ABSTRACT

This paper presents an empirical examination of the relationship between physical exercise and generalized distress within a stress process framework by examining how chronic strains, self-esteem, mastery, and social support influence this relationship. The analysis employed the 1994 wave of the National Population Health Survey consisting of a sample of 12,636 Canadians between 20 and 64 years of age. Findings suggest that physical exercise is a significant predictor of generalized distress independent of chronic strain, self-esteem and social support. However, mastery mediated the association between physical exercise and distress. Moreover, mastery moderated the relationship indicating that it is a more important resource for people who are inactive.

ABRÉGÉ

Ce document présente une étude empirique portant sur la relation entre l'activité physique et la détresse généralisée dans le cadre d'un processus de traitement du stress au moyen d'une analyse de l'influence des douleurs et fatigues chroniques, de l'estime de soi, de la maîtrise de la situation et du soutien social sur cette relation. L'analyse a été effectuée dans le cadre de l'Enquête nationale sur la santé de la population de 1994 à l'aide d'un échantillon de 12 636 Canadiens de 20 à 64 ans. Les résultats semblent indiquer que l'activité physique est un paramètre de prévision de la détresse généralisée quel que soit les douleurs et les fatigues chroniques, l'estime de soi et le soutien social. Cependant, la maîtrise de la situation avait un effet modérateur sur le lien entre l'activité physique et la détresse. De plus, le fait que la maîtrise de soi ait un effet modérateur sur cette relation semble indiquer qu'il s'agit d'une ressource plus importante pour les gens qui sont inactifs.

The Relationship between Physical Exercise and Distress in a National Sample of Canadians

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An increasing area of interest in the area of public health in recent years is the relationship between physical exercise and mental health.¹⁻⁶ While the physiological benefits of exercise have long been understood, the psychological benefits are much less studied.^{2,3} Two detailed literature reviews on the connection between physical exercise and psychological health have identified several studies that have found that clinical populations appear to derive a psychological benefit from exercise.^{1,2} These reviews note, however, that the methodology remains suspect on several counts. Specifically, there is no clearly accepted definition of what falls under the label of mental health;^{1,5,7-9} some studies focus on a specific type of exercise and a specific outcome while exercise generally may produce positive long-term mental health benefits;¹⁰ and the overwhelming use of clinical samples or randomized control trials (RCT)^{3,7,11,12} hampers the generalizability of findings.

Previous population-based studies have addressed these criticisms. For example, Stephens⁵ provides evidence as to the robust relationship between physical activity measured by caloric output and a broad array of mental health measures such as general well-being, depression, anxiety, and positive and negative affect while controlling for age and gender as potential confounding variables. A longitudinal

analysis of the Alameda County Study examined a broad array of potential confounders including socio-demographic characteristics, socio-economic status, physical health, health habits and social support and found a significant effect of previous physical activity as well as changes in activity level on subsequent depression.⁴ Another longitudinal study also found a positive benefit of moderate or high physical activity as measured by caloric output on subsequent depression compared to those engaging in irregular physical activity regardless of energy expenditure while controlling for socio-demographic factors and activity limitations.⁶

These analyses go some distance to address the above methodological criticisms. However, a more central deficit in the literature identified in the review articles by Biddle¹ and Scully et al.² is the absence of any underlying conceptual or theoretical understanding of the complex processes involved between physical exercise and mental health. This deficit in the literature persists. While these population studies vary considerably in their inclusion of potential confounding variables, without some sort of underlying conceptual or theoretical understanding to explain how mental health could be linked with elevated caloric expenditure, research continues to be disjointed and piecemeal.^{2,13,14}

One theoretical framework that has seen much popularity in the social scientific literature on depression and mental health, the stress process paradigm,¹⁵⁻²² may provide a potential underlying conceptual grounding. This paradigm focusses on the relationship between social stress such as acute life events and chronic strains and subsequent mental health outcomes.^{17,23-26} In addition, personal resources, such as

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self-esteem, mastery and social support, have been identified as important mechanisms that intervene in this process as mediating and/or moderating factors.^{16,17,19,22,27-30} This may be an appropriate model to examine the relationship between physical activity and mental health as other studies have identified various factors included in this model such as self-esteem, social support and the reactivity to psychosocial stressors as confounders in this relationship.^{1,2,4,8,13} By situating this analysis within the stress process framework, we attempt to examine the complex relationship between physical exercise and mental health and how this relationship may be affected by factors identified in the stress process.

METHODS

For this analysis, we employ the 1994 wave of the National Population Health Survey by Statistics Canada.³¹ Using a stratified, multi-stage design, this first wave of the NPHS consisted of 19,600 households, with a minimum representation of 1,200 households from all 10 provinces.³¹ People on Indian Reserves, Canadian Forces Bases, or in institutions and some remote areas of Quebec and Ontario were excluded. Of the 18,342 possible respondents aged 12 and older, 17,626 participated resulting in a response rate of 96.1%. Included in this analysis were individuals aged 20 to 65 (N = 12,636). All analyses were computed using the standardized weighting scheme suggested by Statistics Canada.³¹

Measures

The dependent variable, generalized distress, was measured using a subset of six items of a larger scale of 45 items developed at the University of Michigan.^{31,32} The six items tapped dimensions of feeling hopeless, worthless, sad, and nervous. Higher scores indicate greater distress ($\alpha = 0.79$).

Physical activity was measured using energy expenditure values based on caloric output. Caloric output was categorized into three groups to indicate active, moderately active and inactive based on cut-points used previously in the Ontario

Physical Exercise	N	Mean	SD	Scheffe Test†	
				Inactive	Moderately Active
Inactive	7,199	3.62	3.62	—	—
Moderately active	2,754	3.25	3.27	**	—
Highly active	2,120	3.21	3.26	**	ns

† Tests of significance using Scheffe's test of multiple group comparisons.
* $p < 0.01$; ** $p < 0.001$

Health Study and the Campbell's Survey of Well-Being.^{33,34} This scale was recoded into 2 dichotomous variables to compare active and moderately active individuals to inactive people (comparison group). All analyses were replicated using the continuous measure of caloric output and the overall results remained unchanged (results available upon request to authors).

General chronic strain is a sum count of 16 questions in which the respondent was asked whether certain situations were perceived as stressful or not. These items are a subset of a larger scale developed by Wheaton.³⁵ The index is adjusted and standardized to account for the number of situations applicable to each respondent. For example, those who are married and/or have children answered more questions than others.

Self-esteem is a subset of 6 items from Rosenberg's 10-item scale providing a self-evaluation of one's perceived sense of self.^{36,37} The items are constructed using a 5-point Likert scale to indicate how strongly one agrees or disagrees with the items measuring one's personal self-worth ($\alpha = 0.85$).

Mastery refers to the extent to which individuals view themselves to be in control of their own lives. This construct is measured using Pearlin and Schooler's 7-item scale.³⁸ Respondents were asked how strongly they agreed or disagreed with each item on a 5-point scale ($\alpha = 0.76$).

Social support is the sum of 4 questions developed for the NPHS that measure dimensions of perceived social support.³¹ Respondents were prompted to answer yes or no to four questions asking whether they had someone who they could confide in, count on, gives them advice, and makes them feel loved.

The control variables include age, sex, marital status, level of education, income adequacy, number of children in household, main activity in the labour force, obesity and smoking status. Age was collapsed into five-year intervals over the life span from 20-24 to 60-64. Sex was coded as a dichotomous variable with female as the reference category. Marital status consisted of two variables comparing single and other (separated/divorced/widowed) to those married. Level of education was recoded into 6 discrete categories from no schooling to master/doctorate. Income adequacy consisted of five levels indicating increasing income and was calculated by adjusting data on total household income by household size. The criterion for each category was based on Statistics Canada low-income cut-offs.^{39,40} Number of children in the household was measured by two variables to indicate the presence of children under six years of age and children 6-11 years old. Main activity in the labour force was recoded into a series of dichotomous variables where the comparison group was individuals working full-time for pay/profit or going to school full-time. Alternate groups included individuals caring for family, caring for family and working part-time, recovering from illness/disability, looking for work, retired and other. Obesity was coded into two dichotomous variables based on the body mass index (BMI) to indicate obese (≥ 27 kg/m²) and overweight (≥ 25 kg/m² and < 27 kg/m²) from normal weight (< 25 kg/m²).⁴¹⁻⁴³ Because the BMI is subject to bias within certain populations, pregnant women and those younger than 20 or older than 65 were excluded from analysis. Smoking was coded as a dichotomous variable comparing smokers (1) to non-smokers and previous smokers (0).

TABLE II
Generalized Distress Regressed on Physical Exercise, Chronic Stress, Self-Esteem, Mastery, Social Support, Sociodemographic Indicators and Obesity (N = 11,268)[†]

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Active‡	-0.051**	-0.048**	-0.045**	-0.041**	-0.012	-0.044**	-0.020*
Moderately Active‡	-0.052**	-0.042**	-0.026**	-0.038**	-0.022*	-0.033**	-0.014
Age		-0.142**	-0.081**	-0.127**	-0.160**	-0.164**	-0.112**
Sex¶		-0.091**	-0.064**	-0.086**	-0.078**	-0.106**	-0.067**
Single§		0.026	0.045**	0.012	0.021	0.009	0.023
Sep/Div/Wid§		0.063**	0.049**	0.062**	0.054**	0.048**	0.041**
Education		-0.018	-0.002	-0.012	0.025*	-0.006	0.038**
Income Adequacy		-0.081**	-0.042**	-0.071**	-0.025**	-0.067**	-0.008
Smoke††		0.096**	0.047**	0.093**	0.086**	0.091**	0.052**
Household<6		0.028*	0.022	0.022	0.018	0.036**	0.019
Household 6-11		0.019	0.023*	0.012	0.011	0.027*	0.018
Care‡‡		0.032*	0.028*	0.017	0.010	0.031*	0.010
Part-time‡‡		-0.039**	-0.048**	-0.053**	-0.053**	-0.037**	-0.060**
Illness‡‡		0.161**	0.137**	0.126**	0.104**	0.158**	0.093**
Looking for work‡‡		0.042**	0.027**	0.037**	0.016	0.031**	0.008
Retired‡‡		0.003	0.022	-0.001	0.006	0.005	0.017
Other‡‡		0.026*	0.022*	0.019	0.018	0.022	0.013
Over weight¶¶¶		0.011	-0.006	0.005	0.005	0.011	-0.007
Obese¶¶¶		0.008	0.004	0.013	0.004	0.004	0.002
Chronic Stress			0.396**				0.285**
Self-esteem				-0.277**			-0.115**
Mastery					-0.410**		-0.250**
Social Support						-0.190**	-0.082**
R ²	0.004	0.100	0.244	0.173	0.252	0.134	0.341

† All effects are standardized OLS regression coefficients.

‡ Categorical variables with inactive as the reference group.

¶ Categorical variable coded as male=1 and female=0.

§ Categorical variables with married as reference group.

†† Categorical variable coded as smoker=1 and non smoker or previous smoker=0.

‡‡ Categorical variables with working full-time or going to school full-time as the reference group.

¶¶¶ Categorical variables with normal weight as the reference group.

* p < 0.01; ** p < 0.001

RESULTS

Table I presents the bivariate relationship between physical exercise and generalized distress. A Scheffe test of multiple group comparisons indicated that people who were inactive reported significantly higher levels of distress compared to people who were moderately or highly active. The difference between those moderately active and highly active was nonsignificant.

Table II presents the results of the hierarchical OLS regression analysis. Model 1 regressed generalized distress on activity. Respondents coded high in activity as well as those coded as having moderate activity had significantly lower levels of generalized distress. In Model 2, after controlling for sociodemographic factors and obesity, the significant effect of physical activity persists. In subsequent models, we assessed how other factors previously identified within stress process research influence the relationship between physical activity and distress. In Model 3, general chronic strain had a large effect on distress. However, the significance of physical activity on general-

ized distress remained indicating it was independent of chronic strain. Self-esteem (Model 4) appears to be a protective factor for distress but the effect of physical exercise persisted independently. In Model 5, the effect of mastery on distress was significant. Moreover, mastery had a substantial mediating effect on the relationship between physical exercise and distress, especially among the highly active. The effect of social support (Model 6) on distress was significant but largely independent of physical exercise. In Model 7, we included all stress process factors together in the full model. Chronic strain continued to have the greatest effect on mental health followed closely by mastery. The association between physical activity and generalized distress was reduced by over 50% for both the active and moderately active. An inspection of previous models indicates that this reduction is attributable principally to mastery.

The final analysis tested for interactions between physical exercise and chronic stress, self-esteem, mastery and social support to assess whether these factors moder-

ated the relationship between physical activity and distress. The only significant interaction was between mastery and physical activity. Figure 1 illustrates that mastery was a more important resource among those who reported being inactive. Among people with lower levels of mastery, those inactive reported significantly higher levels of distress than those active or moderately active. Among people with higher levels of mastery, physical exercise had no differential effect on generalized distress.

DISCUSSION

The results indicate that physical activity is a significant predictor of mental health in addition to the well-established effects of chronic strain, self-esteem, mastery and social support. Those moderately active and highly active report significantly lower levels of generalized distress compared to inactive individuals while the difference between the moderate and high activity groups is nonsignificant.

This analysis attempted to ground the examination of this relationship within an

underlying theoretical framework – the stress process. The stress process predicts that psychosocial resources will provide some protection for people with higher levels of stress. In this analysis, it appears that the protective mechanism of mastery is also important for the relationship between physical exercise and generalized distress. While physical activity appears to be independent of stress, self-esteem and social support, mastery both mediates and moderates its relationship with distress. This suggests that physical activity may increase one's perceived sense of control which serves as a protective resource against psychological distress.^{19,38} Moreover, inactive people with lower levels of mastery are at the greatest risk for distress. As such, mastery is more important as a protective mechanism for people who are not physically active.

One caveat to these findings is that it presupposes the relationship between these factors is in the specified direction. The reverse argument, that high distress inhibits physical activity is also plausible and the cross-sectional nature of these data do not permit an examination of the causal ordering. A recent examination of the longitudinal NPHS data⁶ does find prior physical activity to be associated with subsequent prevalence rates of depression. However, this study examined the relationship using a minimum of sociodemographic control variables and it did not examine whether changes in activity are related to changes in depression. A central limitation of replicating the current analysis using the longitudinal NPHS to assess change over time is the exclusion of social stress and psychosocial resource variables in the second wave of data collection. Nevertheless, a preliminary examination of these longitudinal data by the authors do indicate that changes in physical activity between 1994 and 1996 are significantly associated with changes in generalized distress (results available upon request to authors). A second limitation of this study is a general limitation of population surveys to control for several factors that may bias the conversion of the metabolic cost of activities. While this detail is beyond population surveys, these studies complement clinical and RCT studies that have the capacity to control these factors, contributing to a multifaceted under-

standing of the complex relationships between health and the social environment allowing policy makers to develop informed policy and funding decisions that will improve the overall health of Canadians.

The positive findings here follow results reported by Biddle¹ and Scully et al.² suggesting that the benefits of physical exercise for improved mental health extend far beyond the clinical subpopulation to the majority of adults in Canada. Moreover, following Scully et al.² and others,^{3,14} it attempts to address recent criticisms about the conceptual grounding of research in this area by situating this research within a guiding theoretical paradigm in an effort to gain a clearer understanding of the complexities of the relationship between physical activity and mental health.

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REFERENCES

1. Biddle S. Exercise and psychosocial health. *Res Q Exerc Sport* 1995;66(4):292-97.
2. Scully D, Kremer J, Meade MM, et al. Physical exercise and psychological well being: A critical review. *Br J Sports Med* 1998;32(2):111-20.
3. Glenister D. Exercise and mental health: A review. *Nutrition Reviews* 1996;54(4-2):S53-S65.
4. Camacho TC, Roberts RE, Lazarus NB, et al. Physical activity and depression: Evidence from the Alameda County Study. *Am J Epidemiol* 1991;134(2):220-31.
5. Stephens T. Physical activity and mental health in the United States and Canada: Evidence from four population surveys. *Prev Med* 1988;17:35-47.
6. Chen J, Millar WJ. Health effects of physical activity. *Health Reports* 1999;11(1):21-29.
7. King AC, Taylor CB, Haskell WL. Effects of differing intensities and formats of 12 months of exercise training on psychological outcomes in older adults. *Health Psychol* 1993;12(4):292-300.
8. Anthony J. Psychological aspects of exercise. *Clinics in Sports Medicine* 1991;10(1):171-80.
9. Steptoe A, Butler N. Sports participation and emotional wellbeing in adolescents. *Lancet* 1996;347:1789-92.

10. Alberta Fitness Leadership Certification Association. Leadership Manual, January 1985.
11. Bravo G, Gauthier P, Roy PM, et al. Impact of a 12-month exercise program on the physical and psychological health of osteopenic women. *J Am Geriatr Soc* 1996;44(7):756-62.
12. Adams L. How exercise can help people with mental health problems. *Nursing Times* 1995;91(36):37-39.
13. Crews DJ, Landers DM. A meta-analysis review of aerobic fitness and reactivity to psychosocial stressors. *Med Sci Sports Exerc* 1987;19(5):S114-S120.
14. Weyerer S, Kupfer B. Physical exercise and psychological health. *Sports Med* 1994;17(2):108-16.
15. Frankel BG, Speechley M, Wade TJ. *The Sociology of Health and Health Care: A Canadian Perspective*. Toronto: Copp Clark, 1996.
16. Avison WR, Gotlib IH (Eds.). *Stress and Mental Health: Contemporary Issues and Prospects for the Future*. New York: Plenum Press, 1994.
17. Pearlin LI. The sociological study of stress. *J Health Soc Behav* 1989;30:241-56.
18. Ensel WM, Lin N. The life stress paradigm and psychological distress. *J Health Soc Behav* 1991;32:321-41.
19. Pearlin LI, Menaghan EG, Lieberman MA, et al. The stress process. *J Health Soc Behav* 1981;30:241-56.
20. Lazarus RS. The stress and coping paradigm. In: Eisdorfer C, Cohen D, Lieberman A, Maxim P (Eds.), *Models for Clinical Psychopathology*. New York: McGraw Hill, 1981.
21. Lazarus RS, Kanner A, Folkman S. Emotions: A cognitive-phenomenological analysis. In: Plutchik R, Kellerman H (Eds.), *Theories of Emotion*. New York: Academic Press, 1980.
22. Folkman S. Personal control and stress and coping processes: A theoretical analysis. *J Pers Soc Psychol* 1984;46:839-52.
23. Turner RJ, Wheaton B, Lloyd DA. The epidemiology of social stress. *American Sociological Review* 1995;60(Feb.):104-25.
24. Wheaton B. Sampling the stress universe. In: Avison WR, Gotlib IH (Eds.), *Stress and Mental Health: Contemporary Issues and Prospects for the Future*. New York: Plenum Press, 1994.
25. Dohrenwend BS, Dohrenwend BP (Eds.), *Stressful Life Events: Their Nature and Effects*. New York: Wiley, 1974.
26. Brown GW, Harris TO (Eds.), *Life Events and Illness*. New York: Guilford Press, 1989.
27. Turner RJ, Marino F. Social support and social structure: A descriptive epidemiology. *J Health Soc Behav* 1994;35:193-212.
28. Cobb S. Social support as a moderator of life stress. *Psychosomatic Medicine* 1976;38:300-14.
29. Holahan CJ, Moos RH. Social support and psychological distress: A longitudinal analysis. *J Abnorm Psychol* 1981;90:365-70.
30. Wheaton B. Stress, personal coping resources, and psychiatric symptoms: An investigation of interactive models. *J Health Soc Behav* 1993;24:208-29.
31. Statistics Canada. National Population Health Survey. Public Use Microdata File User Documentation; 1996.
32. Wade TJ, Cairney J. Age and depression in a nationally representative sample of Canadians: A preliminary look at the National Population Health Survey. *Can J Public Health* 1997;88(5):297-302.
33. Stephens T, Craig CL. The well-being of Canadians: Highlights of the 1988 Campbell's Survey. Ottawa: Canadian Fitness and Lifestyle Research Institute, 1990.
34. Ontario Health Survey 1990, User's Guide, vol 1, Documentation. Toronto: Ontario Ministry of Health, 1992.
35. Wheaton B. Chronic stress: Models and measurement. Paper presented at meeting of the Society for the Study of Social Problems, Cincinnati, Ohio, 1991.
36. Rosenberg M. *Society and the Adolescent Self-Image*. Princeton, NJ: Princeton University Press, 1965.
37. Rosenberg M. *Conceiving of Self*. New York: Basic Books, 1979.
38. Pearlin LI, Schooler C. The structure of coping. *J Health Soc Behav* 1978;19:2-21.
39. Statistics Canada. Income Distributions by Size in Canada. Ottawa: Statistics Canada, 1980; Supply and Services Canada.
40. Statistics Canada. Rebasing Low Cut-Offs to 1978. Technical Reference Paper (Cat No. 8-3302-519). Ottawa: Minister of Supply and Services, Canada; 1983.
41. Østbye T, Pomerleau J, Speechley M, et al. Correlates of body mass index in the 1990 Ontario Health Survey. *CMAJ* 1995;152:1811-17.
42. MacDonald SM, Reeder BA, Chen Y, et al. Obesity in Canada: A descriptive analysis. *CMAJ* 1997;157(suppl):S3-S9.
43. Cairney J, Wade TJ. Correlates of body weight in the 1994 National Population Health Survey. *Int J Obesity* 1998;22:584-91.

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