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Review

A birth of inactivity? A review of physical activity and parenthood

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Abstract

Objective. To review the existing research on physical activity and parenthood in order to establish direction for future research.

Method. Articles were limited to English peer-reviewed journals, published from 1989 to 2007. Major findings from 25 independent samples were summarized based on common subtopics of: physical activity of parents compared to non-parents, physical activity barriers, employment and marital status, number of children, and theory-based work applied to parents.

Results. Parenthood and physical activity involvement showed a negative relationship (meta-analytic $d=0.41$ to 0.48, correcting for sampling error) when compared to non-parents. Mothers were generally less active than fathers. Associations were found between specific barriers and parental physical activity, but the relationship between physical activity and marital/employment status as well as number/age of children was inconsistent. Finally, the use of theoretical models applied to understanding early family development and physical activity has been limited.

Conclusions. Parents with dependent children are clearly more inactive than non-parents and the topic has received disproportionably scant research considering the size of the effect. Current research has largely been focused on mothers, and has relied heavily on cross-sectional designs and self-report measures. Future work should focus on longitudinal designs across family development, gender and role interactions, and include social ecological frameworks and objective physical activity measurement.

Keywords: Exercise; Dependent children; Socio-demographics; Inactivity; Gender; Parents

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Introduction

Moderate physical activity (PA) is a key component in maintaining one's health and quality of life, while inactivity is associated with increased levels of mortality and chronic disease (Center for Disease Control and Prevention, 2005). Despite the public and academic awareness of these benefits, PA participation remains low in North America (CDC, 2005; Canadian Fitness and Lifestyle Research Institute, 2002). Certain sociodemographic groups are less likely to be active. For example, inactivity is associated with lower levels of income and education and women are more likely to be inactive than their male counterparts, however, both sexes tend to exercise less as they age (CDC, 2005). An understanding of demographic groups with low PA prevalence is important to establish direction in tailored public health PA interventions.

One specific demographic that may be at a high risk of inactivity is parents with dependent children. Parenthood is a major life event that requires considerable lifestyle changes and thus could be associated with a general decline in PA. There appears to be a decrease in total number of physical activities people are involved in during the childbearing years and an increase in obesity (Nielsen et al., 2006). For example, data on the prevalence of PA suggests there is a deflection curve in decreased PA levels and increased BMI during childbearing years (Association of Canadian Studies, 2005; Myers et al., 1989; Leslie et al., 2001; Nielsen et al., 2006), that is to say that there is a noticeable change at this point after which PA and BMI do not return to their original levels. This is supported by research that shows PA decreases during the perinatal period (Pereira et al., 2007), new mothers are often inactive in the postpartum months (Gennaro and Fehder, 2000), and that there may be unique psychosocial predictors of exercise among new and expectant mothers (Hinton and Olson, 2001). Other qualitative research argues that changes to exercise patterns across the transition to motherhood vary depending on pre-pregnancy activity levels and life experience (Devine et al., 2000). Other aspects of parenthood may also affect population PA. For example, parents are central agents in the socialization and development of PA behavior patterns in their children (Gustafson and Rhodes, 2006; Moore et al., 1991) and a decline in the PA of parents may be central to family inactivity. Given this information, understanding PA among early parenthood may be important for future health promotion endeavors.

Objective

To our knowledge, no existing review of PA and parenthood has been conducted. Given the importance of this life-event and the health consequences associated with it, a review is warranted. Thus, the purpose of this narrative review is to unite and discuss the existing literature focusing on parenthood and PA, identify central common subtopics, and to provide a platform for future research.

Methods

Data sources

This review, completed in July 2007, includes a total of 31 peer-reviewed studies obtained through systematic database searches, and manual cross-referencing of bibliographies. The databases used included: Web of Science, Academic Elite, PsycInfo, Medline, and PubMed, representing databases from multiple disciplines related to health and physical activity. Search terms included various combinations of the key words physical activity, exercise, activity, health AND parents, dependents, parenthood, new parents, transition to parenthood, mothers, and fathers. This initial electronic search technique yielded 1882 articles; this was further reduced to 89 studies by eliminating duplicates, obtaining abstracts, and based on inclusion criteria. Thirty-one articles met the inclusion criteria. However, of these 31 studies, only 25 were from independent data sets (grouped and highlighted in grey in Table 1). Four studies used a sample of women from the Women, Infants and Children (WIC) program in the United States (Fahrenwald and Noble-Walker, 2003; Fahrenwald and Shangreaux, 2006; Fahrenwald et al., 2004; Fahrenwald et al., 2005), three studies used the sample from the Australian Longitudinal Study on Women's Health (Bell and Lee, 2005; Brown and Trost, 2003; Brown et al., 2000), and two studies used the same 1113 sample of Canadian women (Verhoef and Love, 1992, 1994). Although all these studies are presented in Table 1, in order not to give more weight to these samples, topics will be discussed in relation to independent samples.

Inclusion and exclusion criteria

Articles included in this review are from English peer-reviewed scholarly journals, published from 1989 to 2006. Unpublished dissertations/theses, and conference proceedings were not included in this review. The inclusion criteria extended to all studies including a PA measurement and including parental PA as an outcome variable. Parents were defined as adults, 18 or older with dependent children in the home, where participants were not in the immediate postpartum period (Verhoef and Love, 1992, 1994). This review seeks to examine parenthood beyond pregnancy and the first few months of the postpartum period, thus this review does not include articles focused on the perinatal months only. Those studies that focused on adolescent parents were also excluded, as this is a unique population. Physical activity was inclusive of, and used interchangeably with, PA subcomponents such as exercise and Leisure Time Physical Activity (LTPA).

Data extraction and synthesis

The major findings of each study were noted as subtopics, and as suggested by Sallis, Prochaska and Taylor (2000), only subtopics that were present in three or more studies were highlighted in the review. Similar to content analysis methods (Patton, 2002), an initial reading of the literature provided a concept of what topics were generally discussed across the studies. Each study was then read through a second time by the first author, and major findings were identified. Both authors then categorized the major findings independently based on the suggested methods of Sallis et al. (2000). Subtopics that met these criteria were discussed and agreed upon by both authors with 100% correspondence. Upon completion, the articles were reread to ensure that the coding

scheme was appropriate. Subtopics included available evidence on primarily intra- and interpersonal factors: parents versus non-parents, gender differences, barriers to parental exercise, parental employment/marital status, and number/age of children in the home.

Cohen's effect size *d* values were calculated when the necessary statistical information was available (e.g., means and standard deviations, odds ratios or correlations). Available effect size values are summarized in Table 1. It was deemed that there were too few studies with uniform methodology, results, and measures to conduct a full meta-analysis on most subtopics; thus subtopics are discussed in a narrative review based on the aforementioned subcategories.

A summary *d*, however, was calculated for the subtopic of parents versus non-parents to supplement the discussion. Unlike the other subtopics, 'parents versus non-parents' contained a relatively large number of studies with homogeneous measures thus allowing for a small meta-analysis to be conducted. The intent of the summary effect size for this subtopic was to evaluate the import of parenthood on physical activity and is intended to supplement the narrative review. Random effects meta-analytic procedures with correction for sampling error (Hunter and Schmidt, 2004) were used to compare the PA of parents and non-parents. These results were analyzed and interpreted using Cohen's d (1992) and studies with results expressed with effect sizes other than *d* were converted prior to analyses. In some instances, the results were presented in a form where effect size could not be calculated (e.g., percentage, incomplete results). Several authors were contacted and asked to provide the needed information if possible and we allowed for a two-month response time.

Results

Study characteristics

Of the 25 independent samples, 16 were cross-sectional, 4 were longitudinal, and 5 were intervention-based. Seventeen samples focused on female participants, only 1 was based solely on fathers, and 7 included both male and female parents (see Table 1). The 25 samples yielded 64,694 participants, with sample sizes ranging from 32 to 24,454 participants; of the total sample size, 16,709 were male and 47,985 were female. Participants ranged in age from 18 to 65, though studies with older adults were generally broken down by age category. All but one of the studies used a self-report measure to assess PA among the participants (see Table 1).

Parents versus non-parents

A total of 17 studies examined parents versus non-parents with 14 independent samples. Thirteen cross-sectional data sets (Burton and Turrell, 2000; Myers et al., 1989; Brown et al., 2000; Drago, 2001; Marcus et al., 1994; Verhoef et al., 1992; Verhoef and Love, 1992; Nomaguchi and Bianchi, 2004; Sternfeld et al., 1999; Scharff et al., 1999; Woodward et al., 1999; Nielsen et al., 2006) and four longitudinal studies (Grace et al., 2006; Burke et al., 2004; Brown and Trost, 2003; Bell and Lee, 2005) identified differences in PA between parents and non-parents. All but three (Scharff et al., 1999; Woodward et al., 1999; Grace et al., 2006) of the findings indicated a negative relationship between parenthood and activity level.

Study effect sizes ranged from trivial ($d=0.12$) to moderate ($d=0.62$), however, suggesting considerable heterogeneity in the overall effect. Still, because this is the central topic to the review, a summary effect size was calculated using random effects meta-analysis methods correcting for sampling error (Hunter and Schmidt, 2004). A total of 10 of the 14 independent samples provided the necessary statistics to calculate a Cohen's *d* (Brown and Trost, 2003; Drago, 2001; Verhoef et al., 1992; Verhoef and Love, 1992; Nomaguchi and Bianchi, 2004; Sternfeld et al., 1999; Scharff et al., 1999; Nielsen et al., 2006; Grace et al., 2006; Burton and Turrell, 2000). The summary statistic was $d=0.41$, a small to moderate effect size in favor of non-parents, with an estimated sampling error of 0.16, and sampling error variance of 0.00 (95% credibility interval was −0.37 to 1.19). This large sampling error suggests the presence of moderators. A concern in this analysis was that there may be a heavier weighting in the summary *d* from the two large studies included in the calculation. In instances such as this, Hunter and Schmidt (2004) suggest that the meta-analysis be performed both with and without these large samples. Thus, without the two largest studies, the summary $d=0.48$, a moderate to large effect size, with an estimated sampling error of 0.15, and a sampling error variance of 0.00 (95% credibility interval was −0.28 to 1.20). These findings provide preliminary evidence of the negative relationship between parenthood and PA, but evaluations of moderators are needed.

Further, evaluating the results by design quality, the large-scale, longitudinal study also found parents to be significantly less active than non-parents; OR=1.78, $p<0.01$ (Brown and Trost, 2003); this same sample is discussed by Bell and Lee (2005); OR=1.80–2.20, $p<0.0001$. Thus, findings by vote counting procedures, meta-analysis, and quality-based scrutiny of design all converge on the finding that parents with dependent children are less active then non-parents.

Mode of physical activity

Parenthood seems to affect general PA, yet this result yields little discussion as to whether type of activity moderates the effect. To this end, four studies have compared specific modes of activity in relation to parenthood (Grace et al., 2006; Scharff et al., 1999; Sternfeld et al., 1999; Verhoef and Love, 1994). Sternfeld et al. (1999) identified that mothers exercised 37% less and were involved in 32% less leisure activities than childless women, yet they were over 10 times more likely to engage in household activities. Thus, leisure-time activities had been replaced by household activities perhaps due to a change in roles. Similar studies on this topic further illustrate this issue. Research has shown that mothers engage in more daily lifestyle activity than non-mothers (Grace et al., 2006) and that mothers engage in considerably more activities of daily living (generally through household activities) than childless women (Scharff et al., 1999). In sum, the evidence suggests a marked shift in activity type during motherhood, with a decrease in total moderate and strenuous physical activity but an increase in household activities. Other studies examined various types of leisure activities such as cycling, jogging, other sports, and fitness center activities) across age groups (Nielsen et al., 2006) and genders (Myers et al., 1989), but not specifically in relation to parenthood. However there was a significant drop

Table 1
Summary of the 31 articles on physical activity and parenthood that were reviewed in July, 2007

Researchers	Year	Participants	Design	Measures	Statistical results by category
Bell, S. & Lee, C.	2005	*N*=8545 –Australian Longitudinal Study of Women's Health	Longitudinal (4 years)	Self report	*Parenthood*: Inactivity, OR=1.8 to 2.2, $p< .0001$ $d= 0.54$, small to moderate ES *Employment/marriage*: Inactivity OR=2.8 (married, unemployed, mother) OR=2.2 (married, employed, mother) OR=1.0 (Single, childless, students/work) Moderate ES
Brown, W.J. & Trost, S.G.	2003	*N*=7281 –Australian Longitudinal Study of Women's Health	Longitudinal (4 years)	PA self-report (Modified questions from the Australian National Heart Foundation Risk Factor Prevalence Study).	*Parenthood*: Inactivity OR=2.27, $p<.0001$ for adjusted OR, $d = 0.62$ Small ES *Employment/marriage*: Inactivity OR=1.00 (Partnered Parent), 1.32 (Single parent), $p<.05$ for unadjusted OR. Trivial-Small ES. *Number/Age of children*: OR = 1.36 (Second Baby), 1.00 (No second child), $p<.01$ Small ES
Brown, W.J, Mishra, G. et al.	2000	*N*= 9480 –Australian Longitudinal Study of Women's Health	Cross-sectional	Self report: –general health: Medical Outcomes Study's SF-36 –PA: modified questions from 1980–1989 Australian National Heart Foundation Risk Factor Prevalence Study.	*Parenthood*: M=16.4 (PA score with children), 19.1 (w/o kids) $p<0.05$, $d = 0$ .19 Small ES
Brown, P.R. et al.	2001	*N*=543 (all mothers) –Australia	Cross-sectional	Self-reported PA involvement and barriers (developed from current literature), and PA social support (modified from Social Support for Exercise Scale). –Discussion group.	*Barriers*: Reported Barriers: 98.6% said time commitments to children 86.7% said time commitments for chores 76.2 % said time commitments to partner 74.0% said fatigue No significant values reported here. *Number/age of children*: Significantly more reported PA barriers if >1 child: χ^2 =27.108, $df = 12$, $p<.01$, Small ES†
Burke, V. et al.	2004	*N*= 405 (194 men, 211 women, age 18 and 25) –Australia	Longitudinal (6years)	Self-report: –PA: 7-day PAR	*Parenthood*: d=0.20, Trivial ES *Gender*: 53% mothers sedentary, 40% fathers sedentary *
Burton, N.W. & Turrell, G.	2000	*N*=24 454 (11 029 women, 13425 men) –Australian Health Survey	Cross-sectional	Self-report: –PA: 2 week recall (METs calculated based on duration, frequency and intensity of activities).	*Parenthood*: For insufficient activity, OR=1.61, d=0.38 *Employment*: parenthood confounded relationship between hours of employment and PA, particularly for women. *Gender*: 71% of fathers and 76% of mothers were insufficiently active. OR(fathers)=1.61, OR(mothers)=2.19, OR(non-parent)=1 *
Cody, R. & Lee, C.	1999	*N*= 32 (all mothers) –Australia	Intervention	Self report: –Modified questions from Marcus, Shelby et al. SOC (1992); Marcus, Rakowski et al. pros and cons (1992); and 5 Likert questions (pros and cons of PA). Theoretical Model; Stage of Change (SOC)	Barriers: Social support is key in adherence to PA program* *Number/age of children*: * *Theoretical Models*: Those mothers who progressed to higher stages self-reminded about how good they felt more than non-adherers, $F(1, 20)=6.87$, $p<.005$
Cramp, A. & Brawley, L.	2006	*N*= 57 (women) –Canada	Intervention	Self-report: –PA: 7 day PAR –Barriers: modified version of Garcia and King's barrier efficacy scale.	*Barriers*: significant treatment effect for mean barrier efficacy, $F(1, 56) = 10.59$, $p<0.05$, $\eta^2= 0.17$ *Theoretical Models*: significant treatment effect, $F(1, 56) = 14.37$, $p<0.01$, $\eta^2= 0.22$)

Table 1 (*continued*)

Researchers	Year	Participants	Design	Measures	Statistical results by category
Deflandre, A.; Antonini, R.; & Lorant, J.	2004	*N*= 171 (78 mothers and 93 fathers) –Europe	Cross-sectional	Self report: –Sport Activity: report number of hours. –Moderate to Vigorous PA: Bouchard, Tremblay, Leblanc, Lortie and Savard's 3 day activity record.	*Gender*: Mothers' PA < fathers' moderate and vigorous PA: $U = 1532$, $p < 0.001$. * *Barriers*: Father Barriers : MVPAρ78)=–0.46, $p < 0.001$, TSPAρ(68)= –0.32, $p<0.01$, Mothers: TSPAρ(93)= –0.45, $p<0.001$ Medium ES
Drago, R.	2001	N=310 (86% female) –Eastern and Midwestern United States	Cross-sectional	Self report: –Diaries citing primary activities during the day; PA measured in number of minutes.	*Parenthood*: Parents exercise 13 minutes less/day $p<0.01$, $d = 0.41$, Moderate ES *Gender*: No statistically significant difference. *Employment/marriage*: No interaction effect measured. *Number/age of children*: Parenting time rergressions (base): Child<5 years $R^2=0.96$, $p<0.01$, Large ES
Fahrenwald, N. & Noble-Walker, S.	2003	*N*=30 (women) –WIC Program, United States	Cross-sectional	Self–report: – SEA tool –PA: 7-day PAR –Exercise Benefits/Barriers Scale. –Self Efficacy for Exercise scale. Theoretical Model: –Transtheoretical Model (TTM)	*Barriers*: Top three barriers: PA Tires Me (M = 2.77, S.D. = 0.63), Fatigue ($M = 2.63$, S.D. = 0.72), PA is hard work ($M = 2.57$, S.D. = 0.73). Twenty percent cited children as a constraint to PA * *Theoretical Models*: Stage of behavior is sig. related to METs of total daily energy expenditure (EE), EE ($r_s = 0.73$, $p < 0.01$) Having one of more children was significantly associated with lower stages of PA behavior. *
Fahrenwald, N et al.,	2004	*N*=44 (sedentary mothers) –WIC Program, United States	Intervention	Self report: –7-day PAR Objective: –Digi-Walker SW200 Step Counter Theoretical Model: –TTM	*Barriers*: Experimental group reported fewer cons post-test than controls, $p<0.001$, $d=1.42$ (Large ES) *Theoretical Models*: Participants in PA intervention progressed to higher stages, controls remained stable, $p<0.001$, $d=1.85$ (Large ES)
Fahrenwald, N., Atwood, J.R. & Johnson, D.R.	2005	*N*=44 –WIC Program, United States	Intervention	Self-report: –Stage of Exercise Adoption Tool –PA: 7-day PAR –Exercise Benefits/Barriers Scale –Self Efficacy for Exercise Scale	*Number of Children*: $r=-0.06$, $p>0.10$ *Barriers*: Perceived Cons were an important behavioral construct in PA change following an intervention: Weekly Moderate PA Minutes ($r = -0.51$), Index of Total Daily EE ($r = -0.52$), Index of Daily Moderate Activity EE ($r = -0.47$), $p < 0.01$ Large ES *Marital Status*: $r=0.03$, $p>0.10$ *Theoretical Models*: TTM intervention effective $r=0.73$, $p<0.01$; Large ES. However, PA behavior increases not mediated by TTM constructs.
Fahrenwald, N. & Shangreaux, P.	2006	*N*=30 (all mothers) –WIC Program, South Dakota, United States	Cross-sectional	Self report: –7-day recall (PA) –Pros and Cons to Exercise Tool –SEE –PEA (processes) Theoretical Model: –TTM	*Barriers*: Perceived cons to PA had a significant linear relationship with stage of change, $p<01$, $r_s= -0.58$, (Moderate-Large ES) *Theoretical Models*: Linear relationship between increasing PA level and advancing TTM stage, $p<0.01$

(*continued on next page*)

Table 1 (*continued*)

Researchers	Year	Participants	Design	Measures	Statistical results by category
Grace, S.L. et al.	2006	*N*=243 (women) –Canada	Longitudinal	Self-report: –PA: Health-Promoting Lifestyle Profile II (frequency and intensity of activities).	*Parenthood*: Non-significant difference, mothers more active than comparison at final measure, *M*(S.D.)= 2.27(0.64), 2.17(0.66), *d*=–0.15 *Mode*: Mean (SD) Activities of Daily Living: Mothers 2.27 (0.64), Non-Mothers 2.17 (0.66).
Marcus, B. et al.	1994	*N*=431 (women) –Rhode Island, United States	Cross-sectional	Self-report: –pros/cons (a 6-point decisional balance scale). –PA: 7-day PAR Theoretical Model: –11-point SOC scale developed.	*Parenthood and Theoretical Models*: Presence of child and lower SOC: (χ^2=6.25, $p < 0.05$).* *Number/age of children*: Presence of child <18 years and lower SOC: (X^2=6.25, $p < 0.05$). *
Miller, Y et al.	2002	*N*=554 (women) –Australia	Intervention	Self-report: –7-day recall –Social Support for Exercise Scale –Marcus and Owen's Self-Efficacy Scale	*Barriers*: Partner support (OR=2.29), *d* = 0.68 and self efficacy (OR=1.86), *d* = 0.49, significantly predicted meeting PA guidelines post-intervention. Moderate ES
Myers, A., Weigel, C., & Holliday, P.	1989	*N*= 382 (179 men, 203 women, aged 16–82) –Canada	Cross-sectional	Self-report: –PA: frequency (Godin, 1986)	*Parenthood*: χ^2= 11.84, *df*=1, *p*<0.001*
Nielsen, T. et al.	2006	*N*=783 (men, age 20–29) –Denmark	Cross-sectional	Self-report: non-standard (# activities/week, km/week bicycling etc.)	*Parenthood*: OR=1.6, *p*<0.05, 95% CI, *d* = 0.36, Small to Moderate ES
Nomaguchi, K. & Bianchi, S.	2004	*N*=13 496 (men and women) –United States	Cross-sectional	Self-report: PA: #times engaging in PA per week, and duration per activity (in number of minutes/activity).	*Parenthood*: *d*=0.12, $p < 0.001$, Trivial ES. *Gender*: Fathers *M*=305.67 minutes PA, Mothers=249.98, *d*= .15 Small ES. *Employment/marriage*: * *Number of children*: One child (*M*=278.38), 2 children (*M*=280.61) minutes PA, *d*= 0.006, Trivial ES. *Age of children*: No children <5 years in age (*M*=308.82), Children < 5 years (*M*=261.81), *d* = 0.13, Small ES.
Sallis, J. et al.	2001	*N*=226 (women) –San Diego, CA, USA	Longitudinal (7year)	Self-report: –PA: 7-day PAR	*Number/Age of Children*: No significant correlation to PA, *p*>0.05 *Employment*: *
Scharff, D. et al.	1999	*N*=653 (women) –Missouri, United States	Cross-sectional	Self-report questionnaire: –PA: reported days/week that she engaged in at least 30 minutes of exercise. –PA categorized into 8 subcategories, then 2 major groups (PADLs –Physical Activity of Daily Living, and LTAs–Leisure Time Activity) Theoretical Model: –SOC model	*Parenthood*: not significant *Number/age of children*: not significant. *Mode*: Motherhood and increased PADLs (OR=3.1, *p*< 0.001) *Theoretical Models*: Precontemplators, contemplators and preparers in the child-bearing prefer PADLs as they age: Age 18–29 11% PADLs, Age 30–39 17% PADLs Age 40–49 27% PADLs, Age 50–59 33% PADLs Age >60 years 39% PADLs *p*<.001, though not specifically mothers.

Table 1 (*continued*)

Researchers	Year	Participants	Design	Measures	Statistical results by category
Soubhi, H.; Potvin, L; & Pradis, G.	2004	*N*= 1136 (533 women, 603 men) –Canada	Cross-sectional	Self-report: LTPA: family support for PA, family rules for PA, and current leisure-time PA, all measured with non-standardized questions.	*Gender*: Site of residence: Female parents PA: Univariate F=5.10, p<.01, Male parent PA; not sig association Site of residence × family type (Multivariate F) Female Parent 3.22, p<0.01, Male Parent 2.69, p<0.05*
Sternfield, B.; Ainsworth, B.; & Queensbury, C.	1999	*N*=2036 (women) –California, United States	Cross-sectional	Self report questionnaire: –Kaiser Physical Activity Survey (KPAS)–derived from the Baecke Questionnaire	*Parenthood*: Sports/Exercise and Active Living Involvement: OR= 1.36; d=0.25, Small ES. *Mode*: Low Sports and Exercise (OR=1.36); Low Active Living (OR=1.36); High Household/Caregiving Activity (OR=5.66) *Number/age of children*: Sports/Exercise involvment (non-parents as ref) >1 child: OR= 0.64. Active Living involvement, >1child: OR= 0.68
Urizar, G. et al.	2005	*N*=68 (women) –San Francisco, USA	Intervention	Self report: –PA: 7-day Physical Activity Recall	*Barriers*: Maternal stressors, (r = 0.26, p<0.05), Moderate ES *Number/age of children*: ß = 0.31, p<0.05 *Marriage*: ß = 0.25, p = 0.08.
Verhoef, M.; Love, E.; & Rose, M.	1992	*N*=5939 (women) –Canada	Cross-sectional	Self report: –PA: non-standardized questions regarding intensity, duration, frequency and type of exercise.	*Parenthood*: r=0.21, p<0.01, d=0.45, Moderate ES *Employment/marriage*: Marital status × Parenthood: –Previously married non parent r = –0.16 –Single non-parent r = –0.40, Small-moderate ES
Verhoef, M & Love, E.	1994	*N*=1113 (women). –Calgary, AB, Canada	Cross-sectional	Self-report: –LTPA: Godin and Shephards 7-day recall, and Godin's validated 6-month assessment tool.	*Number/age of children*: χ^2 = 17.03, df =3, p<0.001; F(7,3176)=9.31, p<0.001 * *Parenthood*: r = 0.13; p<0.01, Small ES *Barriers*: Absence of barriers with/without children: r=0.14, p<0.01, Small ES *Employment/Marriage*: * *Number/age of children*: * *Mode*: Mothers/Non-Mothers: Strenuous Activity (28.6% vs 44.4%, p<0.01), Moderate Activity (55.1% vs 68.8%, p<0.01),
Verhoef, M. & Love, E.	1992	*N*=1113 (women) –Calgary, AB, Canada	Cross-sectional	Self-report: –LTPA: Godin and Shephardís 7-day recall, and non-standardized questions about level of activity.	Mild Activity (64.4% vs 66.3%, p>0.01) *Parenthood*: Inactivity, OR= 1.66, d=0.40 Small-Moderate ES *Barriers*: Perceived barriers, OR=.38, Medium ES
Woodward, D. et al.	1989	N=707 (Women). –Sheffield, England	Cross-sectional	Self report: –survey and structured interview.	*Employment/marriage*: confounded by parenthood * *Parenthood*:* *Employment/marriage*: Single mothers vs Single non-mothers: Sports: r = 0.21, Fit/yoga: r =0 .25, Small-moderate ES *Number/age of children*: No significant differences when children are < or > 5 years of age, Trivial ES
Young, L., James, A., & Cunningham, S.	2004	*N*=2184 (478 lone mothers, 1706 partnered) –Canadian NPHS	Cross-sectional	Self report: –average duration and frequency of activities in past 3 months.	*Marriage*: no significant difference.

(*continued on next page*)

Table 1 (*continued*)

Researchers	Year	Participants	Design	Measures	Statistical results by category
Young, L., Cunningham, S., & Buist, D.	2005	*N*=1446 (Women). –U.S. NHANES III	Cross-sectional	National Health and Nutrition Examination Survey III –PA instrument not provided.	*Employment/Marriage*: – Lone mothers less likely to be inactive, OR= 0.77

* Insufficient statistical data provided to calculate an effect size.
† ES is an abbreviation for effect size.

in sports, fitness center and total number of activities as males progressed into the childbearing years, perhaps suggesting that these activities are being replaced by other obligations (Nielsen et al., 2006).

Gender

Women in general tend to be less active than men (CDC, 2005; Leslie et al., 2001), and this trend may be exacerbated among new parents. Gender was compared in six studies (Burke et al., 2004; Drago, 2001; Nomaguchi and Bianchi, 2004; Burton and Turrell, 2000; Soubhi et al., 2004; Deflandre et al., 2004). The latter four of the aforementioned studies found significant gender differences on a PA measure in relation to parenthood. Effect size could only be established in two of the studies and was shown to be small and medium.

Mothers are generally less active than fathers and parenthood seemed to have a greater effect on mother's PA than father's (Burton and Turrell, 2000). Mothers generally spend less time engaged in LTPA than fathers, potentially due to a greater amount of time spent on parenting responsibilities (Drago, 2001; Nomaguchi and Bianchi, 2004). The large scale study conducted by Nomaguchi and Bianchi (2004) found that mothers spend an average 1 h and 26 min less time on PA every 2 weeks than fathers. The present findings, therefore, suggest that PA transitions during parenthood may be moderated by gender with mothers experiencing the largest decline. However, the limited available research still suggests that fathers are also at risk of inactivity (Nielsen et al., 2006; Nomaguchi and Bianchi, 2004) when compared to non-fathers. Thus, further research of PA and parent couples, including further examination of perceived parental roles and duties, would expand our understanding of the gender discrepancy that currently appears in the literature.

Barriers to PA

Physical activity barriers were assessed in 8 of the 25 independent samples and 12 of the total 31 articles (Verhoef and Love, 1992, 1994; Cody and Lee, 1999a; Deflandre et al., 2004; Farhrenwald and Noble-Walker, 2003; Fahrenwald et al., 2005; Fahrenwald et al., 2004; Fahrenwald and Shangreaux, 2006; Brown et al., 2001; Miller et al., 2002; Urizar et al., 2005; Cramp and Brawley, 2006). Of these studies, two produced ranked lists of data outlining the most commonly cited barriers where data were reported in percentages. Four studies correlated a barrier measure with parenthood and/or PA. Finally, six studies tested the effect of an intervention on PA barriers using various theoretical foundations as outlined in Table 1. Given the difference in design and methods it is not advisable to calculate a summary d. However, the findings were still interesting and informative, yet given the disparity among the studies data are summarized in narrative form here only.

Studies showed that many perceived barriers were experienced to a higher degree with the presence of children (Verhoef and Love, 1994; Cody and Lee, 1999a) and perceiving PA barriers was negatively related to involvement in and time spent exercising (Verhoef et al., 1992; Urizar et al., 2005). The most commonly cited barriers to PA among parents included lack of time and social support, fatigue, childcare, and obligations to other roles (Verhoef and Love, 1994; Fahrenwald and Noble-Walker, 2003; Deflandre et al., 2004; Fahrenwald and Shangreaux, 2006; Brown et al., 2001; Miller et al., 2002). Lack of money was also cited as a constraint, but strongly covaried with socio-economic status (Verhoef and Love, 1994; Brown et al., 2001). Commitment to family/role obligations was a central constraint; fatigue was also commonly cited (Soubhi et al., 2004; Fahrenwald and Shangreaux, 2006). The absence of such barriers was experienced in only 24.7% among mothers, compared with 38.8% of non-mothers (Verhoef and Love, 1994).

Social support and childcare were paramount in alleviating PA barriers, especially for mothers (Verhoef and Love, 1994; Cody and Lee, 1999a; Deflandre et al., 2004; Fahrenwald and Shangreaux, 2006; Miller et al., 2002). Access to social support could alleviate some of these barriers, and allow mothers to negotiate around the constraints inhibiting PA (Brown et al., 2001); availability of childcare during non-work hours was positively associated with PA (Verhoef et al., 1992).

Although all populations experience PA constraints, such as time, evidence suggests that parents perceive barriers at a greater magnitude than non-parents (Verhoef and Love, 1994), and mothers may experience unique barriers such as maternal stressors (Urizar et al., 2005). Further, the issue of time as a barrier is fundamental, because role overload predicts inactivity (Verhoef and Love, 1992), and the number of free hours has been found to be the most important time-related predictor of mothers' PA participation (Verhoef and Love, 1994).

Parental employment and marital status

Given the potential impact of time constraints and role conflict on PA involvement, it seems logical that employment

and marital status would affect parental exercise levels. Thirteen studies (11 independent samples) tested specific associations between parent PA and employment *or* marital situation, but there was little consistency across the findings (Sallis et al., 2001; Urizar et al., 2005; Bell and Lee, 2005; Woodward et al., 1999; Verhoef et al., 1992; Verhoef and Love, 1992, 1994; Nomaguchi and Bianchi, 2004; Young et al., 2004; Young et al., 2005; Brown and Trost, 2003; Drago, 2001).

Nomaguchi and Bianchi (2004) and found that married people, parents, and full-time employees spend less time exercising. Other research showed that the only variable correlated with increases in mothers' PA was lower hours of work (Sallis et al., 2001). Working parents also spent less time not only engaging in PA, but also spent significantly less time involved in passive leisure and work than non-parents (Drago, 2001).

In relation to marital status, single parenthood was significantly associated with higher levels of inactivity in several studies (Woodward et al., 1999; Brown and Trost, 2003). Other research showed that lone mothers were more likely to be active (Young et al., 2005), or that there was no significant difference in PA levels between partnered and single mothers (Young et al., 2004).

Attention should be drawn to the large scale longitudinal study by Bell and Lee (2005) that found the strongest effect for inactivity was for married mothers outside of the work force (OR=2.8, $p<0.001$), followed by married, working mothers (OR=2.2, $p<0.001$). Similarly, interaction effects indicated that marital status did not have an effect on PA for non-parents, but did for married mothers (Verhoef et al., 1992).

Opposing findings have shown, however, that neither employment nor marital status were associated with level of PA, and that parenthood confounded analyses of marital and employment status (Verhoef and Love, 1992, 1994). Furthermore, married/partnered mothers of teenagers have been shown to have higher levels of activity than lone mothers, thus further opposing the studies mentioned above. Perhaps parenthood creates a role overload which may confound the effects of marital and employment status, thus showing no significant relationship to PA levels among parents (Verhoef and Love, 1992).

Many of the studies found significant results among each separate socio-demographic variable and PA, but did not conduct multivariate analyses to probe for any interaction effect specifically comparing parenthood and marriage or employment with PA (Myers et al., 1989; Brown et al., 2000; Brown and Trost, 2003; Marcus et al., 1994; Sternfeld et al., 1999; Scharff et al., 1999; Urizar et al., 2005; Sallis et al., 2001; Young et al., 2005, 2004). Verhoef et al. (1992) and Bell and Lee (2005) were the exceptions, having found significant interaction affects between parenthood, PA, and marital status/employment. Where these variables were compared, there was a wide range in results and little consistency; effect size ranged from trivial to moderate. This incongruity in the literature calls for further longitudinal, multivariate analysis of the interaction and impact of these various roles on PA.

Number and age of children

A total of 14 studies, all independent samples, discussed the number/age of children in a household in relation to parental PA, yet the findings were equivocal. Five studies indicated that the age of the child was central in PA (Brown and Trost, 2003; Drago, 2001; Marcus et al., 1994; Nomaguchi and Bianchi, 2004; Sternfeld et al., 1999), three highlighted the number of children in a household as a central variable (Verhoef and Love, 1992; Sternfeld et al., 1999; Cody and Lee, 1999b), five studies found no significant association between either (Fahrenwald et al., 2005; Sallis et al., 2001; Woodward et al., 1999; Scharff et al., 1999; Verhoef and Love, 1994), and one indicated that both variables could be relevant (Urizar et al., 2005).

Nomaguchi and Bianchi (2004) found that having a young child in the household was significantly related to a decreased PA time, but the number of children present was not. Similarly, the presence of a child under the age of 18 was significantly associated with varying levels of exercise adoption, and that women with young children were more likely to fall into a lower level (Marcus et al., 1994). While studies have shown that parents with multiple children are still at risk of being inactive, some research shows that the age of children in a household may be associated with PA involvement (Urizar et al., 2005).

Speculation as to why the age of the child is pertinent is two-fold. First, younger children require more parental care and attention; this is supported by the finding that having a child less than 5 years of age is postulated to increase child care time by 1 h per day (Nomaguchi and Bianchi, 2004). Provision of childcare is central in allocating time for PA (Cody and Lee, 1999a,b). A second potential explanation is that there is little structural support available to aid with childcare until the child is over the age of five, thus old enough to go to school and partake in a form of subsidized childcare.

Other research has indicated, however, that total number of children is a key variable and that PA levels decrease with the birth of subsequent children (Sternfeld et al., 1999; Brown and Trost, 2003). Women with >2 children were significantly more likely to report that lack of time due to family obligations prevented them from engaging in regular exercise than those with only one child (Brown et al., 2001), showing a negative relationship between the number of children and amount of PA among parents (Verhoef and Love, 1992). This perspective might be explained using the rationale that additional children require additional care giving activity, thus consuming more time. For example, parents with 2 or more children spent more time involved in household/care giving duties than households with only one young child (Sternfeld et al., 1999).

Other studies found no PA associations with either age or number of children (Sternfeld et al., 1999; Scharff et al., 1999; Woodward et al., 1999; Sallis et al., 2001). There was also little difference in rates of sport/fitness involvement among women with varying ages of children (Woodward et al., 1999). Parenthood was shown to significantly affect PADLs, but there was no-association between PA stage of change and having children <12 years old (Scharff et al., 1999). Verhoef and Love's (1994) study yielded similar results, reporting that although the age of

the youngest child and number of children were associated with increased constraints, both were unrelated to PA participation among mothers, suggesting motherhood itself was the central issue.

Given the equivocal findings, and the inconsistent ES ranging from trivial to large, we hesitate to draw conclusions. The lack of agreement in the literature provides opportunities for future research focused primarily on the effect of socioeconomic and family structure variables on parental PA.

Theoretical models

Theoretical models can be valuable tools in explaining PA behavior and participation levels within a population, as they provide insight into the mechanisms and development of individual health behaviors. Eight studies (5 independent samples) applied theoretical models (Marcus et al., 1994; Scharff et al., 1999; Cody and Lee, 1999a; Fahrenwald and Noble-Walker, 2003; Fahrenwald and Shangreaux, 2006; Cramp and Brawley, 2006; Fahrenwald et al., 2004) and two studies included constructs similar to many behavioral theories (e.g., beliefs, goal-setting, and attitudes) but did not outline a specific theory that was used (Urizar et al., 2005; Myers et al., 1989).

Research using the stages of change applied to PA has shown that women in lower stages report significantly lower levels of PA than those in the action and maintenance stages (Fahrenwald and Noble-Walker, 2003) and that PA behavioral stage, as well as behavioral constructs, are also associated with PA interventions for mothers (Fahrenwald et al., 2004). Of note, social cognitive theory was used in a theory-based PA intervention among mothers and was shown to be effective at increasing PA as well as barrier efficacy and outcome expectations (Cramp and Brawley, 2006). Overall the literature is too limited to draw conclusions, however, on the major constructs that predict parental PA within various theoretical paradigms.

Conclusion

The purpose of this review was to unite the existing literature regarding parenthood and PA. Common subtopics were highlighted and discussed to illustrate some of the emerging findings and provide direction for future research. The central findings in this review show that parents, in particular mothers, are at high risk for inactivity. Though effect sizes were considerably heterogeneous, the summary effects were within the small–medium range, thus demonstrating that parenthood may be a very critical correlate of inactivity. Barriers of concern were fatigue, lack of time, and lack of social support and childcare, however current literature tended to focus on the listing of barriers rather than measuring effect. There were mixed findings in regard to age and number of children as a predictor of parental PA. Similarly, there were inconsistent and incomplete findings pertaining to the interactive effects of parenthood, employment and/or marriage on PA involvement. These equivocal findings are interesting on their own as they highlight the need for sustained research focused on underlying moderators of the parenthood and PA relationship.

This review also highlighted the paucity of prospective research focused on parenthood and PA, and limited theory-based work. Given our findings, it can be concluded that the topic has been understudied. Several current gaps and limitations in the field create a solid agenda for future research. First, most studies were cross-sectional, with a focus on mothers. Only one study could be found specifically examining fatherhood and PA; thus evidence is limited despite initial evidence that parenthood negatively affects fathers as well as mothers. Further, the interaction between couples, the social support they provide each other, and understanding the roles/duties they fulfill in the context of parenthood may be imperative in increasing levels of PA. Focus group evidence shows lack of childcare, and dependence on husband/partner to provide child supervision as a key PA barrier (Cody and Lee, 1999b), thus examining these dyads may be crucial in understanding PA changes among parents.

Second, qualitative data (Cody and Lee, 1999b) have also highlighted some unique concepts ripe for future research. One theme that emerged that warrants future exploration relates to PA and parental efficacy. Mothers in a focus group identified benefits of PA that are specific to motherhood such as the ability to cope with the parental role more effectively after exercising. This idea surfaces in other research which found that a healthier lifestyle was related to more parenting confidence in fathers (Walker et al., 1998), and reduced stressors among mothers (Currie, 2004). However, qualitative studies to date have focused on women and do not generally focus specifically on PA. This methodology may be particularly useful in future research to gain insight into the topic areas where quantitative findings thus far have been equivocal by providing more detailed information, and informing future theory and health promotion development.

Third, physical activity measurement has relied too heavily on self-report instrumentation; only one study utilized an objective measure (Fahrenwald et al., 2004). Future research using objective measures will be helpful in validating our understanding of PA behavior in this population, and in providing less subjective and more robust data. Physical activity is often inaccurately reported, combines PA types, and often excludes non-leisure activity such as chores and occupational PA (Montoye et al., 1996). Given the shift in PA modes that may occur from parenthood, accurate measurement is prudent.

Fourth, although ethnicity was often reported in descriptive statistics, ethnicity was only discussed directly in relation to parental PA in two studies (Sallis et al., 2001; Fahrenwald and Shangreaux, 2006), and cultural values in relation to parenthood and PA seem likely. Thus this might be another important avenue for future research in this population. Similarly, studies represented a variety of developed nations such as the United States (12) and Australia (8), Canada (8), and the United Kingdom and Europe (3), yet we were unable to find any studies comparing these national data among parent populations. Both these veins of research would contribute to a greater psychosocial understanding of this phenomenon.

Similarly, work applying theoretical models for understanding PA among parents and identifying target variables for

interventions are extremely scarce. Models such as the Theory of Planned Behavior (Ajzen, 1991), Social Cognitive Theory (Bandura, 1998), and the Social Ecological Model (McLeroy et al., 1988) could be explored in greater depth. Indeed, the application of a full social ecological framework spanning intrapersonal to policy-level factors that affect parental PA seems timely. Parenthood is a life event that is influenced by and is embedded in all levels of this model including intrapersonal, interpersonal, institutional, community and policy spheres, yet this framework has not been explored in relation to parental PA. Coding for this review revealed the number of studies that could be categorized as addressing intrapersonal ($n=29$), interpersonal ($n=25$), institutional/organizational ($n=2$), community ($n=2$) and policy ($n=0$) categories was limited largely to intra- and interpersonal factors. Within these categories, variables were further limited given that studies tended to focus on gender, marital status, parent-status, and employment, while often excluding other important factors such as environmental context, social support, and attitude. A greater understanding of the context in which parental PA occurs should inform future health promotion campaigns targeting PA as a preventive health behavior within this population.

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References

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process 50, 179–211.

Association of Canadian Studies, 2005. Part One: Who is the most active of us all? Available at: http://www.acs-aec.ca/English/acs_polling.htm. Accessed January 18, 2005.

Bandura, A., 1998. Health promotion from the perspective of social cognitive theory. Psychol. Health 13, 623–649.

Bell, S., Lee, C, 2005. Emerging adulthood and patterns of physical activity among young Australian women. Int. J. Behav. Med. 12, 227–235.

Brown, W.J., Trost, S.G., 2003. Life transitions and changing physical activity patterns in young women. Am. J. Prev. Med. 25, 140–143.

Brown, W.J., Mishra, G., Lee, C., Bauman, A., 2000. Leisure time physical activity in Australian women: relationship with well-being and symptoms. Res. Q. Exerc. Sport 71, 206–216.

Brown, P.R., Brown, W.J., Miller, Y.M., Hansen, V., 2001. Perceived constraints and social support for active leisure among mothers with young children. Leis. Sci. 23, 131–144.

Burke, V., Beilin, L.J., Dunbar, D., Kevan, M., 2004. Changes in health-related behaviours and cardiovascular risk factors in young adults: associations with living with a partner. Prev. Med. 39, 722–730.

Burton, N.W., Turrell, G., 2000. Occupation, hours worked, and leisure time physical activity. Prev. Med. 31, 673–681.

Canadian Fitness and Lifestyle Research Institute. Physical Activity Monitor, 2002. Available at: http://cflri.ca/cflri/pa/surveys/2002survey/2002survey.html. Accessed October 1, 2005.

Center for Disease Control and Prevention. Available at: http://www.cdc.gov/nccdphp/sgr/sgr.htm. Accessed October 1, 2005.

Cody, R., Lee, C., 1999a. Development and evaluation of a pilot program to promote exercise among mothers of preschool children. Int. J. Behav. Med. 6, 13–29.

Cody, R., Lee, C., 1999b. Physical activity barriers for mothers of preschool children. ACHPER Healthy Lifestyles J. 46, 18–22.

Cohen, J., 1992. A power primer. Psychol. Bull. 112, 155–159.

Cramp, A., Brawley, L., 2006. Moms in motion: a group mediated cognitive–behavioural physical activity intervention. Int. J. Behav. Nutr. Phys. Act. 3 (23).

Currie, U., 2004. Motherhood, stress and the exercise experience: freedom or constraint? Leis. Stud. 23, 225–242.

Deflandre, A., Antonini, P.R., Lorent, J., 2004. Perceived benefits and barriers to physical activity among children, adolescents and adults. Int. J. Sport Psychol. 35, 23–36.

Devine, C., Bove, C., Olson, C., 2000. Continuity and change in women's weight orientations and lifestyle practices through pregnancy and the postpartum period: the influence of life course trajectories and transitional events. Soc. Sci. Med. 50, 567–582.

Drago, R., 2001. Time on the job and time with their kids: cultures of teaching and parenthood in the US. Fem. Econ. 7, 1–31.

Fahrenwald, N., Shangreaux, P., 2006. Physical activity of American Indian mothers. J. Orthop. Nurs. 25, 22–29.

Fahrenwald, N.L., Noble-Walker, S., 2003. Application of the transtheoretical model of behavior change to the physical activity of WIC mothers. Public Health Nurs. 20, 307–317.

Fahrenwald, N., Atwood, J., Noble-Walker, S., Johnson, D., Berg, K., 2004. A randomized pilot test of "Moms on the Move": a physical activity intervention for WIC mothers. Ann. Behav. Med. 27, 82–90.

Fahrenwald, N.L., Atwood, J.R., Johnson, D.R., 2005. Mediator analysis of Moms on the Move. West J. Nurs. Res. 27, 271–291.

Gennaro, S., Fehder, W., 2000. Health behaviors in postpartum women. Fam. Commun. Health 22, 16–26.

Grace, S., Williams, A., Stewart, D.E., Franche, R.L., 2006. Health-promoting behaviours through pregnancy, maternity leave, and return to work: effects of role spillover and other correlates. Women Health 43, 51–71.

Gustafson, S., Rhodes, R.E., 2006. Parental correlates of child and early adolescent physical activity: a review. Sports Med. 36, 79–97.

Hinton, P.S., Olson, C.M., 2001. Postpartum exercise and food intake: the importance of behavior-specific self-efficacy. J. Am. Diet. Assoc. 101, 1430–1437.

Hunter, J.E., Schmidt, F.L., 2004. Methods of Meta-Analysis; Correcting Error and Bias in Research Findings, 2nd ed. Sage Publications, Thousand Oaks, CA.

Leslie, E., Fotheringham, M.J., Owen, N., Bauman, A., 2001. Age-related differences in physical activity levels of young adults. Off. J. Am. College Sports Med. 33, 255–258.

Marcus, B.H., Pinto, B.M., Simkin, L.R., Audrain, J.E., Taylor, ER., 1994. Application of theoretical models to exercise behavior among employed women. Am. J. Health Promot. 9, 49–55.

McLeroy, K.R., Bibeau, D., Stickler, A., 1988. An ecological perspective on health promotion programs. Health Educ. Q. 15 (4), 351–377.

Miller, Y., Stewart, B., Trost, G., Brown, W., 2002. Mediators of physical activity behavior change among women with young children. Am. J. Prev. Med. 23, 98–103.

Myers, A.M., Weigel, C., Holliday, P., 1989. Sex- and age-lined determinants of physical activity in adulthood. Can. J. Public Health 80, 256–260.

Moore, L.L., Lombardi, D.A., White, M.J., 1991. Influence of parents' physical activity levels on activity levels of young children. J. Pediatr. 118, 215–219.

Montoye, H.J., Kemper, H.C., Saris, W.H., Washburn, R.A., 1996. Measuring Physical Activity and Energy Expenditure. Human Kinetics, Ontario, Canada.

Nielsen, T.L., Wraae, K., Brixen, K., Hermann, A.P., Andersen, M., Hagen, C., 2006. Prevalence of overweight, obesity, and physical inactivity in 20- to 29-year-old, Danish men. Relation to socioeconomic status: the Odense Androgen Study. Int. J. Obes. 30, 805–815.

Nomaguchi, K.M., Bianchi, S.M., 2004. Exercise time: gender differences in the effects of marriage, parenthood, and employment. J. Marriage Fam. 66, 413–430.

Patton, M.Q., 2002. Qualitative Research and Evaluation Methods. Sage Publications, Thousand Oaks, CA.

Pereira, M.A, Rifas-Shiman, S.L., Kleinmam, K.P., Rich-Edwards, J.W., Peterson, K.E., Gillman, M.W., 2007. Predictors of change in physical activity during and after pregnancy. Am. J. Prev. Med. 32, 312–318.

Sallis, J.F., Prochaska, J.L., Taylor, W.C., 2000. A review of correlates of physical activity of children and adolescents. Med. Sci. Sports Exerc. 32, 963–975.

Sallis, J.F., Greenlee, L., McKenzie, T.L., et al., 2001. Changes and tracking of physical activity across seven years in Mexican-American and European-American mothers. Women Health 34, 1–13.

Scharff, D.P., Homan, S., Kreuter, M., Brennan, L., 1999. Factors associated with physical activity in women across the life span: implications for program development. Women Health 29, 115–134.

Soubhi, H., Potvin, L., Paradis, G., 2004. Family process and parent leisure time physical activity. Am. J. Health Behav. 28, 218–230.

Sternfeld, B., Ainsworth, B.E., Queensbury, C.P., 1999. Physical activity patterns in a diverse population of women. Prev. Med. 28, 313–323.

Urizar, G.G., Hurtz, S.Q., Albright, C.L., Ahn, D.K., Atienza, A.A., King, A.C., 2005. Influence of maternal stress on successful participation in a physical activity intervention. Women Health 42, 63–81.

Verhoef, M.J., Love, E.J., 1992. Women's exercise participation: the relevance of social roles compared to non-role-related determinants. Can. J. Public Health 83, 367–370.

Verhoef, M.J., Love, E.J., 1994. The mixed blessings of motherhood. Health Care Women Int. 15, 297–306.

Verhoef, M.J., Love, E.J., Rose, M.S., 1992. Women's social roles and their exercise participation. Women Health 19, 15–29.

Walker, L.O., Fleschler, R.C., Heaman, M., 1998. Is a healthy lifestyle related to stress, parenting confidence, and health symptoms among new fathers. Can. J. Nurs. Res. 30, 21–36.

Woodward, D., Green, E., Hebron, S., 1999. The sociology of women's leisure and physical recreation: constraints and opportunities. Int. Rev. Soc. and Sport 24.

Young, L.E., James, A.D., Cunningham, S.L., 2004. Lone motherhood and risk for cardiovascular disease. Can. J. Public Health 95, 329–335.

Young, L.E., Cunningham, S.L., Buist, D.M., 2005. Lone mothers are at a higher risk for cardiovascular disease than partnered mothers. Data from the national health and nutrition examination survey III (NHANES III). Health Care Women Int. 26, 604–621.