endorsing higher physical health-motivated exercise was associated with a greater indirect effect of physical activity on depressive symptoms (low physical health-motivated exercise: B = -0.002, CI [-0.003, -0.001]; high physical health-motivated exercise: B = -0.004, CI [-0.005, -0.003]).

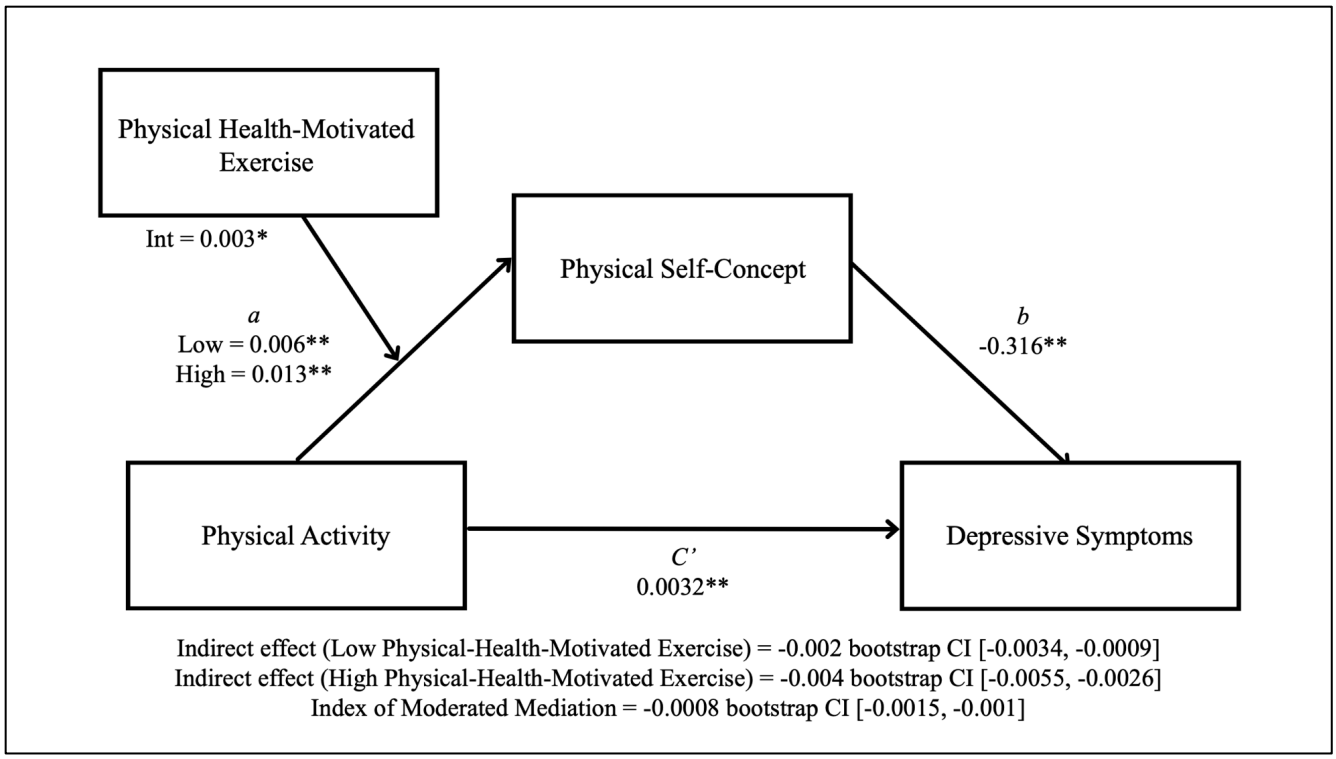

Figure 1. Moderated-mediation model for physical health-motivated exercise. *p < 0.05, **p < 0.01.

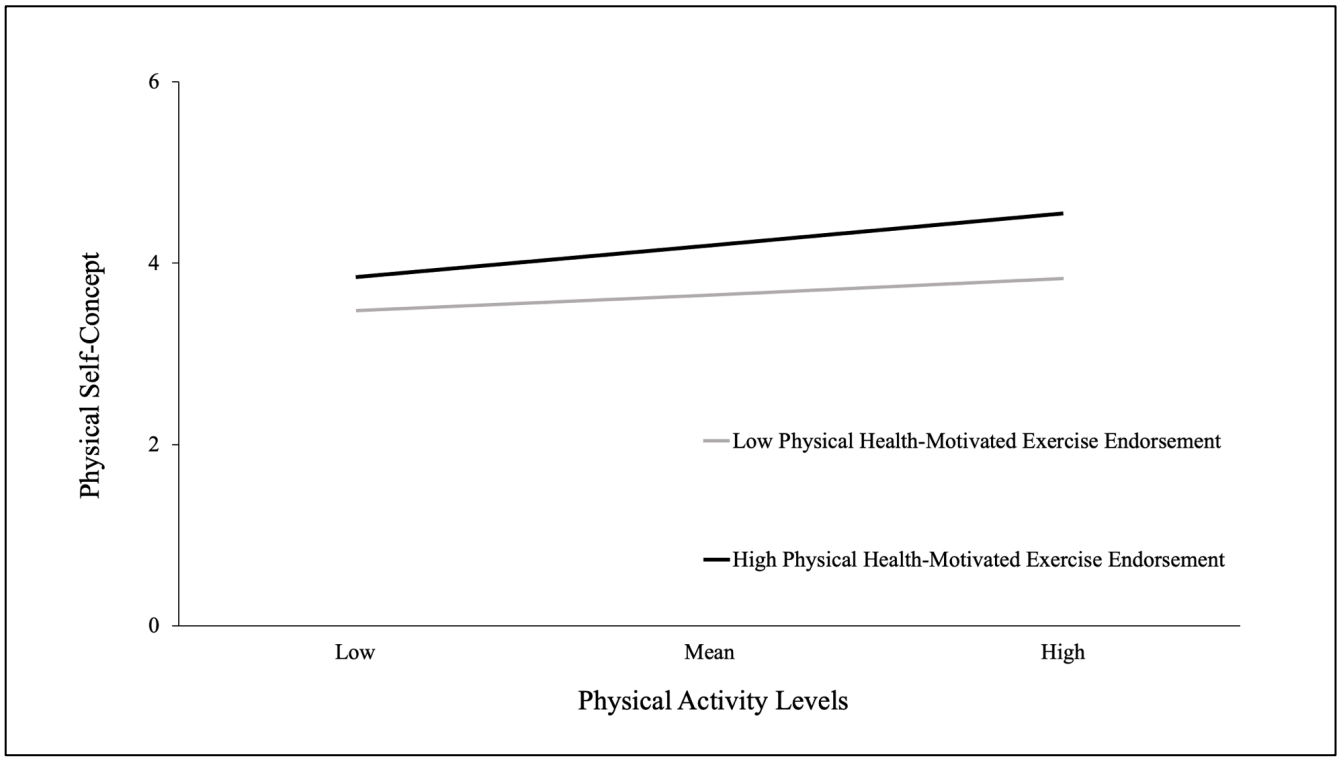

Figure 2. Associations between physical activity and physical self-concept by levels of physical health-motivated exercise.

DISCUSSION

Physical activity is widely discussed as beneficial for preventing and reducing depressive symptoms (e.g., 2, 17). However, the influence of psychosocial factors on varying outcomes of physical activity is seldom examined; thus, little is known regarding how and for whom physical activity is the most effective in reducing depressive symptoms. Consistent with past research (8, 13, 18, 23, 31, 38), we found that physical self-concept was a mediator between physical activity and depressive symptoms. Our moderation hypotheses were partially supported, with physical health-motivated exercise as a moderator of the association between physical activity and physical self-concept.

Contrary to Hypothesis 1 and results from studies with similar models (23, 31), there was no significant correlation between physical activity and depressive symptoms, nor was there a significant total effect of physical activity on depressive symptoms in the mediation model. Furthermore, while we anticipated a negative direct effect of physical activity on depressive symptoms, the direct effect observed in the mediation model was positive. Thus, when controlling for physical self-concept, physical activity was associated with increased depressive symptoms. These unexpected total and direct effects may result from inconsistent mediation caused by a suppressor, thus rendering them not logically interpretable (6, 20, 30). Consequently, when physical self-concept is not accounted for, physical activity may no longer be a meaningful predictor of depressive symptoms. Alternatively, this parameter estimate may be biased due to the cross-sectional nature of the data (22). Moreover, the context of the COVID-19 pandemic, during which this data was collected, may be a confounding variable overwhelmingly influencing the level of depressive symptoms present. Consistent with nationally representative American adult survey data during the COVID-19 pandemic (9), depressive symptoms in the present sample were, on average, rather elevated.

Hypothesis 2 was supported such that physical activity was moderately associated with physical self-concept and physical self-concept was moderately associated with depressive symptoms. This was a weak indirect effect comparable to that of Görgülü and colleagues (13) and McPhie and Rawana (23). Although the cross-sectional data prevents us from making causal conclusions, our results are aligned with current theory and findings. Indeed, engagement in physical activity may encourage mastery and self-efficacy, leading to an overall increase in physical self-concept and decrease in depressive symptoms (35, 36).

Of the three exercise motivations tested (i.e., appearance, physical health, and mental health), only physical health-motivated exercise moderated the association. Individuals endorsing higher levels of physical health-motivated exercise tended to have stronger positive associations between physical activity and physical self-concept and, consequently, were more likely to experience fewer depressive symptoms. Thus, we expand on previous findings that health-related motives for physical activity are associated with less anxiety whilst exercising (27), with our results indicating that these positive psychological outcomes may extend past the physical activity engagement itself. Individuals with elevated physical health motivations may have predominantly functional, as opposed to objectified, perceptions of their bodies, which could be

protective against negative psychological outcomes of self-objectification in the context of physical activity (11). Further, and in accordance with Self-Determination Theory, individuals engaging in physical activity for reasons related to their physical health, may find the activity more fulfilling leading to increased psychological need satisfaction and overall mental well-being, including reduced depressive symptoms (32).

Contrary to our hypothesis, appearance-motivated exercise did not moderate the association between physical activity and physical self-concept. However, similar to previous research (10), appearance-motivated exercise was weakly and inversely correlated with physical self-concept and weakly and positively correlated with depressive symptoms. Appearance-motivated exercise, while not a significant moderator, was still predictive of poorer mental health. A more rigorous methodology is needed to ascertain its implication in the proposed model. Additionally, despite being positively correlated with physical activity and physical self-concept, mental health-motivated exercise was not a significant moderator, nor was it associated with depressive symptoms. One potential explanation could be that for those experiencing more severe depressive symptoms, motivation to exercise, even at small amounts, may be limited given difficulties engaging in a behaviourally activating tasks (1). Conversely, those experiencing few depressive symptoms may be more likely to endorse alternative motivations given the lack of current mental health challenges.

Despite the utility of the present findings, limitations exist and must be considered when interpreting results. First and foremost, due to the cross-sectional nature of the data no causal conclusions can be made, and the presented parameter estimates are prone to bias (22). However, cross-sectional mediations driven by theory (e.g., 8, 23), continue to be informative and often serve as the impetus to conduct longitudinal analyses (3). Regardless, the implementation of a longitudinal design remains necessary to substantiate our proposed model. The measurement of physical activity should also be interpreted cautiously. Despite using a gold-standard measure (12), its self-report nature may be susceptible to bias and measurement error. Finally, the primarily undergraduate sample may not generalize to the wider young adult population. However, considering the atypically high levels of depressive symptomatology, it is likely an accurate reflection of the experiences of university-aged students (37), particularly in the context of COVID-19 (9). In sum, future studies would benefit from a longitudinal design, wearable technology to assess multiple indicators of physical activity (e.g., steps, heart rate, calories burned), and a more diverse sample.

Given the increasing need to prevent depressive symptoms, particularly amongst young adults, it is imperative to develop a comprehensive understanding of the mechanisms by which current cost-effective and accessible preventions work to improve their delivery and efficacy. Moderated-mediation analyses are an effective means to achieve this (3). In view of our findings, we conclude that physical activity may be a useful antidepressant intervention for young adults; however, the small effect size observed here suggests that it is likely not ideal as a stand-alone intervention when additional professional or pharmacological treatments are concurrently available. We suggest that when implementing physical activity as a prevention or intervention technique, providing accompanying education around its physical health benefits and reducing

messaging around physical appearance and aesthetics may benefit clients. Priority areas for future research include the use of longitudinal designs and increasingly valid and reliable measurements of physical activity, such as wearables. Additionally, greater emphasis on understanding for whom physical activity is most effective is needed to improve the utility and ethical delivery of its use as a prevention and intervention strategy.

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REFERENCES

1. American Psychiatric Association. Depressive disorders. In: Diagnostic and Statistical Manual of Mental Disorders. 5th ed. American Psychiatric Publishing; 2013.

2. Biddle SJH, Ciaccioni S, Thomas G, Vergeer I. Physical activity and mental health in children and adolescents: An updated review of reviews and an analysis of causality. Psychol Sport Exerc 42: 146-155, 2019.

3. Cerin E. Ways of unraveling how and why physical activity influences mental health through statistical mediation analyses. Ment Health Phys Act 3(2): 51-60, 2010.

4. Chang LY, Fu M. Disentangling the effects of intergenerational transmission of depression from adolescence to adulthood: The protective role of self-esteem. Eur Child Adolesc Psychiatry 29(5): 679-689, 2020.

5. Clayborne ZM, Varin M, Colman I. Systematic review and meta-analysis: Adolescent depression and long-term psychosocial outcomes. J Am Acad Child Adolesc Psychiatry 58(1): 72-79, 2019.

6. Conger AJ. A revised definition for suppressor variables: A guide to their identification and interpretation. Educ Psychol Meas 34: 35-46, 1974.

7. Dale LP, Vanderloo L, Moore S, Faulkner G. Physical activity and depression, anxiety, and self-esteem in children and youth: An umbrella systematic review. Ment Health Phys Act 16: 66-79, 2019.

8. Dishman RK, Hales DP, Pfeiffer KA, et al. Physical self-concept and self-esteem mediate cross-sectional relations of physical activity and sport participation with depression symptoms among adolescent girls. Health Psychol 25(3): 396-407, 2006.

9. Ettman CK, Abdalla SM, Cohen GH, Sampson L, Vivier PM, Galea S. Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic. JAMA Netw Open *3(*9): 1-12, 2020.

10. Frederick CM, Ryan RM. Differences in motivation for sport and exercise and their relations with participation and mental health. J Sport Behav 16(3): 124-146, 1993.

11. Fredrickson BL, Roberts TA. Objectification theory: Toward understanding women's lived experiences and mental health risks. Psychol Women Q 21(2): 173-206, 1997.

12. Godin G. The Godin-Shephard leisure-time physical activity questionnaire. Health & Fitness Journal of Canada 4(1): 18-22, 2011.

13. Görgülü E, Bieber M, Engeroff T, et al. Physical activity, physical self-perception and depression symptoms in patients with major depressive disorder: A mediation analysis. Eur Arch Psychiatry Clin Neurosci 271(7): 1205-1215, 2021.

14. Hayes AF. Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. Commun Monogr 76(4): 408-420, 2009.

15. Hayes AF. Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. New York: Guilford Publications; 2014.

16. Homan KJ, Tylka TL. Appearance-based exercise motivation moderates the relationship between exercise frequency and positive body image. Body Image 11(2): 101-108, 2014.

17. Hu MX, Turner D, Generaal E, et al. Exercise interventions for the prevention of depression: A systematic review of meta-analyses. BMC Public Health 20(1): 1255, 2020.

18. Kandola A, Ashdown-Franks G, Hendrikse J, Sabiston CM, Stubbs B. Physical activity and depression: Towards understanding the antidepressant mechanisms of physical activity. Neurosci Biobehav Rev 107: 525-539, 2019.

19. Littrell S, Fugelsang JA. Bullshit blind spots: The roles of miscalibration and information processing in bullshit detection. Think Reason: 1-30, 2023.

20. MacKinnon DP, Krull JL, Lockwood CM. Equivalence of the mediation, confounding and suppression effect. Prev Sci 1(4): 173-181, 2000.

21. Marsh HW, Martin AJ, Jackson S. Introducing a short version of the physical self description questionnaire: New strategies, short-form evaluative criteria, and applications of factor analyses. J Sport Exerc Psychol 32(4): 438-482, 2010.

22. Maxwell SE, Cole DA, Mitchell MA. Bias in cross-sectional analyses of longitudinal mediation: Partial and complete mediation under an autoregressive model. Multivariate Behav Res 46(5): 816-841, 2011.

23. McPhie ML, Rawana JS. Unravelling the relation between physical activity, self-esteem and depressive symptoms among early and late adolescents: A mediation analysis. Ment Health Phys Act 5(1): 43-49, 2012.

24. Mental illness and addiction: Facts and statistics. Centre for Addiction and Mental Health. Accessed June 1, 2023. https://www.camh.ca/en/driving-change/the-crisis-is-real/mental-health-statistics

25. Meule A. Contemporary understanding of mediation testing. Meta-Psychol 3: 1-7, 2019

26. Navalta JW, Stone WJ, Lyons, S. Ethical issues relating to scientific discovery in exercise science. Int J Exerc Sci 12(1): 1-8, 2019.

27. O'Hara SE, Cox AE, Amorose AJ. Emphasizing appearance versus health outcomes in exercise: The influence of the instructor and participants' reasons for exercise. Body Image 11(2): 109-118, 2014.

28. Panão I, Carraça EV. Effects of exercise motivations on body image and eating habits/behaviours: A systematic review. Nutr Diet 77(1): 41-59, 2020.

29. Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. Appl Psychol Meas 1(3): 385-401, 1977.

30. Rucker DD, Preacher KJ, Tormala ZL, Petty R. Mediation analysis in social psychology: Current practices and new recommendations. Soc Personal Psychol Compass 5(6): 359-371, 2011.

31. Ryan MP. The antidepressant effects of physical activity: Mediating self-esteem and self-efficacy mechanisms. Psychol Health 23(3): 279-307, 2008.

32. Ryan RM, Deci EL. Self-determination theory: Basic psychological needs in motivation, development, and wellness. Guilford Publications; 2017.

33. Sharma S, Agarwala S. Self-esteem and collective self-esteem as predictors of depression. J Behav Sci 24(1): 21-28, 2014.

34. Silberstein LR, Striegel-Moore RH, Timko C, Rodin J. Behavioral and psychological implications of body dissatisfaction: Do men and women differ? Sex Roles 19(3-4): 219-232, 1988.

35. Sonstroem RJ, Harlow LL, Gemma LM, Osborne S. Test of structural relationships within a proposed exercise and self-esteem model. J Pers Assess. 56(2): 348-364, 1991.

36. Sonstroem RJ, Harlow LL, Josephs L. Exercise and self-esteem: Validity of model expansion and exercise associations. J Sport Exerc Psychol 16(1): 29-42, 1994.

37. Stallman HM. (2010). Psychological distress in university students: A comparison with general population data. Aust Psychol 45(4): 249-257, 2010.

38. White K, Kendrick T, Yardley L. Change in self-esteem, self-efficacy and the mood dimensions of depression as potential mediators of the physical activity and depression relationship: Exploring the temporal relation of change. Ment Health Phys Act 2(1): 44-52, 2009.

39. Zhang R, Peng X, Song, X, et al. The prevalence and risk of developing major depression among individuals with subthreshold depression in the general population. Psychol Med 53(8): 3611-3620, 2023.