Direct and Buffering Effects of Physical Activity on Stress-Related Depression in Mothers of Infants

Melinda Jane Craike,1 Denis Coleman,2 and Clare MacMahon2
1Deakin University; 2Victoria University

This study examined the role of leisure-time physical activity in reducing the impact of high life stress and time pressure on depression, a buffer effect, for mothers of infants. A direct association between leisure-time physical activity and depression, regardless of both sources of stress, was also tested. A sample of approximately 5,000 mothers of infant children completed questionnaires that measured demographic characteristics, frequency of participation in leisure-time physical activity, life stress, time pressure, and depression (depressive symptoms). Hierarchical multiple regression incorporating an interaction component to represent the buffering effect was used to analyze the data. Frequency of leisure-time physical activity was significantly associated with lower levels of depressive symptoms for both types of stress and acted as a buffer of the association between life stress and depressive symptoms, but did not buffer the influence of time pressure on depressive symptoms. These findings indicated that leisure-time physical activity assists in maintaining the mental health of mothers of infants; however, caution is needed when promoting physical activity for mothers who feel under time pressure.

Keywords: exercise, women, depression, life stress, time pressure, physical activity

Becoming a parent is a key transition during adulthood, and motherhood is a significant life event that requires considerable adjustment. Life transitions can be described as processes involving successive stages characterized by changes in particular demands, challenges, and opportunities. The transition into motherhood includes several phases that occur during a relatively short time and vary according to circumstances such as the strength of the ethic of parental care (Currie, 2004). Change in daily routine and activity as a result of infant needs is often accompanied by stress.

In addition to the difficulties associated with life transitions, mothers of infants are likely to experience time pressures, which are a source of stress (Currie, 2004). Women have less free time than men at all stages in the life course and mothers of dependent children have the least amount of free time (Australian Bureau of...
Statistics, 2008). Women are almost twice as likely as men to be chronically time pressured, and the presence of young children in the family further increases the risk of chronic time pressure (Gunthorpe & Lyons, 2004).

Stress experienced by mothers of infants through life transitions and time pressures sometimes leads to depression (Coyl, Roggman, & Newland, 2002; Perren, von Wyl, Burgin, Simoni, & von Klitzing, 2005). O’Hara and Swain’s (1996) meta-analysis showed that stressful life events are a strong predictor of postpartum depression and estimated that 25–50% of new mothers experience short-term depressed mood and 10–15% postpartum depression.

Participation in leisure-time physical activity (LTPA) may reduce levels of depression in mothers of infants. The influence of LTPA can be direct, by reducing depression regardless of life stress (Biddle, Fox, & Boucher, 2000; Camacho, Roberts, Lazarus, Kaplan, & Cohen, 1991; Motl et al., 2005). Leisure-time physical activity may also act as a coping strategy, by buffering mental health against the damaging impacts of stress (Coleman & Iso-Ahola, 1993; Zuzanek, Robinson, & Iwasaki, 1998).

**Relationships Among Stress, Depression, and LTPA**

Leisure-time physical activity has been shown to have a positive influence on mental health regardless of life stress (Biddle et al., 2000; Camacho et al., 1991; Stephens, 1988) and within the literature there is a growing acceptance of LTPA as a useful strategy for reducing depression among general populations. Lawlor and Hopker (2001) found that LTPA was effective in reducing the symptoms of depression and a recent meta-analysis showed that a single session of LTPA is associated with reductions in anxiety and depression in healthy and symptomatic populations (Guszkowska, 2004). More specifically, research has shown that participation in LTPA is a useful strategy in reducing depression for women (Teychenne, Ball, & Salmon, 2008). These direct LTPA benefits are consistent across clinic-based and community-wide LTPA interventions (Craft, Freund, Culpepper, & Perna, 2007; Jorna, Ball, & Salmon, 2006). Generally the benefits are considered stronger for LTPA compared with other forms of physical activity such as occupational physical activity (Mutrie & Hannah, 2007; Stephens, 1988).

Limited research has examined the influence of LTPA on postpartum depression. Although some studies have suggested that LTPA reduces postpartum depression (Armstrong & Edwards, 2004), other research has found that LTPA has no influence on postpartum depression (Daley, Winter, Grimmett, McGuinness, McManus, & MacArthur, 2008). Observational evidence, however, has suggested that community-wide LTPA programs are suitable to postpartum women and these women consistently report benefits of participation in such programs (Daley, MacArthur, & Winter, 2007).

Leisure-time physical activity may also contribute to positive mental health by buffering people’s mental health against the damaging impacts of chronic stressful life events or environments (Coleman, 1999; Coleman & ISO-Ahola, 1993; Zuzanek et al., 1998). That is, LTPA may act as a coping resource when people are stressed by traumatic events or conditions that require considerable personal adjustment. Unlike consideration of the direct influence of LTPA on mental health, the buffering conceptualization of LTPA’s influence takes into consideration the levels of stress
that the person is experiencing and thus provides a more elaborate understanding of the role of LTPA in mental health. A stress buffer is a factor that reduces the impact of stress on well-being primarily when people are under stress, and not when they are not stressed (Cohen & Wills, 1985). Thus, when the level of stress of an individual is low, the impact of the “buffering” factor will be negligible. However, when the level of personal stress is high, a successful buffering factor will block the impact of that high stress. In research terms, buffering moderates the impact of stress on depression and this is reflected in a statistical interaction between stress and LTPA on depression. Leisure-time physical activity might act as a stress buffer because it provides an escape from the stressors or it might induce a sense of competence or well-being with accompanying capacities to resist stressors.

The search for buffering contributions of various leisure activities and dispositions to mental health has tested the capacity of LTPA to buffer the impact of high (but not low) stress on depression in sectors of the general population. These studies have demonstrated only weak direct LTPA effects but failed to show significant buffering effects for LTPA. For example, Coleman (1999) showed that both the presence (versus absence) and high (versus low) levels of LTPA in teachers’ leisure repertoires decreased their levels of depression slightly. As well, Iwasaki and Zuzanek (2001) reported a weak direct reduction of mental distress and depression associated with LTPA involvement. It is notable that, although Iwasaki and Zuzanek did not fully test for a buffering effect, they did demonstrate that the direct effect was present for those who were more highly stressed. A large sample study (Zuzanek et al., 1998) also concluded there was little to no support for the idea that LTPA moderates the relationship between stress and health.

Some evidence shows that mothers believe that LTPA helps to reduce stress (e.g., Currie, 2004; Rich, Currie, & McMahon, 2004). Other researchers have found that increased participation in moderate-intensity LTPA was significantly associated with reductions in the perception of maternal stressors (Urizar et al., 2005). Leisure-time physical activity’s positive impact in helping mothers cope with stress may be a result of greater feelings of well-being; these women experience a space of their own, time out from busy schedules and the burden of childcare, and the feeling of doing something to improve their physical appearance (Currie, 2004).

Due to the prevalence of stress and depression during postpartum and their health and social implications, it is important to understand strategies that have the potential to assist in decreasing the impact of stress on mental health. This research tested the role of LTPA in reducing mothers’ depression through an examination of the direct influence of LTPA on depression and the buffering effects of LTPA against the influences of both life stress and time pressure on depression.

This research sought to address four questions:

1. Is participation in LTPA associated with reduced depression (depressive symptoms) regardless of the perceived stress of mothers of infants?
2. Does participation in LTPA buffer (moderate) the effects of perceived stress on depression (depressive symptoms) in mothers of infants?
3. Is participation in LTPA associated with reduced depression (depressive symptoms) regardless of the mothers’ feeling time pressured?
4. Does participation in LTPA buffer (moderate) the effects of feeling time pressured on depression (depressive symptoms) in mothers of infants?
Method

Participants and Procedure

The data set for this study was obtained from the mothers of the infant cohort of the Longitudinal Study of Australian Children (LSAC). The LSAC was initiated and funded by the Australian Government Department of Families, Housing, Community Services, and Indigenous Affairs. That study had a broad, multidisciplinary base, involving a nationally representative sample of children, and examined issues of government policy relevance. The LSAC informants included the child (when of an appropriate age) and their parents, carers, and teachers (Australian Institute of Family Studies, AIFS, 2006).

To address the research questions, data from the mothers of infants’ cohort of the Wave 1 LSAC (AIFS, 2006) were analyzed. This cohort targeted mothers of infants aged 3–19 months at the time of interview. Thus, mothers were in the post-partum period, defined as the time span of transition from when a woman gives birth to up to 1–3 years after childbirth (Matteson, 2001). This period is also the most labor-intensive phase of parenthood (Walker & Wilging, 2000). The LSAC data set provided 5,107 cases for potential analysis. Section (d) Health and Lifestyle of the LSAC questionnaire, which gathered information on factors of interest to the analysis, was completed by 4720 participants. The process used to select a representative Australian sample for LSAC is detailed elsewhere (AIFS, 2006). Briefly, the child was the sampling unit for the LSAC. A sample of children was selected at random from the Medicare database, which is the most comprehensive database of Australia’s population. A two-stage clustered sampling design was employed, first identifying a sample of postcodes and then selecting children from the selected postcodes. Stratification was used to ensure proportional geographic representation for states/territories and capital city statistical division/rest of state areas (AIFS, 2006).

Families of the selected infants received “letters of invitation” to take part in the study and could “opt out” of the study by phoning a free-call number or returning a reply paid form. The free-call staff members were given training about the study and were able to answer queries and make note of other relevant information (e.g., telephone numbers). After a 4-week opt-out period, the contact details of families were given to the data collection agency, who sent another letter to families advising when an interviewer would be in their area. The final response to the recruitment in the LSAC infant cohort was 57% of those families sent a letter of invitation.

A comparison of the sample group and the Australian Bureau of Statistics 2001 Census of Population and Housing showed that, for almost all characteristics, the sample distribution was only marginally different from the Census distribution. The most significant difference between the sample and the Census infants was in the educational status of the parents, such that infants with mothers who had completed Year 12 were overrepresented in the sample, with proportions 10% higher for the sample than for the Census (AIFS, 2006). Questionnaires were self-completed by families and either returned via a reply paid envelope or collected by a researcher.

Measures

Data for this analysis were taken from responses to the Parent 1 Self-Complete Questionnaire (P1SC), which contains five sections (AIFS, 2006). Section (d),
called *Health and Lifestyle*, of that questionnaire included the items used in this analysis: participation in LTPA, perceived life stress, time pressure, and depression (depressive symptoms).

**Participation in LTPA.** Leisure-time physical activity was assessed using the item, “About how many times (days) each week do you do at least 30 min of moderate or vigorous physical activity (like walking briskly, riding a bike, gardening, tennis, swimming, running etc)?” This was scored from *no days* = 0 to *7 days* = 7. It should be noted that although the item seeks only the number of days that included LTPA it does require that the duration is greater than 30 min and the level of participation is at least moderate.

**Perceived Life Stress.** Life stress was measured using the item, “How difficult do you feel your life is at present?” Responses were gathered on a 5-point Likert-type scale, ranging from *no problems or stressors* = 1 to *very many problems and stressors* = 5.

**Time Pressure.** Time pressure was measured using the item, “How often do you feel rushed or pressed for time?” Responses were recorded on a 5-point scale, ranging from *never* = 1 to *always* = 5. As expected, time pressure was positively correlated (*r* = .335, *p* = .000, *n* = 4025) with perceived life stress.

**Depression.** As an indicator of depression, depressive symptoms were measured using the six items of the K6 Scale (Kessler et al., 2002) that ask participants how often they experienced a range of feelings over the previous 4 weeks. Questions included, for example, “Did you feel nervous?” and “Did you feel hopeless?”. Responses to items were recorded using a 5-point Likert-type scale from *none of the time* = 1 to *all of the time* = 5. Numerical equivalents of the responses to the six items were averaged to obtain a depressive symptoms score. Thus, the depressive symptoms scores could range from 1 to 5, with higher scores indicating higher levels of depression.

The K6 is brief, is easy to administer and score, and has shown excellent validity, sensitivity, and specificity in studies of samples from the general population (Andrews & Slade, 2001; Kessler et al., 2003). Validation studies of the K6 have shown that the scale’s validity (receiver operating characteristic – area under the curve [ROC – AUC]) of about .86 and internal consistency (.89) were high, compared with longer diagnostic screening and assessment instruments in general population samples (Andrews & Slade, 2001; Furukawa, Kessler, Slade, & Andrews, 2003; Kessler et al., 2003). In the current study, the scale showed acceptable internal consistency (Cronbach alpha = .830).

**Sociodemographics.** The mothers’ sociodemographic data that were used in the analysis were age; highest level of schooling, which ranged from “still at school” to “year 12 or equivalent”; post-school qualification, which ranged from “none” to “yes, other qualification”; marital status, which was categorized as either “married” or “not married” (including divorced, separated, widowed, never married); and country of birth, which was categorized as either “Australia” or “other.”

**Data Analysis**

The data were analyzed using SPSS’s (version 16) hierarchical multiple regression. Data screening was undertaken before the regression analyses using procedures
outlined by Tabachnick and Fidell (2001). Some missing values remained in the data set (<6%). All analyses were conducted on the cases with complete data for the particular analysis.

Before the testing of the main regression models, relationships between sociodemographic variables and the dependent variable (depressive symptoms) were assessed using t test, chi-square, correlation coefficients, and ANOVA, as appropriate. The influence of those sociodemographic factors that accounted for significant variation in depressive symptoms were partialled out of the dependent variable in an initial step in the regression analyses.

Two hierarchical multiple regression analyses—each incorporating an interaction component (cross-products of the selected stress and LTPA predictors for each subject) to represent the buffering effect—were used in the main analyses of the data. Thus, the moderating (as well as main) effects on depressive symptoms of participation in LTPA were tested.

To reduce problems of multicollinearity in the multiple regression analyses, scores of the independent variables were centered before creating the interaction components. Centering of scores requires conversion of the scores to deviation scores so that each score has a mean of zero (Tabachnick & Fidell, 2001). The interaction components used in the analysis were the cross-products of (1) life stress and participation in LTPA and (2) time pressure and participation in LTPA.

Results

Sociodemographic Characteristics of the Sample

The age of mothers ranged from 20 to 52 years, with an average age of 34.6 years (SD = 5.23, n = 4702). Data included responses of 28 mothers (0.60% of the sample) who were not the child’s biological parent (e.g., adopted, foster carers). Just over half of the mothers had completed Year 12 schooling or equivalent (58.4%) and over half (54.4%) of mothers had a post-school qualification. Over three-quarters of these mothers were married (76.6%) and over three-quarters of the participants were born in Australia (77.3%).

Across the whole sample, the average number of days of participation in LTPA was 2.7 days per week (SD = 1.89). That is, respondents were physically active for at least 30 min for, on average, two and a half days per week. The average life stress score was 2.45 (SD = 0.80), indicating a moderate level of perceived life stress. The average score for time pressure was 3.45 (SD = 0.88), indicating respondents tended to feel fairly rushed. The level of depressive symptoms was quite low for this group, with an average of 1.65 (SD = 0.58; see Table 1).

Table 1 Means and Standard Deviations of Study Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
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<tr>
<td>Frequency of participation in physical activity</td>
<td>4020</td>
<td>2.66</td>
<td>1.89</td>
<td>0–7</td>
</tr>
<tr>
<td>Perception of stress</td>
<td>4031</td>
<td>2.48</td>
<td>.80</td>
<td>1–5</td>
</tr>
<tr>
<td>Time pressure</td>
<td>4027</td>
<td>3.49</td>
<td>.88</td>
<td>1–5</td>
</tr>
<tr>
<td>Depressive symptoms: K-6 Depression Scale (average item)</td>
<td>4032</td>
<td>1.66</td>
<td>.58</td>
<td>1–5</td>
</tr>
</tbody>
</table>

Note. High scores indicate high levels of the variable. n = 4020–4032.
Frequency of Participation in LTPA as a Buffer of Perception of Life Stress on Depressive Symptoms

Although their effect sizes on depressive symptoms were very small, age, $r(4060) = -.06, p < .01$, and highest level of schooling completed, $r(4030) = .08, p < .01$, were retained for consideration in the main regression models. Highest post-school qualification, when considered alone, accounted for 19.36% of depressive symptom variance, $r(4029) = -.44, p < .01$, and was entered as a socioeconomic variable in the main equations. Both marital status, $F(4, 4034) = 19.08, p < .01$, and country of birth, $r(3992) = -.56, p < .01$, were significantly related to depressive symptoms and thus included in the main regression models. Tukey’s post hoc testing showed that significant marital status differences were between the married and other groups, including divorced ($p < .01$), separated ($p < .01$), and never married ($p < .01$) groups, all with nonmarried experiencing greater stress. These groups were subsequently collapsed into two groups, married and not married, in all regression models.

Perception of stress was moderately related to depressive symptoms, $r(4000) = .51, p < .01$, such that higher levels of perceived stress were associated with higher levels of depressive symptoms. Time pressure was also significantly, but less strongly, related to depressive symptoms, $r(4025) = .25, p < .01$, such that those who felt more rushed were also more likely to have higher levels of depression.

The bivariate intercorrelations between age, highest level of schooling, highest level of post-school qualification, frequency of participation in LTPA, life stress and time pressure with depressive symptoms can be seen in Table 2.

The regression analysis showed that the full prediction model explained a significant 29.0% of the depressive symptoms variance, $R = .54, R^2 = .29, F(7, 3840) = 223.82, p < .01$. After controlling for demographic factors (Step 1), life stress explained a significant additional 25.4% of depressive symptoms variance, $R^2\text{ change} = .254, F\text{ change}(5, 3842) = 1364.75, p < .01$ (Step 2). The nature of this relationship confirmed that as stress levels increased so did levels of depressive symptoms ($\beta = .50$; see Table 3).

The main effect of participation in LTPA was tested before testing for the interaction that tested buffering. After controlling for the effects of demographic factors and life stress, entry of participation in LTPA (Step 3) explained a significant additional increment of 0.3% of depressive symptoms variance, $R^2\text{ change} = .003; F\text{ change}(6, 3841) = 17.80, p \text{ change} < .01$. The nature of this relationship ($\beta = -.06$) suggested a negative association between the mother’s frequency of participation in LTPA and her level of depressive symptoms.

Entry of the cross-product of participation in LTPA and life stress, which represented the interaction of the two predictors (Step 4), explained a significant additional 0.2% of depressive symptoms variance, $R^2\text{ change} = .002, F\text{ change}(7, 3840) = 12.52, p \text{ change} < .01$. The nature of the interaction effect was such that higher frequencies of participation in LTPA were associated with reduced depressive symptoms when life stress was high ($\beta = -05$). Therefore, LTPA had a very small but significant moderating effect on the stress/depressive symptoms relationship for mothers of infants. Estimation of means of depressive symptoms at high (one standard deviation above the mean) and low (one standard deviation below the mean) levels of stress and LTPA shows that although for people with higher levels of LTPA the levels of symptoms increased slightly as life stress increased, for people with lower levels of LTPA, depressive symptoms increased more strongly in association with increased life stress (see Figure 1).
Table 2  Intercorrelations of Study Variables

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Schooling</th>
<th>Post-school qualification</th>
<th>Participation in LTPA</th>
<th>Life stress</th>
<th>Time pressure</th>
</tr>
</thead>
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<tr>
<td>Highest level of schooling(a)</td>
<td>.08**</td>
<td>__</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-school qualification(b)</td>
<td>-.17**</td>
<td>.31**</td>
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<tr>
<td>Participation in LTPA</td>
<td>-.03**</td>
<td>-.03*</td>
<td>.00</td>
<td></td>
<td>-.05**</td>
<td>__</td>
</tr>
<tr>
<td>Life stress</td>
<td>-.01</td>
<td>.02</td>
<td>.01</td>
<td>-.05**</td>
<td>__</td>
<td>__</td>
</tr>
<tr>
<td>Time pressure</td>
<td>.06**</td>
<td>-.07**</td>
<td>-.08**</td>
<td>-.08**</td>
<td>.34**</td>
<td>__</td>
</tr>
<tr>
<td>Depressive symptoms</td>
<td>-.06**</td>
<td>-.08**</td>
<td>.04**</td>
<td>-.08*</td>
<td>.51**</td>
<td>.25**</td>
</tr>
</tbody>
</table>

\(a\)Highest level of schooling: 7 = year 12 or equivalent, 6 = year 11 or equivalent, 5 = year 10 or equivalent, 4 = year 9 or equivalent, 3 = year 8 or below, 2 = never attended school, 1 = still at school.

\(b\)Post-school qualification categories: 1 = no, 2 = no, still studying for first qualification, 3 = yes, trade certificate/apprenticeship, 4 = yes, other qualification.

\(p < .05, ** p < .01\).
Stress Buffering Effect of Physical Activity

The regression analysis (see Table 4) showed that the full prediction model explained a significant 12.6% of the depressive symptoms variance, $R^2 = .35$, $F(7, 3821) = 78.44$, $p < .01$. After controlling for demographic predictors (Step 1), time pressure (Step 2) explained a significant additional 9.0% of depressive symptoms variance, $R^2_{\text{change}} = .09$, $F_{\text{change}} (5, 3823) = 390.51$, $p < .01$. The nature of this relationship demonstrated that as time pressure increased, so did levels of depressive symptoms ($\beta = .30$).

The main effect of participation in LTPA was tested before testing of the interaction effect. After controlling for the effects of demographic predictors and time pressure, entry of participation in LTPA (Step 3) explained a significant additional increment of 0.6% of depressive symptom variance, $R^2_{\text{change}} = .006$, $F_{\text{change}} (6, 3822) = 25.15$, $p_{\text{change}} < .01$. The nature of this relationship ($\beta = -.08$) suggested a negative association between the participant’s frequency of participation in LTPA and their level of depressive symptoms. The main effect of participation in LTPA on depressive symptoms meant that, regardless of an individual’s perceptions of time pressures, on average, more frequent participation in LTPA was associated with lower levels of depression.

Table 3  Regression of Perception of Stress and Frequency of Participation in Leisure-Time Physical Activity (PA), Including the Interaction of these Predictor Variables, on Levels of Depressive Symptoms

<table>
<thead>
<tr>
<th>Variables entered</th>
<th>$\beta_{\text{final}}$</th>
<th>$R$</th>
<th>$R^2$</th>
<th>$F$</th>
<th>Sig.</th>
<th>$R^2_{\text{change}}$</th>
<th>$F_{\text{change}}$</th>
<th>Sig. $\text{change}$</th>
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<tr>
<td>Step 1</td>
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<td></td>
<td></td>
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<tr>
<td>Demographic variables</td>
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<td>.03</td>
<td>29.59</td>
<td>&lt;.01</td>
<td>.03</td>
<td>.03</td>
<td>29.59</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Age (in years)</td>
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<td></td>
<td>&lt;.01</td>
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<td></td>
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<td>Highest level of schooling$^a$</td>
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<td></td>
<td>&lt;.01</td>
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<tr>
<td>Country of birth$^b$</td>
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<td></td>
<td></td>
<td>&lt;.01</td>
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<tr>
<td>Marital status$^c$</td>
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<td></td>
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<td>Step 2</td>
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<td>Perception of stress</td>
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<td>.25</td>
<td>1364.75</td>
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<td>Step 3</td>
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<tr>
<td>Frequency of physical activity</td>
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<td>.29</td>
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<td>17.80</td>
<td>&lt;.01</td>
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<td>Frequency of PA and</td>
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</tbody>
</table>

$^a$Highest level of schooling completed: 7 = year 12 or equivalent, 6 = year 11 or equivalent, 5 = year 10 or equivalent, 4 = year 9 or equivalent, 3 = year 8 or below, 2 = never attended school, 1 = still at school.

$^b$Country of birth: Australia = 1, other = 0.

$^c$Marital status: 1 = married, 2 = not married (divorced, separated, widowed, never married).

Frequency of Participation in Physical Activity as a Buffer of Time Pressure on Depressive Symptoms

The regression analysis (see Table 4) showed that the full prediction model explained a significant 12.6% of the depressive symptoms variance, $R = .35$, $R^2 = .13$, $F(7, 3821) = 78.44$, $p < .01$. After controlling for demographic predictors, time pressure (Step 2) explained a significant additional 9.0% of depressive symptoms variance, $R^2_{\text{change}} = .09$, $F_{\text{change}} (5, 3823) = 390.51$, $p < .01$. The nature of this relationship demonstrated that as time pressure increased, so did levels of depressive symptoms ($\beta = .30$).

The main effect of participation in LTPA was tested before testing of the interaction effect. After controlling for the effects of demographic predictors and time pressure, entry of participation in LTPA (Step 3) explained a significant additional increment of 0.6% of depressive symptom variance, $R^2_{\text{change}} = .006$, $F_{\text{change}} (6, 3822) = 25.15$, $p_{\text{change}} < .01$. The nature of this relationship ($\beta = -.08$) suggested a negative association between the participant’s frequency of participation in LTPA and their level of depressive symptoms. The main effect of participation in LTPA on depressive symptoms meant that, regardless of an individual’s perceptions of time pressures, on average, more frequent participation in LTPA was associated with lower levels of depression.
Entry of the cross-product of participation in LTPA and time pressure (Step 4) did not explain any additional significant increase in depressive symptom variance, $R^2 \text{ change} = .00$, $F \text{ change} (7, 3821) = .66$, $p \text{ change} = .66$. This suggests that level of participation in LTPA is not a significant buffer of time pressure stress for women with infants. As participation in LTPA increases, the level of depressive symptoms decreases, regardless of the person’s level of time pressure.

**Discussion**

After controlling for demographic factors, participation in LTPA by mothers of infants was associated with reduced depressive symptoms regardless of life stress and feeling time pressured. This is consistent with other research that has shown LTPA is a useful strategy in reducing depression for women (Craft et al., 2007; Jorna et al., 2006; Teychenne et al., 2008) and adds to the limited research that supports LTPA as a strategy for reducing depression in mothers of infants (Armstrong & Edwards, 2004; Daley et al., 2007). These findings demonstrate that more frequent participation in LTPA was associated with lower levels of depression at all levels of both life stress and time pressure.

When life stress was considered, LTPA was also associated with a greater reduction in depressive symptoms when life stress was high. Participation in LTPA had
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a buffering effect on life stress. To our knowledge, this is the first study to examine the stress-buffering effect of LTPA for mothers of infants. These results provide support for the stress-buffering effects of LTPA, showing that the benefits of LTPA are greatest in times of highest life stress such as the arrival of a baby. However, the magnitude of the contribution of the buffering effect was quite small. Possibly this was due to the relatively high levels of LTPA (between 2–3 times a week on average) reported by the mothers. If few women had very low levels of LTPA the strength of the interaction is less likely to be evident. The buffering effect may also be underestimated in the regression process because it is entered last in the hierarchical sequencing and some of LTPA’s buffering effect would be partialled out when the main effect of LTPA was tested.

LTPA, however, did not buffer the effects of time pressure on depressive symptoms. Women with children tend to have less discretionary time than other population groups (ABS, 2008), and researchers have shown that the presence of children in the family increases the risk of time pressure (Gunthorpe & Lyons, 2004). Mothers are often left with little time to attend to their own health needs and have few opportunities for self-improvement (Hilbrecht, Shaw, Johnson, & Andrey, 2008; McMurray, 1999; Smith, 1995). The ethic of care felt by many mothers is one of the main barriers to gaining access to sufficient leisure activities including LTPA (Brown, Mishra, Lee, & Bauman, 2000; Miller & Brown, 2005; Tavares &

Table 4  Regression of Time Pressure and Frequency of Participation in Leisure-Time Physical Activity (PA), Including the Interaction of these Predictor Variables, on Levels of Depressive Symptoms

<table>
<thead>
<tr>
<th>Variable</th>
<th>β</th>
<th>R final</th>
<th>R²</th>
<th>F</th>
<th>Sig. change</th>
<th>F change</th>
<th>Sig. change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographic variables</td>
<td>.17</td>
<td>.03</td>
<td>39.39</td>
<td>&lt;.01</td>
<td>.03</td>
<td>39.39</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Age</td>
<td>−.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest level of schooling completed¹</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country of birth²</td>
<td>.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Marital status³</td>
<td>−.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Step 2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time pressure</td>
<td>.30</td>
<td>.35</td>
<td>.12</td>
<td>104.01</td>
<td>&lt;.01</td>
<td>.09</td>
<td>390.51 &lt;.01</td>
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<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of physical activity</td>
<td>−.08</td>
<td>.35</td>
<td>.13</td>
<td>91.41</td>
<td>&lt;.01</td>
<td>.01</td>
<td>25.15 &lt;.01</td>
</tr>
<tr>
<td>Step 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of PA and time pressure interaction</td>
<td>−.01</td>
<td>.35</td>
<td>.13</td>
<td>78.44</td>
<td>&lt;.01</td>
<td>.00</td>
<td>.66</td>
</tr>
<tr>
<td>(Constant)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.13</td>
</tr>
</tbody>
</table>

¹Highest level of schooling completed: 7 = year 12 or equivalent, 6 = year 11 or equivalent, 5 = year 10 or equivalent, 4 = year 9 or equivalent, 3 = year 8 or below, 2 = never attended school, 1 = still at school.
²Country of birth: Australia = 1, other = 0.
³Marital status: 1 = married, 2 = not married (divorced, separated, widowed, never married).
It has been suggested that the stress phenomenon, which describes the harried and stressful nature of day-to-day living, may be accelerated when people seek active living and active lifestyles (Hobfoll, 1998). Our results suggest that LTPA may be a buffer for some sources of stress (perceived life difficulties) but not others (time pressure).

Discrepancies in the role of LTPA in mitigating depression according to different sources of stress suggest that the role of LTPA as a stress buffer may vary according to the type of life stress under investigation. It may, in fact, be unrealistic for LTPA to be a buffer of time stress for such a chronically time-pressured group as mothers of infants. Putting demands on mothers of young children to be physically active may exacerbate feelings of time pressure. This reinforces the notion that the outcomes of different types of stressors should be examined separately, as certain coping mechanisms may be more beneficial for some sources of stress than others.

Perception of life stress had a greater negative impact on depressive symptoms than perception of time pressures for mothers of infants. Thus, it appears that although time pressure is related to depression, the influence of perception of life stress is a more powerful determinant. Indeed, the negative impact of stress on depression has been well established (e.g., Chou & Chi, 2000; Lazarus & Folkman, 1984; Zuroff & Blatt, 2002). The current study shows that, for women, this relationship holds regardless of demographic characteristics such as age, marital status, level of education, or country of birth.

Demographic factors including age, level of schooling, post-school qualification, marital status, and country of birth were each independently related to depressive symptoms in this study. For example, the current research suggests that mothers of infants residing in Australia but born outside of Australia are at increased risk of depression. Research on the influence of ethnicity on depression for mothers of infants is scarce; however, there is some evidence that suggests that immigrant women are more likely to experience depression (Miller & Chandler, 2002). More research is required to assess the role of LTPA for those groups, such as mothers who were born outside of Australia, who are at increased risk of depression.

Although this research highlights the importance of LTPA for the mental health of mothers of infants, the use of LTPA as a way of treating mental health problems poses several problems. Many psychiatrists and psychotherapists do not see their work as pertaining to the body of physiologically based resources such as LTPA. The link between LTPA and psychological distress is often ignored and the potential of LTPA to reduce mental health problems is reduced (Biddle et al., 2000).

Increasing physical activity in women with young children is a challenging task. Women with young children at home are one of the population groups least likely to be physically active (Brown & Trost, 2003; Marcus, Pinto, Simkin, Audrain, & Taylor, 1994). The National Physical Activity Guidelines for Adults recommend that adults participate in at least 30 min of moderate-intensity physical activity on most, preferably all, days of the week (Department of Health and Aged Care, 1999). In this study, only 17.4% of mothers of infants participated in at least 30 min of moderate physical activity on five or more days of the week. Other population data are not directly comparable due to differences in measurement of LTPA; however, estimates from population studies in Australia suggest that around 50% of adults are not undertaking sufficient physical activity for a health benefit (defined as at least 150 min of physical activity over at least 5 days of the week;
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Australian Institute of Health & Welfare, 2006) and women with young children are less likely than women without children to engage in adequate physical activity for a health benefit (Brown et al., 2000). Recent findings from the *Australian Longitudinal Study of Women’s Health* found that women 22–27 years old who had their first or second baby were more than twice as likely to be inactive over a 4-year period, after controlling for baseline LTPA levels (Brown & Trost, 2003).

Research suggests that LTPA is predictive of lower depression, whereas occupational and household physical activities are not (Lin, Halgin, Well, & Ockene, 2008; McAuley & Blissmer, 2000; Stephens, 1988). These findings suggest that mental health effects of physical activity may be specific to the characteristics of the activity itself, rather than mere physiological activation. Choice of activity, self-determination, or quality of time may be important elements in achieving psychological benefits (Mutrie & Hannah, 2007; Stephens, 1988). Thus, future research should examine the role of factors such as choice and autonomy (self-regulation) in the association between physical activity and depression.

**Limitations of the Study**

One of the strengths of this study was its use of a representative sample of women with infant children. Further research is needed, however, that utilizes more comprehensive measurement instruments. In particular, only single-item measures of LTPA participation, perceived life stress, and time pressure were available for the analysis. Longitudinal data would more convincingly demonstrate a causal relationship between LTPA and depression. Furthermore, the differences in levels of depressive symptoms between various sociodemographic groups suggest the need for further research of at-risk groups, such as sole mothers and those from culturally and linguistically diverse backgrounds. Examining the influence of physical activity on depression for various subgroups of women would be useful for designing targeted interventions.

**Conclusions**

In conclusion, this research provides evidence that LTPA is associated with reduced depression in mothers of infants, regardless of life stress or time pressures and is a buffer of the effect of life stress on depression in mothers of infants. Leisure-time physical activity, however, was not a buffer of the influence of time pressure on depression for this group. Leisure-time physical activity should be promoted to new mothers by health care providers as well as providers of LTPA in the general community. These results argue for the encouragement of participation in LTPA as part of a proactive, prevention-oriented model through service delivery and mental health policy.

**Acknowledgments**

This research used data that was collected as part of the study: A Longitudinal Study of Australian Children (LSAC). LSAC was initiated and is funded by the Australian Government Department of Family and Community Services (FaCS) as part of the Government’s Stronger Families and Communities Strategy. Responsibility for the design and management...
of the study rests with the Australian Institute of Family Studies, in collaboration with a consortium of eight other leading research organizations across Australia. The Institute, in turn, subcontracted the Wave 1 data collection to Colmar-Brunton Social Research and I-view/NCS Pearson, which are private social and market research companies. Future waves of data collection will be undertaken by the Australian Bureau of Statistics.

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*Manuscript received: March 30, 2009*

*Revision accepted: September 3, 2009*