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sUNIVERSITY OF CALIFORNIA, SAN DIEGO

SAN DIEGO STATE UNIVERSITY

Physical Activity of Adults in Households with and without children

A dissertation submitted in partial satisfaction of the requirements
for the degree of Doctor in Philosophy

in

Public Health (Health Behavior)

by

Jeanette Irene Candelaria

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2010

The Dissertation of Jeanette Irene Candelaria is approved and it is acceptable in quality and form for publication on microfilm and electronically:

Chair

University of California, San Diego

San Diego State University

2010

DEDICATION

To my parents who taught me about hard work,
Juan and Mari Lú, who helped me grasp the realities of “ethics of care,”
and Chris who has kept my technology working.

There is no substitute for family.

EPIGRAPH

My grandmother started walking five miles a day when she was sixty.
She's ninety-three today and we don't know where the hell she is.

~Ellen DeGeneres

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Chapter 2, in part, has been submitted for publication was prepared in part for publication and will appear as: Differences in Physical Activity among Adults in Households With and Without Children. Candelaria, JI, Sallis, JF, Conway, TL, Saelens, BE, Frank, LD, Slymen, DJ. The dissertation author was the primary investigator and author of this paper. The NQLS study was supported by grant HL67350 from the National Heart, Lung, and Blood Institute.

Chapter 3, in part, is currently being prepared for submission for publication of the material as it may appear in. Parenthood as a Moderator of the Relation between Psychosocial Variables and Physical Activity in Adults. Candelaria, JI, Sallis, JF, Conway, TL, Saelens, BE, Frank, LD, Slymen, DJ. Cain, KL, Chapman, JE. The dissertation author was the primary investigator and author of this paper. The NQLS study was supported by grant HL67350 from the National Heart, Lung, and Blood Institute.

Chapter 4, in part is currently being prepared for submission for publication of the material. Parenthood as a Moderator of the Relation of Walkability and Park Proximity Variables to Adult Physical Activity. Candelaria, JI, Sallis, JF, Conway, TL, Saelens, BE, Frank, LD, Slymen, DJ, Cain, KL, Chapman, JE, Learnihan, V. The dissertation author was the primary investigator and author of this material. The NQLS study was supported by grant HL67350 from the National Heart, Lung, and Blood Institute.

VITA

EDUCATION

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	FIELD OF STUDY
Arizona State University	BS	May 1985	Health Science
San Diego State University	MPH	Dec 1993	Health Promotion
SDSU/UCSD	PhD	Dec 2010	Public Health Health Behavior

PERSONAL - Bilingual, Spanish/English - reading, writing, presentations

PROFESSIONAL EXPERIENCE

2/07 – present	Polycom Grant Expert – grant proposal preparation - procurement of funds for technology
9/02 – Present	Student – UCSD/SDSU Joint Doctoral program – Behavioral Health Sciences
1/06-5/06	Instructor - San Diego State University - Plagues Through the Ages – Prepared syllabus and lectures, delivered lectures, assignments and exams, assigned and posted grades in collaboration with co-instructor.
12/98 – 7/02	Needs Assessment Team Coordinator (Independent Contract) – Work with team members to develop needs assessment tool and conduct health education needs assessment and report for Viejas Indian Tribe and for Community Health Group HMO members.

SDSU FOUNDATION

3/06 – 7/06	Researcher – SDSU Foundation – Manuscript and grant proposal preparation
9/04 - 3/06	Co-Investigator - Research Core Director for CDC-funded San Diego Prevention Research Center.
7/99 – 4/05	Coordinator for National Cancer Institute-funded Smoking Prevention for Latino Middle School Students – Project FUERTE to train college undergraduates to train and mentor high school students as advisors to deliver a tobacco prevention curriculum and mentoring program to middle school youth and their families.
7/98-6/02	Coordinator for TRDRP funded Family Factors in Smoking Acquisition Among Latino Youth to investigate the incidence of parental prompting of child smoking and examine to what extent parental prompting predicts children's smoking acquisition.
2/98-12/01	Coordinator for TRDRP funded core activities for the Tobacco Control in Latino Communities SDSU Center. Interact with projects to develop

materials and conduct process evaluation for Community Health Advisor activities, oversee logistical aspects of the program, and prepare manuscripts.

- 3/97-2/98 **Coordinate** manuscript and grant proposal preparation, contracts and related tasks - SDSU Center for Behavioral and Community Health Studies.
- 7/99-12/99 **Coordinate** evaluation of several in class components of the Sweetwater Union High School District Tobacco Use Prevention Education program
- 1/97-12/98 Evaluation Working Group (EWG), HRSA Funded Border *Vision Fronteriza*, **SDSU Project Coordinator** for Evaluation of San Diego area Border Health Initiative Affiliated (*promotora*) Projects.
- 8/92-2/97 **Project Coordinator** – NHLBI –funded Cardiovascular Nutrition Education Among Low Literate English as a Second Language (ESL) students.
- 7/90-12/92 **Project Coordinator** – TCS Funded YO-SHOUT - Coordinate adaptation of curriculum and leader instruction for Tobacco Education and Refusal Skills Training for implementation in seven Community Based Youth Organizations in San Diego and Imperial Counties.
- 1/88-12/92 **San Diego State University Foundation** – Kaiser Family Foundation funded Project Salsa - **Health Educator** - Coordinate school component of Community Nutrition Program for border community and assist with community health screening, breast-feeding promotion and grocery store interventions.

MARICOPA COUNTY DEPARTMENT OF HEALTH SERVICES

- 3/85-6/87 **Bureau of Health Education, Smoking Cessation Program**
Coordinator: Develop and coordinate a county-wide smoking cessation program for low-income pregnant women in 12 Primary Care Centers; Serve on county smoking policy development committee; Advise area corporations regarding smoking programs and policies; Coordinate worksite smoking cessation program for blue-collar women; Conduct community smoking cessation and prevention activities;
- Health Educator-West Region:** Facilitate Health Education meetings to develop education plan/budget for west area; develop and conduct health care/promotion classes, Eng/Spa, multiple topics; assist with grant proposal preparation; coordinate personnel in-service, Girl Scout and daycare Heartsmart training & curriculum distribution; serve on various state-level conference planning committees

RELEVANT VOLUNTEER EXPERIENCE:

- CALIFORNIA** •**Girl Scout Daisies Troop 8341**, Assistant Leader 2008 – present – Responsible for preparing and tracking Try It activities and assisting with program activities and outings.

- Boy Scouts Troop 676**, 2009 – present, Assistant Scout Master, High Adventure Leader
- Boy Scouts Pack 621**, Den 4 Leader 2005 – 2009 - guided 10 boys through scouts from Wolves through Webelos - all received Arrow of Light award, Pinewood Derby Coordinator, 2005/06, Popcorn Kernal 2006/07, Scout Fair Activity Coordinator 2007/2008
- Poway Unified School District Videoconference Coordinator** 2008 - present - obtain funding as needed and coordinate domestic and international videoconferencing for multiple PUSD schools, K-8th grades including applied science, social studies, literature, geography, and dual language programs.
- Canyon View Elementary School** – 2004 - present - Class Volunteer, Library Assistant, Running club, writing editor, videoconference coordinator 08-10
- Valley Elementary School** - Classroom and activity volunteer, 2005 – present, assist with math and science activities – 2009/10, Speaker for multiple health topics in Spa/Eng, as requested 2005-present, Videoconference coordinator 2008 –present, VE Educational Foundation Board Grants Chair - Coordinate mini-grant program and grant proposal preparation - multiple topics 2009-present, Tiger Trackers volunteer - 2010
- Healthy San Diego Consumer Advisory Committee, Quality Improvement subcommittee** - 1995-6/02.
- Latino Caucus of APHA** – member 1992-2006. Local Activities Coordinator for San Diego APHA meeting, 1995, 2nd Vice Chair, 1996, Mentoring Program Coordinator, 1996-97
- Latino Health Council of San Diego** - 1992-02. Health Promotion Committee, Minority Recruitment to Health Careers Committee, president-elect - 1993-94, President – 1995, data committee chair.
- Lincoln High School/GSPH Summer Internship Program** - planning committee, 1992, program coordinator (obtained funding for and conducted program activities), 1993-2002
- SD Big Sister League, Inc.** - Big Sister, 1987-present
- American Cancer Society CA** - 1988-1997. Hispanic Branch, BSE Special Touch Facilitator and Trainer, Speakers Bureau, Kids Against Cancer Committee, Community Services Committee, Task Force on the Underserved
- Latino/Hispanic Tobacco Control network** - 1991-1993
- Co-Chair - Youth Track** - Celebrating CA's Tobacco Revolt: Three Yrs of Progress (conference - 1992)

- Steering Committee** - Youth Summit for a Tobacco Free California - Sacramento, 1991
- County of San Diego Tobacco Control Coalition** & Comprehensive Prevention Committee, 1990-1992
- Community Nutrition Task Force** - active member, 1988-1991
- San Diego County Chapter SOPHE** - 1987-90 - Program Planning Committee 87-88, Membership Committee Chair 88-90

ARIZONA

- Arizona Public Health Association** - Member, 1985-87 - Health Education Section vice chair-person 1986; Coordinated State-wide Health Education Media contests, judging and awards presentations, 86 & 87; AzPHA conference planning committee, 85-87
- American Cancer Society AZ** - Trained in various aspects of cancer prevention and early detection; Conducted ACS smoking cessation classes; Assisted with development of Hispanic Education Committee, GASPAR Award for outstanding smokeout program
- Mesa Primary Care Center** - Assisted with Health Fair planning and implementation, staff fitness program and Spanish and English prenatal classes
- Arizona State University - Student Health Center:** Planned, marketed, conducted and prepared reports for Smokeouts and other health promotion events; conducted weekly classes on birth control and BSE and assisted with evening, gynecological screening and education clinic
- Program Mano De Ayuda - Orphanage/Clinic - Morelia, Michoacan Mexico:** Functioned in role of administrator in absence of directors, supervised children; assisted in clinic with childbirth and other treatments; prepared and conducted English classes in local business school.

AWARDS AND HONORS:

Latino Caucus of APHA, President's Award, 1995

SDSU Grad School of Public Health-1992-Outstanding Health Promotion Student

American Cancer Society CA-1990-Best Rated Speaker & Life Preserver Awards

Arizona Public Health Association-1986-Outstanding Health Educator Award

ASU Medallion of Merit and Board of Regents Scholarships

Golden Key National Honor Society

Eta Sigma Gamma Honorary Health Science Organization

PUBLICATIONS:

Woodruff, S.I., Candelaria, J.I., & Elder, J.P. (2010) Recruitment, training outcomes, retention, and performance of community health advisors in two tobacco control intervention for Latinos. *Journal of Community Health* 35 (2), 124-34

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PRESENTATIONS (10 MOST RECENT):

- Candelaria, J.I., Sallis, J.F., Conway, T.L., Saelens, B.E., Frank, L.D., Slymen, D.J., Cain, K.L, Chapman, J.E. Differences in Physical Activity among Adults in Households With and Without Children. Poster presented at the 31st Annual Meeting of the Society of Behavioral Medicine. Seattle, Washington. April 8, 2010.

- Woodruff, SI Candelaria, , JI, Elder, JE (2009, January 15-18). Recruitment, Training Outcomes, Retention, and Performance of Community Health Advisors in Two Tobacco Control Interventions for Latinos. Poster presentation at the 2009 Annual Conference of the Society for Social Work and Research, New Orleans, LA
- Martinez, S., Coleman, K., Candelaria, J., Terpstra, J., Ainsworth, B., Patrick, K., Elder, J. (2006, February). Needs and assets mapping in low-income communities: A case study of using multiple methods and technology to promote physical activity in Latino families. Poster session presented at the 3rd Annual Active Living Research Conference, Coronado, CA
- Candelaria, JI, Kritz-Silverstein, D, Barrett-Connor, E, Wingard, DL. Is Breastfeeding History Associated with Obesity and Body Fat Distribution in Postmenopausal Women? Presented at N Amer Menopause Society, San Diego, Sep 05
- Candelaria, JI, Kritz-Silverstein, D, Barrett-Connor, E, Wingard, DL. Is Breastfeeding History Associated with Obesity and Body Fat Distribution in Postmenopausal Women? Presented at the San Diego Epidemiology Research Exchange, San Diego, May 2005
- Candelaria, JI, Elder JP, Villasenor, A, Iniguez, E, Slymen, DJ. Project FUERTE, Final Results from a Peer-delivered Youth Smoking Prevention program. Presented at the 132nd Annual Meeting of the American Public Health Association, Washington, DC, November, 2004
- Iniguez, E, Villasenor, A, Candelaria, JI, Elder, JP. Changes in Psychosocial Characteristics and Smoking Related Behaviors of High School Students Acting as Peer Advisors in a Smoking Prevention Intervention Presented at the 132nd Annual Meeting of the American Public Health Association, Washington, DC, November, 2004
- Iniguez, E, Villasenor, A, Candelaria, JI, Elder, JP. A comparison of rules regarding indoor smoking in Latino, White and Asian homes. Presented at the 132nd Annual Meeting of the American Public Health Association, Washington, DC, November, 2004
- Villasenor, A, Iniguez, E, Woodruff, SI, Candelaria, JI, Elder, JP. Effect of Family Support and Acculturation on Smoking Susceptibility and 12-month Tobacco Use Uptake among Latino Middle School Students in a Tobacco Prevention Project. Presented at the 132nd Annual Meeting of the American Public Health Association, Washington, DC, November, 2004
- Elder JP, Candelaria, JI, Villasenor, A, Iniguez, E. Project FUERTE, Results from a Peer-delivered Youth Smoking Prevention Program. Presented at the NCI Tobacco Control Investigators Meeting, San Diego, CA, June, 2004

FUNDED GRANT PROPOSALS - CA

- | | |
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| 2004-2009 | Elder, JP, Patrick, K, Ainsworth, B, San Diego Prevention Research Center (Centers for Disease Control and Prevention \$3.4 million) |
| 1999-2003 | Elder, JP, Slymen, D., Litrownik, A., Candelaria, JP., Smoking Prevention for Latino Middle School Students (National Cancer Institute, \$1,780,000) |

- 1998-2000 Laniado-Laborín, R., Sallis, J., Woodruff, SI, Candelaria, JI, Family Factors in Smoking Acquisition Among Latino Youth (University of California, Tobacco-Related Disease Research Program, \$861,516).
- 1998-2000 Elder, JP, Candelaria, J. Tobacco Control in Latino Communities Center Proposal: Project Core (University of California, Tobacco-Related Disease Research Program, \$238,259)
- 1997-1999 Elder, JP, Candelaria, J. Minority High School Student Research Apprenticeship Program (National Institutes of Health, National Center for Research Resources, 1997-1999 \$87,225)
- 1992-1996 Elder, J, Goldbeck, A, Criqui, M., Talavera, G., Candelaria, J., Campbell, N., Rupp, J. CVD Nutrition Education for Low Literate ESL Students (National Heart, Lung and Blood Institute, \$1,590,300)
- 1992-1994 Litrownik, A., Lovato, C., Candelaria, J. Tobacco Prevention For Hard to Reach Youth (University of California, Tobacco-Related Disease Research Program, \$221,180)
- 1993-95 Scutchfield, D., Candelaria, J. Minority High School Student Research Apprenticeship Program (National Institutes of Health, National Center for Research Resources, 1993-\$25,000, 1994-\$21,000, 1995-\$21,000)
- 1990-93 Sallis, J., Candelaria, J. , Edwards, C., Assessing Tobacco Refusal Skills in Latino Youth (California Department of Health Services, \$704,000)
- 1990-1992 Litrownik, A., Candelaria, J., Tobacco Use Prevention with Youth Organizations (California Department of Health Services \$120,000)
- 1991-92 Elder, J., Candelaria, J., Swanson, L., Nutrition Education Training - Choose Well, Be Well, minigrant program. (California State Dept. of Education, \$5000).
- 1990-91 Litrownik, A., Candelaria, J., Edwards, C., Tobacco Use Prevention with Youth Organizations (California Department of Health Services \$365,000)
- 1990-91 Elder, J., Candelaria, J., Swanson, L., Nutrition Education Training - Choose Well, Be Well, minigrant program. (California State Dept. of Education, \$6000).

ABSTRACT OF THE DISSERTATION

Physical Activity of Adults in Households with and without children

by

Jeanette Irene Candelaria

Doctor of Philosophy in Public Health (Health Behavior)

University of California, San Diego, 2010
San Diego State University, 2010

Professor James F. Sallis, Chair

This dissertation research responded to needs identified by researchers to better understand factors that influence different domains of physical activity (leisure, transportation, occupational, and household) and sedentary behavior at different life stages. In the context of the Ecological Model of Active Living, the present studies contributed to filling specific gaps in the literature on the effect of parenthood on physical activity. The studies addressed gaps related to sex-specific effects on parents, number and age of children, and how parenthood might interact with psychosocial and environmental factors to impact physical activity.

Participants were 909 women and 965 men, aged 20 to 57 years. Paper 1 examined components of the intrapersonal level of the Ecological model, assessing the effect of parenthood on physical activity while controlling for demographic and biological factors and environmental features. Paper 2 explored interpersonal Ecological Model factors to assess whether parent status moderated the association between six psychosocial variables and physical activity outcomes. Paper 3 examined components of the environmental level of the Ecological Model to assess whether parent status moderated the association between eight objectively measured and four reported built environment variables and physical activity outcomes.

In general, parents and non parents had similar levels of physical activity and responded similarly to psychosocial and environmental factors. Key differences were found at the individual, interpersonal, and environmental levels that could be helpful in developing parent-targeted interventions and merit further investigation. At the individual level, parents reported higher levels of household activity and less sitting time than non-parents, indicating favorable effects of parenthood. Compared to parents with children aged 0-5, non-parents and parents with children aged 6-17 reported less household activity and more sitting time, indicating the latter may be appropriate physical activity intervention targets. At the interpersonal level, social support was found to be a stronger correlate of physical activity for parents than non-parents, implying that social support-based interventions may be particularly effective for parents. At the environmental level, evidence of a parental disadvantage in access to recreation facilities and walkable neighborhoods supports the use of more broadly-targeted policy approaches to ensure parent access to physical activity resources.

CHAPTER 1
INTRODUCTION

INTRODUCTION

Physical Activity and Health

Men and women who are more active have lower rates of all-cause mortality, chronic diseases like coronary heart disease, high blood pressure, type 2 diabetes, colon cancer, breast cancer, and depression compared to less active persons [1]. To achieve these health benefits, experts recommend that adults engage in 30 to 60 minutes per day of moderate to vigorous intensity physical activity, such as brisk walking, on 5 or more days of the week (2.5 hours per week) [1]. Most adults are not meeting the physical activity guidelines to promote and maintain health [2, 3]. Physical activity interventions for adults have shown only moderate effects with little long-term maintenance, so improved interventions are needed [4].

Demographic Differences in Physical Activity.

A number of demographic characteristics have consistently been associated with physical activity, for both men and women. Men of all ages engage in more moderate and vigorous physical activity than women [5-8]. Socioeconomic status has consistently demonstrated a positive association with physical activity [8], as has a higher level of education [3, 8-10]. Age-related reduction in physical activity is the most consistent finding [11], with younger men and women more active than older adults [3]. Adulthood transitions emerging from age 18 to the late twenties have been found to be associated with declines in physical activity [10-16]. For young adult women, life events such as getting married and starting work were associated with decreased physical activity levels [17], and Rhodes (2008) found older adults had higher levels of perceived control over physical activity than did younger adults [13]. Since the average age of mothers in the US was 26 in 2007 [18], parenthood is likely to be among the emerging adulthood transitions associated with declines or changes in physical activity among younger adults [13, 15].

The Transition to Parenthood

The transition to parenthood is difficult, with anxiety about becoming a parent [9, 19] and acquiring skills and behaviors to care for infants [20, 21]. Adjustments must be made to marital

roles [19, 20, 22] and job demands [19, 23], and there are impacts on emotional and physical well-being [24-29].

Effects of parental role changes on physical activity have been reported, with parents found to be less active than non-parents [15, 17, 24, 26, 29-34]. The societal impact of parenthood on physical activity could be substantial given that, in 2007, nearly 35% of US households had at least one person under 18 years [35]. Few studies have examined the specific impact of having children on parent physical activity. An understanding of the types of physical activity in which parents engage can help to formulate intervention strategies to either increase current activity or target alternative activity domains.

Parental Roles and Physical Activity

Sex-specific parenting roles may have effects that vary by domain of physical activity. Having children in the home has been positively associated with time spent doing household activity for both women and men; however, women have retained responsibility for core housework [36-43]. Sternfeld (1999) found that mothers participated in exercise and leisure activities 37% and 32% less frequently, respectively, but were over 10 times more likely to do household activities than childless women [44]. Several studies found that mothers spent more time in routine child care and developmental activities, while fathers spent more time teaching or playing, suggesting that children might be a source of physical activity for fathers [41, 43, 45]. Knoester (2006) found slight increases in child care and household labor done by fathers in recent compared to past decades. Knoester also found that a new child living in the household reduced men's social participation, including physically active social participation, but increased their participation in service organizations, hours of employment, and interactions with and support from extended family [46]. Common barriers to physical activity for parents included lack of free time and social support, fatigue, childcare, and familial commitments [17, 24].

Psychosocial Factors related to Physical Activity among Parents

Among the numerous psychosocial correlates that have been evaluated, self-efficacy, social support from friends and family, expected benefits, and enjoyment of physical activity have

been found to have consistently positive associations with physical activity [8, 47, 48]. Barriers to physical activity have been found to be negatively associated with physical activity [8, 47].

Because these psychosocial variables can function in different ways depending on the situation [47] and the geographic and cultural settings, information is needed on how they operate within different contexts and subgroups [8]. Trost (2002) identified a need for more information on correlates of physical activity by domain (transport, leisure, occupational, household) and sedentary behaviors. Based on time use data, and the often cited physical activity barrier of lack of time [17, 24, 29], parenthood could be a particularly critical barrier to physical activity that contributes to perceived lack of time.

Parenthood may also be a moderator of psychosocial correlates of physical activity. Role changes related to parenthood, such as time devoted to childcare and increased housework, can reduce the time adults have for personal activity [33, 49-51]. These changes may be sufficiently disruptive to reduce the strength of the relationship between psychosocial variables and parent physical activity [30, 52, 53], and may vary with age of child, stage of life, number and type of social roles, and parent ability to negotiate for support [49, 54]. For example, an adult who highly values physical activity and has considerable confidence in engaging in physical activity may retain these attitudinal predilections when becoming a parent, but care-giving responsibilities may decrease the amount of time he/she has available to engage in physical activity. If parenthood disrupts such associations, the implication is that interventions targeting psychosocial factors would be less effective for parents and other strategies may be needed. Several physical activity interventions for parents have had low efficacy [51, 55, 56], and weaker associations of physical activity with psychosocial variables for parents may partially explain lack of effects [31]. Less favorable levels of psychosocial variables, for example differences in resources from which to draw for family support, or more barriers due to time constraints for parents than non-parents [24, 49, 51, 57], could interfere with intervention effectiveness.

Environmental Factors and Physical Activity among Parents

The physical attributes of neighborhoods, have been consistently linked with physical activity [58-63]. Recreation-related environmental factors like convenience of sidewalk and trail facilities, proximity to park and recreation services and accessibility of equipment and recreation destinations have had consistent associations with leisure activity [8, 48, 61, 64-66]. Walkable neighborhoods, those with greater street connectivity, mixed land use, and high residential density, have been associated with walking or biking to get to and from places (transportation activity) and higher total physical activity [60, 61, 63, 66-69].

There have been several studies of environmental factors and parenthood. Tilt found that adults with children living at home walked most frequently to parks compared to other destinations, and aesthetic factors and living close to a variety of destinations was positively associated with walking trips [70]. Riva (2007) found that women aged 35–44 (80% of women aged 40 to 44 were mothers in 2006 [71]) were less likely to use local facilities for physical activity than women aged 25–34 and 45–55 [72], which may indicate that parental demands inhibit physical activity in this group. Cleland (2008) found access to public transport and trusting neighbors were predictive of increases in leisure walking in a prospective study of mothers [73]. Connected streets that provide direct routes (street connectivity), pedestrian crossings, and slow local traffic speed predicted higher transport-related walking. Satisfaction with local facilities (parks, sports venues, fitness/recreation centers) was associated with increasing both leisure and transport-related walking, and social environment was important for maintaining high levels of leisure- and transport-related walking [73].

Theoretical Framework

The Community Guide recommends informational (community-wide campaigns), behavioral and social (Individually-adapted health behavior change programs, community-based social support interventions, and enhanced school-based physical education), and environmental and policy approaches (community- and street-scale urban design and land use policies, creation of or enhanced access to places for physical activity combined with informational outreach

activities, and point-of-decision prompts to encourage use of stairs) for interventions to promote physical activity [74-78]. These approaches indicate the relevance of psychosocial-based health behavior change models [79] and the ecological model which encompasses a wider range of influences and provides a framework for a more multi-level, longer lasting, population-based approach [80, 81].

Health behavior change models specifying psychological and social influences have dominated physical activity research and practice [82, 83]. Though these models have yielded some intervention success [77], they have targeted primarily small groups or individuals and are limited by low recruitment, little impact, and poor maintenance [79, 83, 84]. This approach has the benefits of reaching those at high risk, in a personal manner, and with a benefit-to-risk ratio that favors the individual [85, 86]. It may be limited in potential, however, due to imprecision in individual risk assessment which may obscure perceived risks and benefits, decrease motivation to change, and diminish achievement and maintenance of behavioral change [85].

The “ecological” model for health promotion interventions considers interpersonal, organizational, community, and public policy factors that support healthy behaviors [80]. These more broadly-targeted models employ environmental and policy level change tactics that can stimulate social norm changes, synergizing a shift in the distribution of exposure, impacting disease incidence in a population. Effects of such global changes, demonstrated with other public health interventions involving policy changes [87-89], may address root causes of the epidemic of sedentary lifestyles through environmental and policy factors [85, 86, 90] that make it easier for everyone to make beneficial changes to their health, which may be an advantage for hard-to-reach groups [85, 86].

Sallis and colleagues (2006) applied the ecological model to active living as an alternative to models specifying psychological and social influences [79] because ecological models seem especially well suited for examining place-specific health behaviors such as physical activity [81]. Ecological frameworks can incorporate psychosocial models using hypotheses specific to psychosocially relevant levels of the model. Ecological models maintain

that the most powerful multilevel models are those that consider access issues (built environment or place), include motivational and educational components to promote use of available places (campaigns and behavioral interventions), and incorporate procedures that will impact social norms and culture (policy changes) [81, 91].

The ecological model is ideal for examining the impact of a child under age 18 living in the household, on parent physical activity. Ongoing changes in intrapersonal variables impinge upon parents to continually consider and act on factors related to age-appropriate safety, education, and health needs of their children. Further, the number of social roles may affect parents differently at different stages of their lives when they may feel more or less committed to various social roles and have access to higher or lower levels of social, material, and economic supports [54]. The continual and changing demands of parenthood may impede parent engagement in physical activity.

Parents who were able to balance time and other obligations that allowed them to engage in physical activity before they had children, might be overcome by demands for their time that come with having a child living in the household. For example, adults might enjoy and place a high value on the benefits of physical activity, but the anticipated and unexpected impact of children, might shift their perceptions of barriers, self-confidence, and social support for physical activity to the point that they feel they must modify their priorities to omit physical activity. This is exemplified in a study of physical activity interventions demonstrating that mothers are interested in and can successfully adopt more physically active lifestyles, but their physical activity levels are continually disrupted due to family related constraints and maternal stressors [56].

In the demographic realm the “cost” of participating in physical activity (time spent away from children, funds to pay a sitter) may be related to income but manifest itself as a barrier in the psychosocial realm. Features of the built environment may help to level out the balance, but parents may select neighborhoods for educational reasons (better schools) and convenience to work [92, 93] which may be indicative of a reduced priority for physical activity or possible

reduced self-efficacy in the psychosocial realm. For mothers to engage in physical activity, ability to plan ahead for physical activity [94] and having sources of childcare may be more important than physical environment characteristics, and implies a need for sources of social or financial support. Parental obligations and time constraints [24, 49, 51, 57], may weaken or render moot the effects of environmental characteristics, such as nearby parks and recreational facilities, that generally make it easier for adults to engage in physical activity [8, 48, 61, 65, 66].

Study Aims

Though limited, existing evidence suggests parenthood and childrearing are related to parental PA. Additional studies are needed to examine men as well as women, multiple domains of physical activity, and a range of potential explanations or mechanisms of a “parenthood” effect.

Data from the Neighborhood Quality of Life Study (NQLS) was examined to investigate the differences in adult physical activity in households without children compared to households with children. NQLS is an observational epidemiologic study conducted in 16 neighborhoods in each of two metropolitan areas on opposite coasts of the U.S. It was designed to allow comparisons between adults residing in neighborhoods, stratified based on neighborhood walkability characteristics and median household income [59].

Three papers were prepared for this process to gain a better understanding of factors that may prevent or enable parents to engage in physical activity and to pinpoint modifiable intervention targets. The papers examined the various domains of physical activity (including household, leisure, transportation and occupational domains) among adults without children living in the home (non-parents), compared to those for adults with children under age 18 living in the household (parents), and with analyses stratified by sex of the adult. The first study compared differences in physical activity between adults with and without children. Objectively measured moderate-to-vigorous physical activity (MVPA) and self-reported physical activity in multiple domains were assessed (household, leisure, transport and occupational activity). It was hypothesized that adults in households with children would engage in less physical activity than those in households without children. Exploratory analyses examined a) differences by physical

activity domain with expectations of greater differences in leisure (less in parents) and household (more in parents) domains than occupational or transportation domains; and b) physical activity based upon the ages and number of children, which were expected to be related to physical activity outcomes.

The second study assessed whether parenthood moderated the association between self-reported psychosocial variables (self-efficacy for and enjoyment of physical activity, perceived benefits and barriers, and social support) and physical activity. A secondary purpose was to examine differences between parents and non-parents on the psychosocial measures. The hypothesis was that levels of psychosocial variables found to consistently support physical activity, such as high self-efficacy for physical activity, high social support for physical activity, and low barriers to physical activity would be related to physical activity for non-parents, but less strongly related for parents because demands of child-rearing could overcome psychosocial factors.

The third study assessed whether parenthood moderated the association of various objective and self-reported environmental variables with adult physical activity. Objective variables included built environmental features in a 1 km street network buffer around each participant's home created using Geographic Information Systems (GIS) [95]. Four sub-scales of the Neighborhood Environment Walkability Survey (NEWS) [96, 97], that did not overlap conceptually with the GIS measures, were used to characterize perceived attributes of the neighborhood thought to be particularly relevant to parents. It was hypothesized that for parents, environmental factors such as greater street connectivity, mixed land use, walkability, and high residential density would have weaker associations with objectively-measured overall physical activity and self-reported transportation activity compared to adults without children. It was also hypothesized that for parents, convenience of sidewalk facilities, aesthetics, and proximity to park and recreation services would have stronger associations with objectively-measured overall physical activity, self-reported leisure and transportation activity, and sedentary behavior compared to those without children.

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CHAPTER 2
DIFFERENCES IN PHYSICAL ACTIVITY AMONG ADULTS
IN HOUSEHOLDS WITH AND WITHOUT CHILDREN

ABSTRACT

Background: The relation of parent status to physical activity (PA) is poorly understood

Methods: Data for 909 women and 965 men, aged 20 to 57, recruited from two U.S. regions, were used for analyses. Mixed Models were used to assess differences in PA, with analyses stratified by sex. The primary outcome was accelerometer-measured total daily minutes of moderate-to-vigorous PA (MVPA).

Results: Having a child in the household was not related to parents' MVPA, but mothers reported more total PA than women without children. For both mothers and fathers, self-reported household activity was higher and sitting time lower, compared to non-parents. Both men and women with children aged 0-5 reported the highest levels of household activity and the lowest sitting time, with household PA generally higher and sitting time lower with more children.

Conclusions: Considering the potential impact of child-rearing on parent time demands, there was little difference in parents' objectively measured MVPA compared to non-parents. There was no evidence that leisure, transport, or occupational activity varied by parenthood. Parents with children aged 6-17 reported more sitting and less household activity than parents of younger children, suggesting the former may be priority targets for PA and sedentary behavior interventions.

INTRODUCTION

The transition to parenthood is difficult, with anxiety about becoming a parent [1, 2] and acquiring skills and behaviors to care for infants [3, 4]. Adjustments must be made to marital roles [1, 3, 5], job demands [1, 6], and there are impacts on emotional and physical well-being [7-9]. Effects of parental role changes on physical activity have been reported [7, 9], and the societal impact could be substantial given that, in 2007, nearly 35% of US households had at least one person under 18 years [10, 11].

A number of sources reported that parents were less active than non-parents [7, 12-17]. Common barriers to physical activity for parents included lack of free time and social support, fatigue, childcare, and familial commitments [7, 15].

Sex-specific parenting roles may have effects that vary by domain of physical activity. Having children in the home was positively associated with time spent doing household activity for both women and men; however, women retained responsibility for core housework [18-25]. Mothers participated in exercise and leisure activities 37% and 32% less frequently, respectively, but were over 10 times more likely to do household activities than childless women [26]. Several studies found that mothers spent more time in routine child care and developmental activities, while fathers spent more time teaching or playing, suggesting that children might be a source of physical activity for fathers [25, 27]. Knoester [28] found slight increases in child care and household labor done by fathers. He also found that a new child living in the household reduced men's social participation, including physically active social participation, but increased their participation in service organizations, hours of employment, and interactions with and support from extended family [28].

In summary, parenthood appears to affect adult physical activity, with decreases in leisure, and increases in household physical activity. Contributing to these changes may be parental perceptions of decreased convenience and accessibility to physical activity due to increased demands on their time and increased attentiveness to child-related issues. Available studies, however, under-represent fathers, are based primarily on self-reported data, or data

drawn from studies designed for demographic rather than health purposes [18]. There is a lack of information regarding the impact of number and age of children on parental physical activity across all domains.

The present study compared differences in physical activity between adults with and without children under age 18 living in the household, with analyses stratified by sex of adult. Objectively measured moderate-to-vigorous physical activity (MVPA) and self-reported physical activity in multiple domains were assessed (household, leisure, transport and occupational activity). Number and age of children were examined for their association with parent physical activity.

METHODS

Design

Based on an ecological model that emphasizes multiple levels of influence on behaviors [11, 29], the Neighborhood Quality of Life Study (NQLS) compared physical activity outcomes among residents of neighborhoods that differed on objective neighborhood “walkability” characteristics and median household income in two U.S. metropolitan areas [30]. Neighborhoods were selected to meet criteria for four quadrants in each region: 1) high walkability - high income; 2) low walkability - low income; 3) high walkability - low income, and; 4) low walkability - high income [31]. High walkable neighborhoods had relatively higher residential density, retail floor area ratios, land use mix, and intersection density compared to low walkable neighborhoods. Income was classified as low or high based on deciles from the 2000 census, with median household incomes less than \$15,000 or greater than \$150,000 excluded, to avoid outliers, and two middle deciles omitted to separate low from high categories. Details can be found elsewhere [30, 31].

Recruitment and Informed Consent

Participants were recruited between 2002-2005, from 32 selected neighborhoods, 16 each from Seattle-King County and Baltimore-Washington DC regions, with sampling designed to be balanced by sex [31]. Households were randomly selected using information from a marketing

company. Introductory letters were mailed, followed by telephone calls. Recruitment details and informed consent procedures have been reported elsewhere [30, 31]. This study was approved by Institutional Review Boards from participating institutions.

Participants

As reported in Sallis et al. [30], data were collected from 2199 participants, who were from 20 to 65 years of age, not residing in group living establishments, able to walk, willing to wear an accelerometer, and able to complete written surveys in English. Compared to census population data, the sample was older, had fewer females, more whites, fewer Hispanics, and higher household incomes than residents of neighborhoods in which participants lived. Participation and retention rates have been reported [30].

Data for 1051 women (445 with children in the household), and 1136 men (464 with children in the household) were available. Potential confounds were identified related to age inequality between adults in households with and without children. The first relates to a reduction in aerobic capacity of close to 10% per decade with aging [32, 33], and the second to age-related reduction in physical activity, among both men and women, with younger adults being more active than older adults [34, 35]. To reduce the confounding effect of mean age differences between samples, participants aged 58 or older were omitted from both groups. The cut point was based on U.S. data indicating that the birth rate for women aged 35-39, 40-44, and 45-49 was 43.8, 8.7, and 0.5 per 1000, respectively [36]. Omitting those aged 58 or older (with children over age 18 if parents were age 40 at birth) was expected to result in a substantial reduction of older participants. This omission resulted in a drop in mean age from 46.8 to 42.9 for non parents and from 42.4 to 41.7 for parents, removing 35 participants with children and 281 without. This left a total of 909 women (405 with children), and 965 men (418 with children) for present analyses.

Measurement

Data collection procedures

Surveys and accelerometer data were collected twice, with a 6-month interval, but only data from the first survey were used in present analyses [31]. Participants were given the option of completing a mailed, online or telephone interview survey [31].

Objective Measure of Physical Activity

Moderate-to-vigorous physical activity (MVPA) over a 7-day period was assessed with ActiGraph accelerometers (www.theactigraph.com; Fort Walton, FL) set to record intensity of movement each minute. The ActiGraph measures acceleration in the vertical plane, with output directly related to intensity of motion. Reliability and validity have been extensively documented [37]. As described previously [30], for each measurement, participants were instructed to wear the accelerometer snugly around the waist for seven days. A valid day consisted of at least 8 valid hours, with valid hours having no more than 30 consecutive 'zero' values. Participants were asked to re-wear the accelerometer if there were not at least 5 valid days, or at least 66 valid hours, across seven days. For valid days, each minute was scored as meeting at least a moderate intensity physical activity criterion or not, based on published cut points [38]. Average daily minutes of MVPA for valid days was the summary variable used in analyses [30, 31].

Self-reported Physical Activity

The International Physical Activity Questionnaire (IPAQ) self-administered long version was used to assess physical activity in four domains: occupational, household, transportation, and leisure, as well as total physical activity and past 7-day time spent sitting [39]. For each domain, participants were asked for the number of days during the past week they engaged in vigorous or moderate activity for at least 10 minutes and the typical minutes per day. A sum of the total minutes per week of moderate and vigorous activity was calculated for each domain, without weighting for intensity. IPAQ has been found to have good test-retest reliability, and tests of validity using correlations with ActiGraphs (median Spearman correlation of .30), were comparable to other self-reports [39].

Body mass index (BMI)

Self-reported weight and height was used to calculate BMI (kg/m²).

Demographic Information

General demographic information was reported on the first survey: age, sex, ethnicity (re-categorized as non-Hispanic white or nonwhite [including Hispanic]), five levels of educational attainment (from less than high school to a graduate degree), and marital status (re-categorized as married/living together or other). The number of children under age 18 living in the household and ages of up to six children were obtained by survey.

Statistical analyses

The sample was characterized using descriptive statistics, and mixed effects regression models (SPSS version 17.0) were fitted for all continuous dependent variables. The IPAQ variables were natural-log transformed due to skewness (cut point ≥ 2.0). Accelerometer MVPA, IPAQ reported total sitting minutes per week, and BMI were used without transformations. The transformed variables were used for the statistical analysis procedures, and back-transformed means and confidence intervals were used to indicate central tendencies.

The analyses took neighborhood clustering into account, using a two-level data structure in which subjects were nested within neighborhoods. The primary exposure of interest was the presence of one household member less than 18 years of age. Analyses were conducted across adults with and without children in the household to explore differences in physical activity levels by domain of physical activity. Due to sex differences in physical activity and household roles [7, 41], analyses were conducted separately for males and females. Models were adjusted for the demographic covariates and BMI (except when BMI was the outcome). The variable for site (Seattle or Baltimore) and a variable representing the four neighborhood income-by-walkability quadrants were included as fixed effects. If results yielded Hessian warnings, analyses were run without the term for neighborhood clustering because the intraclass correlation (ICC) for neighborhood clustering was determined to equal zero.

The primary analyses examined the association of parenthood with MVPA. Secondary analyses examined the association of parenthood with IPAQ-reported physical activity, sitting and BMI. Exploratory analyses examined whether parental outcomes varied by age (categorized by age of youngest child) and number of children.

RESULTS

Participant characteristics

A higher percentage of men with children were married or living with a partner compared to those without children (see Table 2.1). Men with a child more often lived in low-walkable/high income neighborhoods compared to those without children who most often reported living in high-walkable/low income neighborhoods.

Women with a child were younger than those without a child, reported fewer years of education, and were more likely to report being married or living with a partner (see Table 2.1). Women with children were more likely to live in low-walkable rather than high-walkable neighborhoods in comparison to women with no children.

Physical Activity, sitting, and BMI by parent status

Table 2.2 shows that for men, having a child in the home was significantly related to 3 of the 8 outcomes. Men with children had a higher BMI and reported less sitting time and more household-related physical activity, compared to men without children.

For women, significant differences were found for 3 of the 8 outcomes (see Table 2.2). Women with children reported engaging in less sitting behavior, more household-related physical activity, and more total IPAQ-reported activity, compared to women without children. There also was a trend ($p=.06$) for women with no children to report more leisure time PA than did women with children in the home.

Physical Activity, sitting, and BMI by age of children

Table 2.3 shows that, for men, differences in physical activity by child age group were found for sitting time and household activity, as illustrated in Figure 2.1 a and b. Men with children aged 0-5 reported the lowest amount of sitting time, and non-parents and those with

teens reported the highest. In a parallel finding, men with children aged 0-5 reported the highest level of household activity, which dropped to no-child levels with older children. Differences for women with, versus without, children in the household were also found for sitting time and household physical activity, as shown in Table 2.3 and Figure 2.1 c and d.

Women with children aged 0-5 reported lower sitting time than any other group, and twice as much household activity as women with no children, although these differences decreased with child age. Accelerometer measures of MVPA were lowest for women with children aged 0-5. There were no BMI differences in men or women by child age.

Physical Activity, sitting, and BMI by number of children

Number of children under age 18 in the household was related to sitting time and household activity for men (See Table 2.4 and Figure 2.2 a and b). Fewer minutes sitting were reported with increasing numbers of children, except men with 3 or more children for whom sitting time was highest. Household physical activity was generally higher with the number of children. For women, differences were found in past 7-day sitting time, household activity, and total IPAQ measured physical activity (See Table 2.4, and Figure 2.2 c and d). For sitting time, there was a general trend for fewer sitting minutes with more children in the household. Women with no children reported the least household activity, with higher activity for those with more children. Women with 3 or more children had much higher scores for self-reported total physical activity than all other groups. There were no BMI differences in men or women by number of children in the household.

DISCUSSION

Having children in the home was not related to men's total physical activity, whether assessed objectively or by self report. In contrast, women with children reported more total physical activity than women without children, but there were no accelerometer-based differences between women with and without children. BMI was higher for men with children, with no BMI differences observed between women with versus without children. For other physical activity domains, findings indicated that for both men and women with children, household activity was

higher and sitting time was lower, compared to those without children. However, the apparent impact of children was much stronger for women's activity. Women with children reported spending over 8 hours less per week sitting, 2.5 hours more in total activity, and 2.3 hours more in household activity than women without children. Men with children reported sitting 4.5 fewer hours per week and doing household activity an hour per week more than men without children. Having children in the home was not related to self-reported leisure activity, transport activity, or job-related activity for either men or women.

Findings related to more household activity for men and women with children in the home are consistent with other studies on the impact of children on parent physical activity, particularly the larger effects for mothers [18-26, 42]. Previous studies indicated a trend for less leisure activity among parents [7] and fathers [43] while the present study indicated no child effect for leisure, occupation, or transport domains. The present study added a new finding that women with children in the home reported more total activity considering all domains, primarily due to higher household activity, though this was not confirmed by accelerometry.

Household activity and sitting time were significantly related to age and number of children in the home. Women with children aged 0-5 were found to have the highest level of household activity, but lowest accelerometer measured MVPA. This discrepancy might be due to the inability of the accelerometer to measure common household and child care-related activity such as lifting and carrying infants and toddlers [44-46]. An alternative explanation is that the demands of parenting young children may cause a temporary drop in other activity domains, as suggested by Lee [47]. In the present study, for women with children aged 6-12 and 13-17, there were no differences in accelerometer-measured MVPA compared to women with no children.

Urizar previously found that perceived maternal stressors reduced participation in physical activity, regardless of the number of children at home [13]. However, present results indicated that women and men with more children reported fewer sitting minutes and more household activity. A striking finding was that both men and women with 3 or more children reported substantially more household activity. Women who had 3 or more children reported

higher IPAQ total activity minutes than all other groups, probably accounted for by more household activity.

Strengths and limitations

The use of both objective and self-report measures of physical activity strengthens this study compared to previous studies using only self reports. Accelerometers are considered objective indicators of PA [37], and the validated IPAQ allowed examination of physical activity domains relevant to the study of the influence children have on adults in the home. Use of self-reported data to calculate BMI was a limitation.

This study was not designed to investigate physical activity and parent status per se, but there were sufficient participants with and without children in the home to allow meaningful comparisons by subgroups, including number and age of children. That the study sample was largely White, fairly well educated and that participants were somewhat more affluent than non-participants limits the generalizability of findings. Accelerometry, and the activity count thresholds used to characterize MVPA, likely underestimates activities like lifting and carrying infants and other household activities (e.g., cleaning up after children), which might especially impact its accuracy with parents of young children.

Implications

Considering the potential impact of child rearing on available time, the total physical activity of participants with children in the home was remarkably similar to those without children, especially when measured objectively. There was no evidence that leisure, transport, or occupational activity varied by having children in the home. On the positive side, those with children reported less sitting and more household activity than those without children, patterns that indicate lower health risks [48-50]. However, parents with school-age children in the home reported more sitting and less household activity than those with younger children, so individuals with school-age children and adults with no children may be prime targets for interventions.

Future research should target populations with more socioeconomic and ethnic variability to explore whether demographic diversity moderates physical activity effects of living with

children. The potential moderating role of parental employment should be examined, because worksites could be an effective intervention venue to reach parents with children transitioning to school age.

ACKNOWLEDGEMENTS

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Table 2.1 - Descriptive statistics for demographic variables stratified by child status

	Adults no children <18 years old living in home			Adults with children <18 years old living in home				P
	<u>Men</u>	N	Mean or %	SD	N	Mean or %		
Age		547	43.0	10.21	418	42.7	7.5	t=-0.5 P = 0.75
Area								X ² =6.1 P = 0.01
Living in Seattle area (%)		363	66.4		245	58.6		
Living in Baltimore area (%)		184	33.6		173	41.4		
Education								X ² =7.8 P = 0.2
Did not complete HS		6	1.1		6	1.4		
Completed HS		36	6.6		30	7.2		
Some college/vocational		160	29.3		100	24.0		
Completed college		203	37.2		146	35.0		
Graduate degree		141	25.8		135	32.4		
Race/ethnicity								X ² =0.7 P=0.4
White, non-Hispanic (%)		430	79.2		320	76.9		
Children by age (yes)								
Aged 0-5		0			173	41.4		
Aged 6-12		0			145	34.7		
Aged 13-17		0			99	23.7		
Number of Children < 18 in HH								
One		0			163	39		
Two		0			182	43.5		
3+		0			73	17.5		
Marital status								X ² =162.6 P<0.001
Married /Living with partner		290	53		381	91.1		
Not Married /Living with partner		257	47		37	8.9		
Quadrant								X ² =38.2 P<0.001
Low walkability/low income		136	27.0		113	27.9		
Low walkability/high income		81	16.1		121	29.9		
High walkability/Low income		145	28.8		82	20.2		
High walkability/High income		142	28.2		89	22.0		
<u>Women</u>	N	Mean or %	SD	N	Mean or %	SD		P
Age	504	42.87	10.65	405	40.55	8.16	t=-3.723 X ² =.014	P < .001 P = 0.91
Area								
Living in Seattle area (%)	288	57.1		233	57.5			
Living in Baltimore area (%)	216	42.9		172	42.5			
Education	N	%		N	%			X ² =15.7 P < 0.01
Did not complete high school	6	1.2		14	3.5			
Completed high school	30	6.0		33	8.2			
Some college/vocational	120	23.8		115	28.5			
Completed college	194	38.5		122	30.3			
Graduate degree	154	30.6		119	29.5			
Race/ethnicity								X ² =2.41 P=0.12
White, non-Hispanic (%)	355	71.1		268	66.3			
Children by age								
Aged 0-5	0			175	43.2			
Aged 6-12	0			138	34.1			
Aged 13-17	0			90	22.2			
Children < 18 in household								
One				192	47.4			
Two				154	38			
3+				59	14.6			
Marital status								X ² =87.23 P<0.001
Married/Living with partner	203	40.4		289	71.5			
Not Married/Living with partner	299	59.6		115	28.5			
Walkability by Income Quadrant								X ² =29.26 P<0.001
Low walkability/low income	124	27.0		85	27.9			
Low walkability/high income	122	16.1		163	29.9			
High walkability/Low income	167	28.8		75	20.2			
High walkability/High income	134	28.2		95	22.0			

Table 2.2 ^aAdjusted mean values for adult physical activity and BMI by child status.

Men	No children in household	Children in household	F	P
Variable	n=517 Mean (CI)	n=408 Mean (CI)		
Accelerometry measured moderate-to-vigorous physical activity (min/day)	38.4 (35.5, 41.3)	35.9 (32.8, 38.9)	2.4	0.12
BMI (kg/m ²)	26.5 (26.0, 27.0)	27.1 (26.6, 27.7)	4.2	0.04
Past 7-day sitting time (min/week)	2678.7 (2545.8, 2811.6)	2407.5 (2266.3, 2548.6)	10.6	0.001
Leisure activity (antilog min/week)	49.4 (37.9, 64.5)	45.7 (34.5, 60.5)	0.3	0.62
Transport activity (antilog min/week)	32.6 (23.5, 45.2)	30.4 (21.6, 42.6)	0.2	0.7
Job-related activity (antilog min/week)	76.1 (53.6, 108.2)	80.2 (55.5, 115.7)	0.06	0.8
Household activity (antilog min/week)	100.9 (79.0, 128.8)	155.1 (119.8, 200.5)	8.8	0.003
Total IPAQ activity (antilog min/week)	828.0 (720.5, 951.5)	930.8 (802.7, 1079.2)	1.8	0.19
Women	No children	Children	F	P
Variable	n=476 Mean (CI)	n=388 Mean (CI)		
Accelerometry measured moderate-to-vigorous physical activity (min/day)	27.5 (25.1, 29.8)	26.1 (23.8, 28.5)	0.9	0.34
BMI (kg/m ²)	27.2 (26.5, 27.9)	27.2 (26.5, 27.9)	0.0	0.99
Past 7-day sitting time (min/week)	2754.9 (2630.5, 2879.3)	2226.6 (2100.8, 2352.3)	40.6	0.000
Leisure activity (antilog min/week)	60.8 (48.3, 76.6)	45.3 (35.9, 57.2)	3.7	0.06
Transport activity (antilog min/week)	28.3 (20.8, 38.5)	32.4 (23.7, 44.3)	0.7	0.4
Job-related activity (antilog min/week)	47.0 (32.0, 68.7)	45.7 (30.7, 68.3)	0.01	0.92
Household activity (antilog min/week)	182.6 (148.1, 225.0)	319.9 (259.0, 395.1)	19.0	<0.001
Total IPAQ activity (antilog min/week)	809.2 (704.2, 929.8)	961.0 (834.6, 1106.6)	4.0	.05

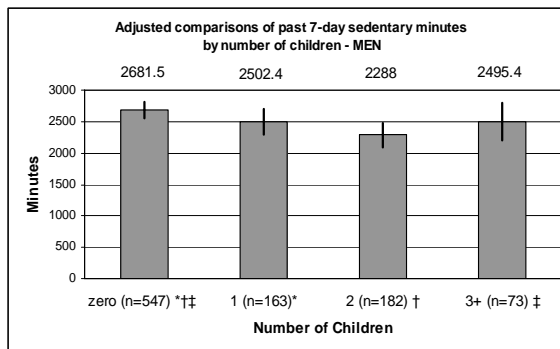
^aAll models, were adjusted for education, ethnicity, site, marital status, age, income-by-walkability quadrant, and with the exception of past 7-day sitting time, neighborhood clustering; BMI also adjusted in physical activity models. Past 7-day sitting was not adjusted for neighborhood clustering because no clustering was present (ICC = 0).

Table 2.3 ^aAdjusted mean values for physical activity related measures, by child age

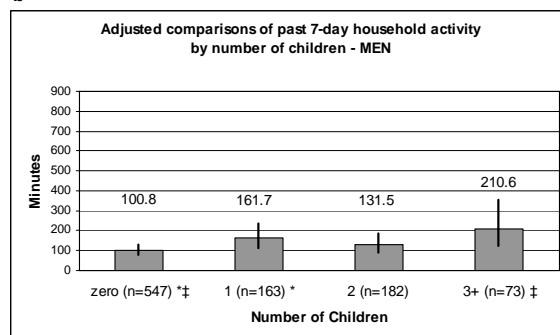
Variable	No children		Children			F	P
	Men n=547	0-5 years old n=173	6-12 years old n=145	13-17 years old n=99			
Moderate-to-vigorous physical activity (min/day)	Mean (CI) 38.3 (35.4, 41.3)	Mean (CI) 36.4 (32.1, 40.6)	Mean (CI) 35.9 (31.6, 40.3)	Mean (CI) 35.2 (29.9, 40.4)		.74	0.5
BMI (kg/m ²)	26.5 (25.9, 27.0)	27.1 (26.3, 27.8)	26.9 (26.1, 27.7)	27.6 (26.7, 28.6)		1.98	0.1
Past 7-day sitting time (min/week)	2679.2 [†] (2547, 2811.4)	2269.5 [‡] (2064.5, 2474.5)	2359.9 ^{†*} (2145.1, 2574.6)	2726.0 [‡] (2464.3, 2987.8)		6.26	<0.001
Leisure activity (antilog min/week)	49.0 (37.6, 63.9)	36.9 (24.8, 54.9)	55.8 (36.8, 84.6)	50.7 (30.6, 83.9)		.87	0.5
Transport activity (antilog min/week)	32.6 (23.5, 45.3)	38.4 (24.6, 60.0)	29.9 (18.9, 47.4)	20.4 (11.9, 35.1)		1.42	0.2
Job-related activity (antilog min/week)	76.1 (53.6, 108.1)	78.8 (46.5, 133.6)	89.7 (50.7, 158.7)	72.6 (36.2, 137.8)		.13	0.9
Household activity (antilog min/week)	101.5 (79.0, 129.0)	209.6 [‡] (145.5, 301.9)	145.5 (99.5, 212.7)	99.5 [‡] (63.1, 158.1)		5.21	<0.001
Total IPAQ activity (antilog min/week)	828.0 (719.8, 951.5)	1042.1 (838.8, 1294.7)	846.4 (673.2, 1063.2)	885.4 (669.8, 1170.3)		1.27	0.3
	Women n=504	0-5 years old n=175	6-12 years old n=138	13-17 years old n=90	F	P	
Moderate-to-vigorous physical activity (min/day)	27.5 (25.2, 29.8)	22.9 (19.6, 26.3)	28.7 (25.1, 32.3)	28.4 (23.9, 32.9)	2.6	0.05	
BMI (kg/m ²)	27.2 (26.5, 27.9)	27.3 (26.3, 28.3)	27.2 (26.1, 28.3)	26.9 (25.6, 28.3)	.08	0.97	
Past 7-day sitting time (min/week)	2750.6 ^{*†‡} (2627.0, 2874.2)	2007.3 ^{*‡} (1820.8, 2193.9)	2341.8 ^{†‡} (2137.9, 2545.7)	2476.8 [‡] (2222.0, 2731.6)	16.6	<0.001	
Leisure activity (antilog min/week)	59.5 (47.2, 75.0)	35.8 (25.3, 50.9)	52.7 (36.0, 77.1)	57.7 (35.8, 93.0)	2.09	0.1	
Transport activity (antilog min/week)	27.8 (20.5, 37.8)	32.6 (21.5, 49.3)	42.0 (27.1, 65.2)	24.5 (14.3, 41.9)	1.35	0.26	
Job-related activity (antilog min/week)	47.4 (32.3, 69.4)	38.4 (20.9, 70.5)	47.9 (26.0, 88.3)	58.7 (27.7, 124.6)	.27	0.85	
Household activity (antilog min/week)	179.5 ^{*†} (145.5, 220.3)	378.0 [*] (280.1, 510.3)	301.6 [†] (218.1, 417.0)	265.9 (177.7, 398.2)	7.6	<0.001	
Total IPAQ activity (antilog min/week)	805.9 (703.5, 924.3)	965.8 (791.6, 1179.7)	972.6 (783.7, 1205.9)	963.0 (736.6, 1258.9)	1.52	0.21	

^aAll models, were adjusted for education, ethnicity, site, marital status, age, income-by-walkability quadrant, and with the exception of past 7-day sitting time, neighborhood clustering. All but BMI were adjusted for BMI. Past 7-day sitting was not adjusted for neighborhood clustering because no clustering was present (ICC = 0). * † ‡ [‡] [‡] [‡] Like symbols across columns indicate significant differences (P < 0.05) between two categories.

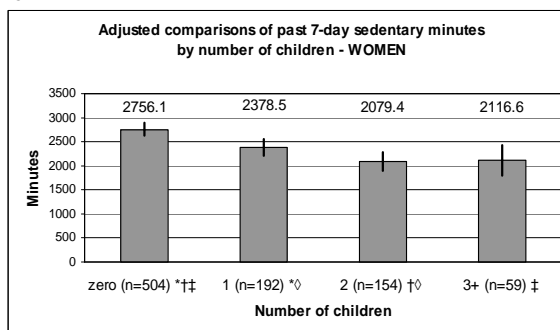
a



b



c



d

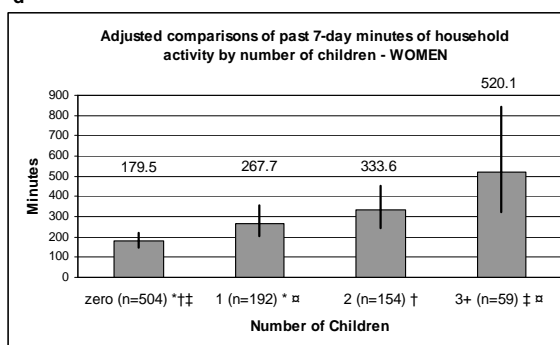


Figure 2.2 Differences in physical activity by number of children
 All models, were adjusted for education, ethnicity, site, marital status, age, income-by-walkability quadrant, and for all but past 7-day sitting time, neighborhood clustering. All but BMI were adjusted for BMI. Past 7-day sitting was not adjusted for neighborhood clustering because no clustering was present (ICC = 0). *† †∅ ∅ ‡ Like symbols indicate significant differences between categories P < 0.05

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CHAPTER 3

PARENTHOOD AS A MODERATOR OF THE RELATION BETWEEN PSYCHOSOCIAL VARIABLES AND PHYSICAL ACTIVITY IN ADULTS

ABSTRACT

Rationale: Parenthood, which may require significant time for child caretaking, may modify the associations between psychosocial variables and adults' physical activity (PA), such that psychosocial variables have weaker associations with PA.

Methods: Data for 909 women (405 parents) and 965 men (418 parents), aged 20 to 57 years and recruited from two U.S. regions were evaluated. The primary outcome was accelerometer-measured total daily minutes of moderate-to-vigorous PA (MVPA). Secondary outcomes were self-reported past-7-day minutes of leisure, transportation, household and total physical activity and sitting time. Mixed models, stratified by sex, were used to determine whether parenthood moderated the association between psychosocial factors (PA-related self-efficacy, social support, barriers, benefits, and enjoyment) and PA.

Results: Significant interactions indicated that family social support was more important for parents than non-parents in several PA domains. For women, social support from friends was more important for parents than non-parents for leisure and self-reported total activity. For men, high self-efficacy appeared to be advantageous for men without children, but not for fathers. For women, self-efficacy interactions were mixed, with self-efficacy showing more benefit for mothers than non-mothers with walking for transportation, but more benefit to non-mothers for MVPA. No interactions were found for PA benefits or enjoyment for either men or women.

Conclusion: Few of the findings were consistent with expectations that parental obligations diminish the relation of psychosocial factors to parents' PA. Results imply that an emphasis on social support interventions to increase physical activity may be more effective for men and women with children in the household than for those without children.

INTRODUCTION

Most adults are not meeting the physical activity guidelines to promote and maintain health [1, 2]. Physical activity interventions for adults have shown only moderate effects with little long-term maintenance, so improved interventions are needed [3].

An understanding of the correlates of physical activity can help to identify intervention mediators and tailor interventions for specific populations. Among the many psychosocial correlates evaluated, self-efficacy, social support from friends and family, expected benefits, and enjoyment of physical activity have been found to have consistently positive associations with physical activity [4-6]. Barriers to physical activity have been found to be negatively associated with physical activity [4, 5].

Because these psychosocial variables can function in different ways depending on the situation [5] and geographic and cultural settings, further information is needed on how they operate within different contexts and subgroups [4]. Based on time use, and the often cited physical activity barrier of lack of time, parenthood could be a particularly critical barrier to physical activity. In addition to overall activity, Trost (2002) specifically identified a need for more information on correlates of physical activity by domain (transport, leisure, occupational, household) and sedentary behaviors. The potential impact of having children in the household on parent physical activity may be high, given that nearly 35% of US households had at least one person under 18 years of age in 2007 [7].

Parenthood may be a moderator of psychosocial correlates of physical activity that merits additional study. Role changes related to parenthood, such as time devoted to childcare and increased housework, can reduce the time adults have for personal activity [8-11]. These changes may be sufficiently disruptive to reduce the strength of the relationship between psychosocial variables and parent physical activity [12-14]. For example, an adult who highly values physical activity and has considerable confidence in engaging in physical activity may retain these attitudinal predilections when becoming a parent, but parental responsibilities may decrease the amount of physical activity in which he/she engages. If parenthood disrupts such

associations, the implication is that interventions targeting psychosocial factors would be less effective for parents and other strategies are needed. Several physical activity interventions for parents have had low efficacy [11, 15], and weaker associations of physical activity with psychosocial variables for parents may partially explain lack of effects.

Less favorable levels of psychosocial variables, for example more barriers due to time constraints, for parents than non-parents [10, 11, 16, 17], could interfere with intervention effectiveness. Previous analyses of the present dataset found that having a child in the household was not related to parents' accelerometer-based MVPA, but women with children reported more total physical activity than women without children. For both male and female parents, self-reported household activity was higher and sitting time lower, compared to non-parents [18].

The purpose of present analyses was to assess whether having children under age 18 living in the household moderated the association between psychosocial variables (self-efficacy for and enjoyment of, perceived benefits of and barriers to, and social support for physical activity) and physical activity. A secondary purpose was to examine differences between parents and non-parents on the psychosocial measures.

METHODS

Design

The present study used data from the Neighborhood Quality of Life Study (NQLS) which was designed to study a variety of correlates of physical activity in adults [19]. Based on an ecological model that emphasizes multiple levels of influence on behaviors [20, 21], NQLS examined physical activity outcomes among residents of neighborhoods in two US metropolitan areas, stratified on "walkability" characteristics of the built environment and census-based median household income [22]. Neighborhoods were selected to meet criteria for four quadrants in each region: 1) high walkability - high income; 2) low walkability - low income; 3) high walkability - low income, and; 4) low walkability - high income [23]. Details regarding the

walkability and income measures for neighborhood selection are described elsewhere [22, 23]. The study was approved by Institutional review Boards from participating institutions.

Recruitment and Informed Consent

Participants were recruited between 2002-2005, from 32 neighborhoods, 16 each from Seattle, WA and Baltimore, MD regions, with sampling designed to be balanced by sex [23]. Adults from the identified neighborhoods were randomly selected from contact information purchased from a marketing company. Project introduction letters were mailed to potential participant households and followed with telephone calls by project staff [22, 23].

Participants

Data for the study were collected from 2199 participants 20 to 65 years of age, not residing in group living establishments, able to walk, willing to wear an accelerometer, and able to complete written surveys in English [22]. The sample was somewhat older, with fewer females, more Whites, fewer Hispanics, and higher household incomes than residents of neighborhoods in which participants lived (based on Census 2000 data). Participation and retention details are described elsewhere [22].

To reduce potential confounds related to physical activity and age inequality between adults with and without children [24, 25], participants aged 58 or older were omitted from both groups for these analyses. Doing so resulted in a drop in mean age from 46.8 to 42.9 for non parents and from 42.4 to 41.7 for parents, removing 35 participants with children and 281 without. Details are reported elsewhere [18]. A total of 909 women (405 with children), and 965 men (418 with children) remained for these analyses.

Measurement

Data collection procedures

Survey and accelerometer data was collected in two phases, but only data from the first phase were used for the present analysis (See the complete NQLS survey at

<http://www.drjamesallis.sdsu.edu/measures.html>) [23]. Participants provided written consent for their participation. The first phase incentive payment was \$20.

Objective measure of Physical Activity

Total moderate-to-vigorous physical activity (MVPA) over a 7-day period was assessed with ActiGraph accelerometers (model 7164 or 71256; www.theactigraph.com; Pensacola, FL) set to record intensity of movement each minute. The ActiGraph measures acceleration in the vertical plane, with output directly related to intensity of motion. Reliability and validity have been extensively documented [26]. Participants were instructed to wear the accelerometer above the right hip on a study-provided elastic belt fit snugly around the waist for seven days. A valid day consisted of at least 8 valid hours, with valid hours having no more than 30 consecutive 'zero' values. Participants were asked to re-wear the accelerometer if there were not at least 5 valid days, or at least 66 valid hours, across seven days. For valid days, each minute was scored as meeting at least a moderate intensity physical activity criterion or not, based on published cut points [27]. Average daily minutes of MVPA for valid days was the summary variable used in analyses [22, 23].

Self-reported Physical Activity

The International Physical Activity Questionnaire (IPAQ) self-administered long version was used to collect physical activity data in four domains: occupational, household, transportation, and leisure, as well as total physical activity and past 7-day time spent sitting [28]. Occupational physical activity analyses are not reported here because there was no obvious pathway from psychosocial factors to occupational physical activity. For each domain, participants were asked separately for the number of days during the past week they engaged in walking, moderate and vigorous activity for at least 10 minutes at a time and the typical minutes per day. Paired days and minutes measures were multiplied to calculate minutes per week engaged in a given activity. A sum of the total minutes per week of moderate and vigorous activity was then calculated for each domain, without weighting. IPAQ has been found to have good test-

retest reliability, and tests of validity using correlations with ActiGraphs (median Spearman correlation of .30), were comparable to other self-report physical activity measures [28].

Body mass index (BMI)

Self-reported weight and height was used to calculate BMI (kg/m^2).

Demographic Information

Age, sex, ethnicity (recategorized as non-Hispanic white or nonwhite [including Hispanic]), five levels of educational attainment (from less than high school to a graduate degree), and marital status (re-categorized as married/living together or other) were reported. The number of children under age 18 living in the household and ages for up to six children were obtained by survey.

Psychosocial Measures

Social support for physical activity was measured with a shortened version of a previously validated scale [29]. On a 5-point response scale (never to very often) participants rated (separately for friends and family) how often over the last three months their friends and family engaged in supportive behaviors, such as encouraging them to do physical activity or doing it with them. A 3-item scale for friends support and a 3-item scale for family support for physical activity were constructed as the means of item responses. The combined 6-item version had high test-retest reliability [30] and support for validity by association with physical activity [31].

Perceived benefits of physical activity were measured using a 5-point rating scale adapted from that used by Hovell [30], for which participants were asked to rate agreement with 10 possible exercise benefits. Test-retest reliability has exceeded 80% [30]. Scores were computed by averaging the responses on the items [32].

Barriers to physical activity were measured using a 5-point rating scale adapted from Hovell [30]. Participants were asked to rate how often (never to very often) 15 barriers prevented them from being active. Concurrent validity for this scale was demonstrated by significant correlations with vigorous physical activity [31, 33].

Self-efficacy was measured using an abbreviated and adapted version of a validated scale [34]. A 3-item subset explained physical activity in previous studies and demonstrated high test-retest agreement [30]. These items were adapted to create a 6-item scale (3 items regarding confidence for doing vigorous and 3 items for doing moderate physical activity). The mean of responses to the 6 items was computed for the scale score.

Enjoyment of physical activity was assessed using a measure developed by the NQLS investigators. Enjoyment was assessed using a 5-point disagree/agree response scale with 3 questions regarding enjoyment of moderate and 3 questions regarding vigorous activity. For the present analyses, the mean of responses to all 6 items was computed for the scale score (internal consistency alpha = 0.89).

Statistical analyses

The sample was characterized using descriptive statistics such as means, frequencies and percentages. Mixed effects regression models (SPSS version 17.0) were fitted for all continuous dependent variables. The IPAQ physical activity variables were natural-log transformed because they were skewed (skewness cut point ≥ 2.0). Accelerometer MVPA, and IPAQ-reported total sitting minutes per week were used without transformations. Transformed variables were used for the statistical analyses, and back-transformed means and confidence intervals were reported to indicate central tendencies.

The analyses took neighborhood clustering into account using a two-level data structure in which subjects were nested within neighborhoods. The primary exposure of interest for participants was whether the household had a member less than 18 years of age (defined as parenthood, yes=1, no=0). Analyses were conducted to assess whether parenthood moderated the association between six psychosocial variables and six measures of physical activity by testing models that included the parenthood variable, a given psychosocial variable, and a parenthood-by-psychosocial variable interaction term. All models were adjusted for the demographic covariates and BMI. The variable for site (Seattle or Baltimore) and a variable representing the four neighborhood income-by-walkability quadrants were included as fixed

effects to control for study design effects. When results yielded Hessian warnings, models were re-run without including the random effect term for neighborhood clustering because the intraclass correlation (ICC) for neighborhood clustering was determined to equal zero. Finally, due to sex differences in physical activity and household roles [4, 16], analyses were conducted separately for males and females, for a total of 72 tests.

Psychosocial variables were recoded for the present analyses to create low, medium, and high categories, to simplify interpretation. Tertiles were used to ensure a sufficient number of participants per cell and uniformity across cells in n-size. Men and women differed significantly on four of the six psychosocial variables (data not shown), so tertiles were calculated separately for men and women (see Table 3.1). For parenthood-by-psychosocial variable interactions yielding $p < .10$, follow-up analyses were conducted to obtain means for low, medium, and high levels of each psychosocial variable, separately by sex, and for those with and without children.

RESULTS

Participant characteristics

As reported elsewhere, male parents had a higher mean BMI, and a higher percentage were married or living with a partner (91.1%) compared to men without children in the household (53%). Fathers and men without children did not differ by age, over 75% of both groups reported they were Caucasian, and greater than 60% of both had completed college [18]. Female parents and non-parents did not differ by ethnicity, but mothers were younger than women without children (mean age 40.55 versus 42.87), more likely to report being married or living with a partner (71.5% for mothers versus 40.4% women without children), and less likely to have completed college (59.8% versus 69.1%) [18].

Table 3.1 presents sex-specific tertile means for each psychosocial variable. As shown in Table 3.2, men with children reported higher levels of social support from family and higher enjoyment for physical activity than men without children. Mothers also reported more social support from family but less self-efficacy to engage in physical activity than women without children. There were no other significant differences between parents and non-parents for any

other psychosocial factors for either men or women. It is notable that approximately 30% of men and women without children reported 'never' getting support from family for physical activity.

Physical activity in relation to parent status, psychosocial variables, and their interactions

The following significant ($p < .10$) interactions of psychosocial variables with parent status were found for men: family social support for household and transportation activity; and self-efficacy for total IPAQ and transportation activity. For women, interactions were found for family social support for household and leisure activity; friend social support for total IPAQ and leisure activity; and self-efficacy for transportation activity and accelerometer-based MVPA. The latter was the only interaction found concerning MVPA.

Of the 72 tests relating the psychosocial variables to the measures of physical activity, inclusion of the psychosocial variable main effects in the models did not change the parenthood and physical activity associations reported in a previous paper [18], with 2 exceptions. For women, the addition of benefits and barriers in the model changed the relation of parent status to total IPAQ activity from a borderline value to a value of $p \leq 0.05$ (data not shown).

Explanation of Interactions

Family Support

The association between household activity and family social support was stronger for fathers than for men without children, with the greatest change in trajectory occurring from the low to the medium tertile (See figure 3.1a, attached.). There was a 149 minute difference between high and low support for fathers compared to 79 minutes for non-fathers. Transportation activity had an increasing trajectory across levels of family social support for fathers (a 29 minute increase between high and low support), with no trend for men without children (See Figure 3.1b, attached.).

Mothers' household activity decreased from the low to medium tertiles of family social support but increased from the medium to high tertiles. Mothers with high family support reported 83 minutes per week more household activity than mothers with low support (See Figure 3.1c, attached.). For women without children the association showed a continual increase in trajectory

across family social support tertiles, and those with high support reported 118 minutes per week more household activity than non-mothers with low support.

Mothers' leisure activity increased substantially from the low to medium family social support tertile, with little additional increase from medium to high. Mothers with high support reported 37 minutes more of leisure activity per week than women with low support. (See Figure 3.1d, attached.) There was a linear increase in leisure time activity for women without children, with those having high support reporting 21 minutes more leisure activity per week than those with low support.

Social Support from Friends

Interactions with physical activity and social support from friends were found only among women. The association between IPAQ total activity and social support from friends was stronger for mothers than for women without children, with the greatest change in trajectory for mothers occurring from the medium to the high tertile (See Figure 3.1e, attached.). The difference in total IPAQ activity from low to high friend support was 584 minutes per week for mothers compared to 144 minutes per week for women without children. The association between leisure activity and social support from friends was stronger for mothers than for women without children, with a greater change in trajectory from the low to medium tertile for mothers compared to women without children (See Figure 3.1f, attached.). Mothers with high support engaged in 74 more minutes of leisure activity each week than mothers with low support, compared to 53 minutes more across friend-support tertiles for non-mothers.

Self-Efficacy

Interaction patterns of self-efficacy and parent status were different for men and women (See Figure 3.2 a-d, attached.). For fathers, there was an inverse association between transportation activity and self-efficacy, with the greatest decline in transportation activity occurring from low to medium efficacy, and a slight increase from medium to high efficacy (12 minutes decrease in transportation activity per week across self-efficacy tertiles) (See Figure 3.2a, attached.). For men without children, transportation activity increased from low to medium

efficacy, with a slight decrease from medium to high self-efficacy (18 minutes increase per week across self-efficacy tertiles).

For fathers, total IPAQ activity increased from low to medium self-efficacy levels, and decreased from medium to high levels of efficacy (a 130 minute per week increase across self-efficacy tertiles) (See Figure 3.2b, attached.). For men without children, total IPAQ activity increased slightly from low to medium self-efficacy and increased much more from medium to high self-efficacy. High-efficacious men without children reported 585 minutes more total IPAQ activity minutes per week than those with low self-efficacy.

For mothers, transportation activity (Figure 3.2c, attached.) displayed a small decline from low to medium levels of self-efficacy, with an increasing trajectory occurring from medium to high self-efficacy (a 20 minute per week increase across self-efficacy tertiles). For non-mothers transportation activity increased from low to medium levels of self-efficacy and decreased from medium to high efficacy (a 10 minute per week increase from low to high self-efficacy).

For mothers, MVPA decreased from low to medium levels of self-efficacy, with an increasing trajectory occurring from medium to high levels of self-efficacy (a 10 minute per day increase from low to high self-efficacy). For non-mothers MVPA increased linearly from low to high levels of self-efficacy (a 16 minute per day increase across self-efficacy tertiles; See Figure 3.2d.).

DISCUSSION

In the present study, of 72 comparisons, 10 “significant” interactions (at $p \leq .10$) indicated that parent status may moderate the association between psychosocial variables and physical activity outcomes. For men, parenthood moderated family social support associations with household and transportation; and self-efficacy associations with transportation and Total IPAQ activity. For women, parenthood moderated family social support associations with household and leisure activity; social support from friends associations with total IPAQ and leisure activity; and self-efficacy associations with transportation activity and MVPA. Of the 10 interactions, only three supported the hypothesis that associations of psychosocial variables with physical activity

would be weaker for parents. There were more significant interactions indicating psychosocial variables were more strongly associated with physical activity for parents than non-parents.

A main finding was that family social support was more important for parents than non-parents, across multiple physical activity outcomes for both sexes. This was not consistent with expectations that parental obligations might diminish the usefulness of social support among parents [8, 10, 11, 16, 17]. It is possible that family members who offered to or did physical activity with participants, or encouraged them to do so, also helped with child care duties that allowed participants to engage in physical activity [11]. Parents of both sexes with high family social support reported higher household activity minutes per week than parents with low family support. This suggests a kind of reciprocity as described by Wood [13] in which two-parent families adapt to child-rearing demands by modifying care-giving roles and responsibilities. Social support main effect findings were consistent with other NQLS [35] analyses and studies showing support is related to physical activity among adults, adding to the generalizability of the finding [4, 10, 35-37].

For women, social support from friends was more important for parents than non-parents. For both IPAQ total and leisure activity, support from both friends and family was more important for mothers than non-mothers. This fits with Brown's (2001) findings that mothers with access to social support may be in a better position than those without support to navigate obstacles to physical activity [10]. Present findings also correspond with literature suggesting that planning for physical activity is more important for women, as social support from friends implies prior arrangement [38].

With regard to self-efficacy and physical activity, findings were inconsistent by gender and physical activity outcome. There were significant interactions for both men and women with the transportation activity outcome. For fathers, there was generally an unexpected inverse association between self-efficacy and transportation activity, whereas non-fathers had a positive association. For mothers, however, high self-efficacy had a stronger positive association with transportation activity than for non-mothers. Other studies found stronger associations with self-

efficacy and overall activity [39, 40], but previous studies have not examined self-efficacy and transportation activity. The inconsistent findings could be due to a mismatch between self-efficacy items that refer mainly to leisure activity with the transportation activity outcome. The literature has emphasized the relation of active transportation with built environment variables [39, 41].

The role of parenthood in moderating the association of self-efficacy with measures of total physical activity was the best evidence in support of original hypotheses. Men's total IPAQ activity and women's MVPA results were consistent with the hypothesis that, for parents, high self-efficacy would have weaker associations with physical activity than for non-parents. Thus, the demands of parenting may undermine high self-efficacy to be active. This makes sense given findings from other studies that younger women reported higher self-efficacy but more barriers for physical activity than older women, and that having children was associated with less structured and lower intensity physical activity [42]. For younger women, such as mothers in the present study, it is possible that their physical activity schedules or goals were disrupted by parental obligations. It could also be that because self-efficacy is a cognitive construct, it may be more subject to disruption than social support, which may be more observable or concrete (e.g., receiving verbal encouragement to be active).

Strengths and Limitations

The use of both objective and self-report measures of physical activity strengthens the study. Accelerometers are valid objective indicators of physical activity [26], and the validated IPAQ allowed examination of multiple physical activity domains. Use of self-reported data to calculate BMI was a limitation.

The NQLS study was not designed to investigate physical activity and parent status per se. For this reason, it is not known whether the child was biologically related to the parent respondent, and behavior-specific data related to social support or self-efficacy [43] and a child in the household (i.e., how often care for child is available so I can be physically active), were not available.

There were sufficient participants for present analyses to allow meaningful comparisons by sex and multiple physical activity domains with the psychosocial variables. Further examination of the data by number and age of children was not possible due to small cell sizes.

The study sample was largely White, fairly well educated, and participants somewhat more affluent than non-participants. This limits the generalizability of findings.

Implications

Social support was generally a stronger correlate of physical activity for parents than non-parents, across multiple physical activity outcomes and for both sexes. The Community Guide lists social support interventions as an evidence-based approach for physical activity promotion [44]. The results of the present study corroborate the importance of social support-based interventions [11, 45, 46] and imply that such interventions may be particularly effective for parents. Social support may provide practical assistance that helps busy parents overcome barriers. By contrast, self-efficacy was more strongly related to overall physical activity for non-parents than for parents. Though self-efficacy is a consistent correlate of physical activity [4, 5, 6], it may not be sufficient to help parents overcome their barriers.

Based on present findings, interventions that promote new and take advantage of existing social support networks, among both family and friends [45, 47], and that consider the unique needs of parents at different life stages [18, 42, 48] may be recommended for mothers. For fathers, interventions increasing support from spouses, children and other family members may be an effective approach [49].

Research is needed to obtain information on gender-specific social support behaviors that promote physical activity among adults with children in the home. Special attention should be given to research that measures separate effects of the impact of child care availability and physical activity practices that involve parent and child, as well as controlled studies to test related interventions. Future research should include populations with more socioeconomic and ethnic variability to examine whether psychosocial mediators of physical activity for parents differ by demographic diversity.

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Table 3.1 Psychosocial variable cut points and means for low, medium, and high level tertiles, by parent sex

<u>Variables and tertile cut points</u>	<u>Low</u>		<u>Med</u>		<u>High</u>	
	<u>N</u> <u>Mean</u>	<u>SD</u>	<u>N</u> <u>Mean</u>	<u>SD</u>	<u>N</u> <u>Mean</u>	<u>SD</u>
Family Social Support (5 pt scale, 0-4, 4=very often)						
Men (0 = 0 thru .6667), (1 > 0.6667 ≤ 2.0), (2 > 2)	n = 333 .23	.29	n = 369 1.60	.39	n = 260 2.95	.59
Women (0 = 0 thru 1.0), (1 > 1.0 ≤ 2.0), (2 > 2)	n = 367 .37	.41	n = 279 1.67	.28	n = 265 2.99	.57
Social Support - Friend (5 pt scale, 0-4, 4=very often)						
Men (0 = 0 thru .6667), (1 > 0.6667 ≤ 2.0), (2 > 2)	n = 393 .19	.27	n = 360 1.53	.39	n = 209 2.98	.57
Women (0 = 0 thru 1.0), (1 > 1.0 ≤ 2.0), (2 > 2)	n = 381 .39	.41	n = 263 1.69	.29	n = 268 2.99	.60
Benefits of regular PA (5 pt scale, 5=high benefit)						
Men (0 ≤ 3.9000=0), (1 > 3.90 thru 4.50), (2 > 4.5)	n = 306 3.50	.45	n = 353 4.24	.17	n = 253 4.81	.15
Women (0 ≤ 4.1), (1 > 4.1 ≤ 4.7), (2 > 4.7)	n = 362 3.69	.47	n = 362 4.46	.17	n = 362 4.91	.09
Barriers to regular PA (4 pt scale, 0-4, 4=frequent)						
Men (0 ≤ 1.0) (1 > 1.0 ≤ 1.533) (2 > 1.533)	n = 351 .63	.27	n = 286 1.27	.14	n = 328 1.92	.33
Women (0 ≤ 1.133) (1 > 1.133 ≤ 1.733) (2 > 1.733)	n = 278 .64	.30	n = 297 1.41	.17	n = 336 2.16	.36
Efficacy for MVPA (5 pt scale, 5=high efficacy)						
Men (0 ≤ 3.833) (1 > 3.8333 ≤ 4.5) (2 > 4.5)	n = 304 2.64	.49	n = 388 3.76	.27	n = 273 4.68	.27
Women (0 ≤ 3.1667) (1 > 3.1667 ≤ 4.0) (2 > 4.0)	n = 316 2.59	.53	n = 306 3.65	.23	n = 290 4.61	.30
Enjoy MVPA (5 pt scale, 5=high enjoyment)						
Men (0 ≤ 3.333) (1 > 3.333 ≤ 4.1667) (2 > 4.16671)	n = 296 3.09	.58	n = 372 4.16	.23	n = 297 4.91	.13
Women (0 ≤ 3.833) (1 > 3.833 ≤ 4.5) (2 > 4.5)	n = 294 3.09	.58	n = 318 4.19	.24	n = 300 4.89	.14

Table 3.2 Descriptive statistics for psychosocial variables stratified by child status

	<u>Non-parents</u> Adults no children <18 years old living in home N=547		<u>Parents</u> Adults with children <18 years old living in home N=418			
<u>Men</u>	Mean	SD	Mean	SD	t	p
Social Support						
Family (5 pt scale, 0-4, 4=very often)	1.5	1.2	1.8	1.0	-7.9	<.001
Friends (5 pt scale, 0-4, 4=very often)	1.3	1.2	1.3	1.1	0.7	0.48
Benefits of regular PA (5 pt scale, 5=high benefit)	4.1	0.6	4.2	0.6	-1.5	0.2
Barriers to regular PA (4 pt scale, 0-4, 4=frequent barrier)	1.3	0.6	1.3	0.6	-.01	0.99
Efficacy for MVPA (5 pt scale, 5=high efficacy)	3.7	0.9	3.6	0.8	0.7	0.5
Enjoy MVPA (5 pt scale, 5=high enjoyment)	4.0	0.8	4.1	0.8	-2.5	.01
<u>Women</u>	Mean	SD	Mean	SD	t	p
	N=504		N=405			
Social Support						
Family (5 pt scale, 0-4, 4=very often)	1.3	1.2	1.8	1.1	-6.8	<0.001
Friends (5 pt scale, 0-4, 4=very often)	1.5	1.2	1.5	1.2	0.1	0.9
Benefits of regular PA (5 pt scale, 5=high benefit)	4.3	0.6	4.4	0.6	-1.0	0.3
Barriers to regular PA (5 pt scale, 0-4, 4=frequent barrier)	1.4	0.7	1.5	0.7	-0.8	0.4
Efficacy for MVPA (5 pt scale, 5=high efficacy)	3.7	0.9	3.5	0.9	2.2	0.03
Enjoy MVPA (5 pt scale, 5=high enjoyment)	4.1	0.8	4.0	0.8	0.6	0.5

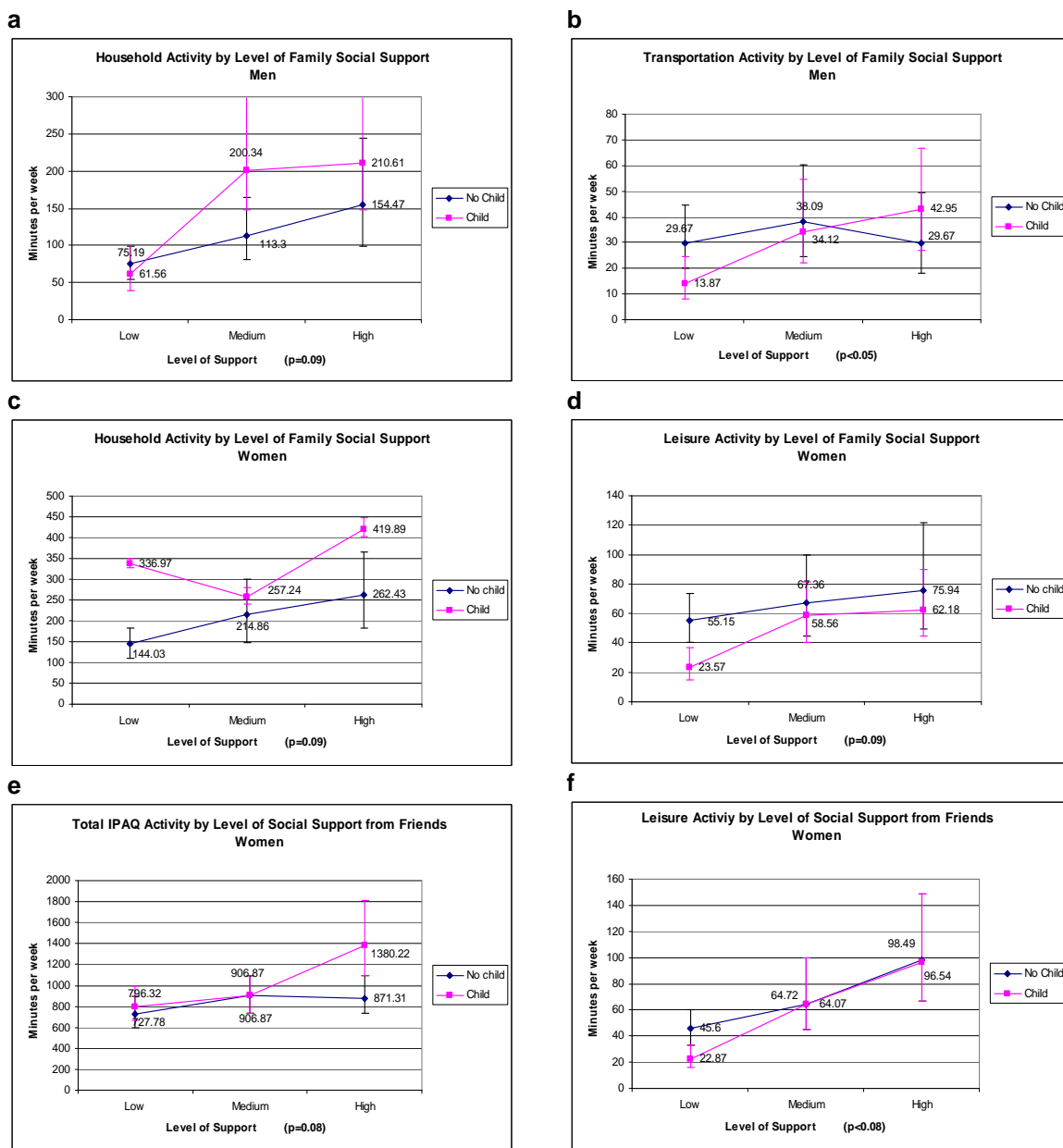


Figure 3.1a-f Social Support for Physical Activity - Adjusted mean values for physical activity by parenthood status. Models were adjusted for education, ethnicity, site, marital status, age, income-by-walkability quadrant, and with the exception of past 7 day sitting time, neighborhood clustering, and BMI. Past 7 day sitting was not adjusted for neighborhood clustering because no clustering was present (ICC = 0).

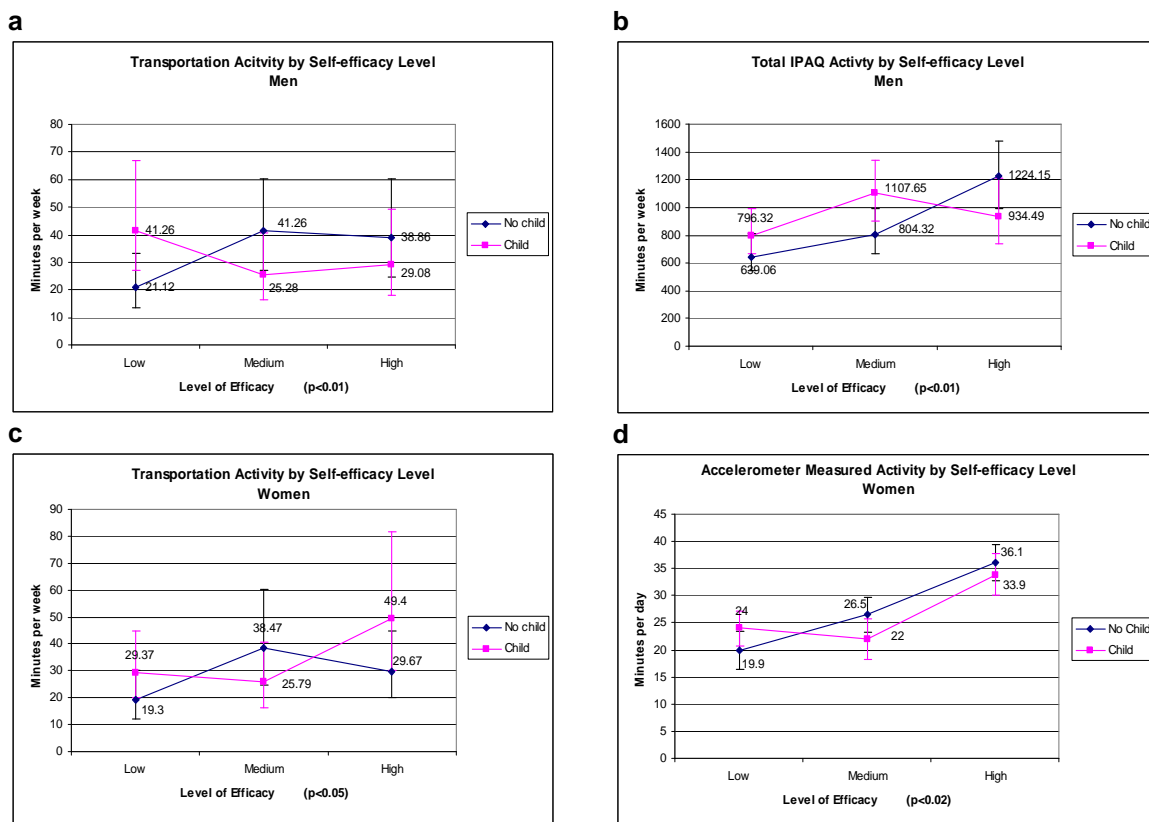


Figure 3.2a-d Self-efficacy for Physical Activity - Adjusted mean values for physical activity by parenthood status. Models were adjusted for education, ethnicity, site, marital status, age, income-by-walkability quadrant, neighborhood clustering, and BMI. Past 7 day sitting was not adjusted for neighborhood clustering because no clustering was present (ICC = 0).

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CHAPTER 4

PARENTHOOD AS A MODERATOR OF THE RELATION OF WALKABILITY AND PARK PROXIMITY VARIABLES TO ADULT PHYSICAL ACTIVITY

ABSTRACT

Rationale: Parenthood factors that can divert parent time to child-rearing may moderate the walkability-physical activity, and park proximity-physical activity associations among adults.

Methods: Data were examined for 909 women (405 parents) and 965 men (418 parents), aged 20 to 57 years and recruited from two U.S. regions as part of the Neighborhood Quality of Life Study. The primary outcome was accelerometer-measured total daily minutes of moderate-to-vigorous PA (MVPA). Secondary outcomes were self-reported past week minutes of transportation and leisure activity, and sitting time. Environmental attributes examined, included features (greater street connectivity, mixed land use, and high residential density) that support the ability to walk to destinations (neighborhood “walkability”) and those that have had consistent associations with leisure activity (convenience of sidewalk and trail facilities, proximity to park and recreation services and accessibility of equipment and recreation facilities). Mixed models, stratified by sex, were used to determine whether having a child (<18 years old) living in the household moderated the association between the eight objective built environmental attributes in a 1 km street network buffer around each participant’s home, four reported built environment NEWS subscale variables (Aesthetics, Pedestrian Safety, Crime, Walking and cycling facilities), and physical activity.

Results: Results indicated that parents are at a disadvantage with respect to built environment features that are conducive to being physically active. Of 96 tests, only 4 significant interactions were found that might indicate parenthood interacted with several built environment features to modify transportation activity and sedentary behavior.

Conclusion: The main finding was that environmental supports for physical activity documented in many previous studies generally applied to parents as well as non-parents. Future studies to identify parent-specific information related to transportation activity destinations and activity options might be useful in forming physical activity promotion strategies. Studies that provide insight into parent selection of neighborhoods for their families might help to pinpoint targets for environmental interventions.

INTRODUCTION

Most adults do not meet the physical activity guidelines to promote and maintain health [1, 2]. For adults with at least one person under 18 years old in the home, approximately 35% of US households in 2007 [3], time demands and anxiety about becoming a parent [4, 5], caring for infants and children [6, 7], and adjusting to parental roles [4, 6, 8], may make it more difficult than for those without children to meet the physical activity guidelines [9-18]. It is possible that parental demands interfere with adults' ability to take advantage of physical activity opportunities in their home environments. Although there is substantial evidence related to the role of physical environments and adult physical activity [19-21], little is known about the specific role of the physical environment for parents or whether convenient resources help parents to engage in physical activity [11].

The physical attributes of neighborhoods, have been consistently linked with physical activity [19, 21-25]. Recreation-related environmental factors like convenience of sidewalk and trail facilities, proximity to park and recreation services and accessibility of equipment and recreation destinations have had consistent associations with leisure activity [24, 26-31].

Walkable neighborhoods, those with greater street connectivity, mixed land use, and high residential density, have been associated with walking or biking to get to and from places (transportation activity) and higher total physical activity [19, 23, 24, 28, 32-35].

Parental demands may interfere with parents' ability to take advantage of physical activity opportunities in their home environments due to time constraints and obligations that may consume opportunities to take the short walk to a nearby grocery store, or visit neighborhood park and recreation centers. Among the studies that have examined environmental factors and parenthood, Tilt found that adults with children living at home walked most frequently to parks compared to other destinations, and aesthetic factors and living within close proximity to a variety of destinations was positively associated with walking trips [36]. Riva found that women aged 35–44 (80% of women aged 40 to 44 were mothers in 2006 [37]) were less likely to use local facilities for physical activity than women aged 25–34 and 45–55 [38], which may indicate that

parental demands inhibit physical activity in this group. In a prospective study of mothers, access to public transport and trusting neighbors were predictive of increases in leisure walking [39]. Connectivity, pedestrian crossings, and slow local traffic speed predicted increases in transport-related walking [39]. Satisfaction with local facilities (parks, fitness/recreation centers) was associated with increasing both leisure and transport-related walking, and social environment was important in maintaining high levels of leisure- and transport-related walking [39].

Based on available studies, it appears neighborhood environment features are related to parents' physical activity, but it is not clear if environmental attributes are related differently for parents and non-parents. Parenthood may moderate the association between environmental factors and physical activity and may do so differently for mothers and fathers [40]. Parent selection of neighborhoods for good schools and convenience to work [41, 42] may be indicative of a reduced priority for physical activity. For mothers to engage in physical activity, ability to plan ahead to be active [43] and having sources of childcare may be more important than physical environment characteristics. Parental obligations and time constraints [11, 44-46], may weaken or render moot the effects of environmental characteristics, such as nearby parks and recreational facilities, that generally make it easier for adults to engage in physical activity [24, 27-30]. Authors have called for improved understanding of the association between environmental factors and physical activity among parents [11, 30].

The purpose of present analyses was to assess whether having children under age 18 living in the household moderated the association of environmental variables with adult physical activity. It was hypothesized that for parents, the association with environmental factors such as greater street connectivity, mixed land use, walkability, and high residential density [19, 23, 28, 34] would have weaker associations with objectively-measured overall physical activity and self-reported transportation activity compared to adults without children due to time demands related to parental roles and obligations. It was also hypothesized that for parents, convenience of sidewalk and trail facilities, aesthetics, and proximity to park and recreation services [24, 28, 34] would have stronger associations with objectively-measured overall physical activity and self-

reported leisure and transportation activity and sedentary behavior compared to those without children, because parents are likely to use these types of facilities with their children. Due to sex differences in physical activity and household roles [11, 30], analyses were conducted separately for males and females.

METHODS

Design

The present study used data from the Neighborhood Quality of Life Study (NQLS) which was designed to study a variety of correlates of physical activity in adults [47]. Based on an ecological model that emphasizes multiple levels of influence on behaviors [18, 48], NQLS compared physical activity outcomes among residents of neighborhoods in two US metropolitan areas, stratified on “walkability” characteristics and median household income [22]. Neighborhoods were selected to meet criteria for four quadrants in each region: 1) high walkability - high income; 2) low walkability - low income; 3) high walkability - low income, and; 4) low walkability - high income [49]. Details regarding the walkability and income measures for neighborhood selection are described elsewhere [22, 49]. The study was approved by Institutional review Boards from participating institutions.

Summary of Previous Analyses

Previous analyses of the present dataset found that having a child in the household was not related to accelerometer-based total MVPA. However, for both male and female parents, self-reported household activity was higher and sitting time lower, compared to non-parents [50]. In separate analyses, parent status was not found to diminish the relation of psychosocial factors to parents’ physical activity, but family social support was found to be more important for parents than non-parents in several physical activity domains. Social support from friends also appeared to be more important for mothers than non-mothers for leisure and self-reported total activity [51].

Recruitment and Informed Consent

Participants were recruited between 2002-2005, from 32 neighborhoods, 16 each from Seattle, WA and Baltimore, MD regions, with sampling designed to be balanced by sex [49].

Adults were randomly selected from neighborhoods using contact information from a marketing company. Project introduction letters were mailed to households and followed by telephone calls [22, 49].

Participants

Data for the study were collected from 2199 participants 20 to 65 years of age, not residing in group living establishments, able to walk, willing to wear an accelerometer, and able to complete written surveys in English [22]. The sample was older, had fewer females, more Whites, fewer Hispanics, and higher household incomes than residents of neighborhoods in which participants lived. Participation and retention details are described elsewhere [22].

Potential confounds were identified related to physical activity and age inequality between adults in households with and without children [52, 53]. To reduce the mean age differences between samples, participants aged 58 or older were omitted from both groups, resulting in a drop in mean age from 46.8 to 42.9 for non parents and from 42.4 to 41.7 for parents, removing 35 participants with children and 281 without (Details are reported elsewhere [50]). A total of 909 women (405 with children), and 965 men (418 with children) remained for these analyses.

Measurement

Data collection procedures

NQLS data collection included two phases of survey and accelerometer assessment, but data only from the first phase were used for the present analysis (See the complete NQLS survey at <http://www.drjamesallis.sdsu.edu/measures.html>) [49]. The first phase incentive payment was \$20 and participants provided written consent for their participation.

Objective measure of Physical Activity

Total moderate-to-vigorous physical activity (MVPA) over a 7-day period was assessed with ActiGraph accelerometers (model 7164 or 71256; www.theactigraph.com; Fort Walton, FL) set to record intensity of movement each minute. The ActiGraph measures acceleration in the vertical plane, with output directly related to intensity of motion. Reliability and validity have been

extensively documented [54]. Participants were instructed to wear the accelerometer above the right hip on a study-provided elastic belt fit snugly around the waist for seven days. A valid day consisted of at least 8 valid hours, with valid hours having no more than 30 consecutive 'zero' values. Participants were asked to re-wear the accelerometer if there were not at least 5 valid days, or at least 66 valid hours, across seven days. For valid days, each minute was scored as meeting at least a moderate intensity physical activity criterion or not, based on published cut points [55]. Average daily minutes of MVPA for valid days was the summary variable used in analyses [22, 49].

Self-reported Physical Activity

The International Physical Activity Questionnaire (IPAQ) self-administered long version was used to collect physical activity data for transportation, and recreation activity domains, as well as total physical activity and past 7-day time spent sitting [56]. For each domain, participants were asked separately for the number of days during the past week they engaged in walking, moderate and vigorous activity for at least 10 minutes and the typical minutes per day. Paired days and minutes measures were multiplied to calculate minutes per week one engaged in a given activity. A sum of the total minutes per week of moderate and vigorous activity was then calculated for each domain, without weighting. IPAQ has been found to have good test-retest reliability, and tests of validity using correlations with ActiGraphs (median Spearman correlation of .30), were comparable to other self-report physical activity measures [56].

Body mass index (BMI)

Self-reported weight and height was used to calculate BMI (kg/m²).

Demographic Information

Age, sex, ethnicity (recategorized as non-Hispanic white or nonwhite [including Hispanic]), five levels of educational attainment (from less than high school to a graduate degree), and marital status (re-categorized as married/living together or other) were reported. The number of children under age 18 living in the household and ages of up to six children were obtained by survey.

Objective built environment- GIS walkability and proximity to parks

Geographic Information Systems (GIS) can be used to objectively measure a wide range of built environment features that may influence adults' physical activity [57, 58]. NQLS assessed multiple types of recreational facilities and built environment features around each participant's residence. A 1 km street network buffer around each participant's home was created to include proximity to public and private recreational facilities. Details of the development of these items are provided elsewhere [32, 58, 59].

To assess the effect of having a child in the home on the association between physical activity and built environmental features, the environmental variables were categorized for ease of interpretation and to ensure adequate cell sizes. For these analyses, the objective built environment variables were categorized based on cut points from published studies or expert recommendations when possible.

Data on *private recreation facilities* in the Seattle and Baltimore regions were collected using electronic and paper telephone directories, like Switchboard.com and Mapquest.com, to enumerate facilities in target counties. Approximately 1000 facilities in the Seattle region and 400 in Maryland were identified, geocoded, and added to the GIS database to create accessibility variables so that a *count of private recreation facilities within 1 km* of each participant was available [58-60]. Categorization used for these analyses was 0 = 0, 1 = 1, and 2 = 2+ facilities.

Public parks were identified in parcel databases, lists from parks agencies, and local maps. Using methods described elsewhere [61], data in GIS were used to determine the total *number of parks within or intersecting the 1 km buffer* around each participant (coded here as 0 = 0-1, 1 = 2+ parks). *Street-network distance (meters) to the nearest park* was also calculated, and coded dichotomously to maintain ordered categories (0 = <.5 miles, 1 = .5+ miles), and since relatively few participants lived greater than 1 mile from a park [26, 59, 62].

Street networks were integrated into GIS and used to create individual built environment measures for the 1 km street-network buffer around each participants' residence [58, 59]. *Net residential density* was calculated based on the number of residential units relative to the amount

of residential land (acres) within the buffer. Cut points used ($0 < 8$, $1 = 8+$ dwelling units per acre) were based on LEED neighborhood development criteria (2009) [63], and consistent with Clifton's findings of greater walk trips with greater than 5000 compared to less than 5000 housing units per square mile using National Household Travel Survey data [64]. *Land use mix* examined the evenness of distribution of the square footage dedicated to residential, entertainment, retail, and mixed (more than one use) land uses within the 1 km buffer [59]. This was tertiled ($0 = \leq 0.08$, $1 = > .08$ but < 0.26 , $2 = 0.26+$ [range 0-1]) for these analyses, because there was no published basis for cut points.

Intersection density, which corresponds with a more direct path between destinations [49], was calculated based on the number of intersections of 3 or more legs per square kilometer. Density fell below the U.S. Green Building Council's LEED (2009) Neighborhood development criteria ($140/\text{mi}^2$ or $363/\text{km}^2$) [63], so data was tertiled for these analyses to create low, medium and high categories of intersections per square kilometer ($0 < 44.86$, $1 = \geq 44.86$ but < 66.80 , $2 = 66.80+$ Intersections/ km^2). *Retail floor area ratio (FAR)*, thought to facilitate pedestrian access [49], was calculated as the square footage of retail/commercial relative to the total land area dedicated to retail/commercial within the buffer [59]. Categories were created to mirror cut points ($0 = 0$, $1 = >0$ to $< .33$, $2 = \geq .33$ to $< .67$, $3 = \geq .67$) used in other NQLS analyses [59] with categories 2 and 3 merged ($2 = 0.33+$) to realize an adequate sample size.

To compare "high" to "low" walkability areas for household related travel, a weighted *walkability index* for each census block group was used, that was derived as a function of net residential density, land use mix, intersection density, and (FAR), and for which values were calculated and normalized using Z-scores. Details related to development of the index are reported elsewhere [49]. Tertile cut points ($0 = \leq -1.89$, $1 = > -1.89$ but < 1.16 , $2 = 1.16+$) were used for coding since they represented at least a 5% increase in walkability per category, which was found to be associated with increased time spent in physically active travel [49].

Self-reported neighborhood environment

Four sub-scales of the Neighborhood Environment Walkability Survey (NEWS) [35, 65] were used to characterize perceived attributes of the neighborhood thought to be particularly relevant to parents. NEWS scales that overlapped conceptually with the GIS measures were not used. Items were rated using a 4 point scale (4 = Strongly agree), with a higher score indicating a more favorable physical activity environment. Scales included six items for neighborhood walking and cycling facilities, 6 items for aesthetics, 11 pedestrian or traffic safety items, and three items on safety from crime, with a mean value for each scale calculated for each individual. Good test-retest reliability and validity have been reported for the NEWS in multiple studies [35, 65, 66]. Information on item wording, response formats, and scoring can be found at: <http://www.drjamesallis.sdsu.edu/measures.html>. For present analyses, scale scores were categorized into 3 groups so that the low and high categories were 0.5 standard deviations below and above the mean, respectively which was roughly equivalent to tertiling the scores.

Statistical analyses

The sample was characterized using descriptive statistics such as means, frequencies and percentages. Mixed effects regression models (SPSS version 17.0) were fitted for all continuous dependent variables. The IPAQ variables were natural-log transformed because they were skewed (skewness cutpoint ≥ 2.0). Accelerometer MVPA, and IPAQ-reported total sitting minutes per week were used without transformations. The transformed variables were used for the statistical analyses, and back-transformed means and confidence intervals were reported in tables and figures to indicate central tendencies.

The analyses took neighborhood clustering into account using a two-level data structure in which subjects were nested within neighborhoods. The primary exposure of interest for participants was whether the household had a member less than 18 years of age (defined as parenthood, yes=1, no=0). Analyses compared adults with and without children to assess whether parenthood moderated the association between the 12 built environmental variables and MVPA, transportation and leisure activity, and sitting minutes. Men and women did not differ

significantly on any of the built environment variables, so common cut points, described previously, were used for both. Due to sex differences in physical activity and household roles [11, 30], analyses were conducted separately for males and females, for a total of 96 tests. Models were tested that included the parenthood variable, an environmental variable, and a parenthood-by-environmental variable interaction term. Models were adjusted for the demographic covariates and BMI. The variable for site (Seattle or Baltimore) and a variable representing the four neighborhood income-by-walkability quadrants were included as fixed effects.

When results yielded Hessian warnings, models were re-run without including the random effect term for neighborhood clustering because the intraclass correlation (ICC) for neighborhood clustering was determined to equal zero. For interactions with $p < .10$, follow-up analyses were conducted to obtain means for the specific categories for each environmental variable, separately by sex, and for those with and without children.

RESULTS

Participant characteristics

As reported elsewhere, male parents had a higher mean BMI, and a higher percentage were married or living with a partner (91.1%) compared to men without children in the household (53%). Fathers and men without children did not differ by age; over 75% of both groups reported they were Caucasian, and greater than 60% of both had completed college [50]. Female parents and non-parents did not differ by ethnicity, but mothers were younger than women without children (mean age 40.55 versus 42.87), more likely to report being married or living with a partner (71.5% for mothers versus 40.4% women without children), and less likely to have completed college (59.8% versus 69.1%) [50].

There were no significant differences between men and women for any of the objective built environment variables (data not shown). Important to note, however, is that both men and women with children differed significantly on every objective built environmental variable compared to men and women without children (See Tables 4.1 and 4.2). Parents lived in places

found to be less conducive to physical activity. For example, there were fewer parks and private recreation facilities, existing parks were further away, and scores were less favorable on the five other objective built environment measures.

Physical activity in relation to parent status, environmental variables, and their interactions

Parent status interacted with four built environment variables for self-reported physical activity. For men, a statistical interaction of parent status with Net Residential Density was found for transportation activity. For women, interactions of parent status with the number of private recreation facilities, and Walkability Index were found for transportation activity. Women's parent status interacted with park count for past week sitting time. No interactions ($p < .10$) of parent status with any of the built environment variables were found for MVPA. For the present analyses, no environmental variable, when included in the statistical models, significantly changed the previously reported associations between parenthood and MVPA, transportation or leisure activity, or sitting time [50, 51].

Explanation of Interactions

Transportation Activity

The association between transportation activity and Net Residential Density showed an increasing trajectory from lower to higher density for fathers, and a decreasing trajectory from low to high for those without children. Fathers in high density areas reported 10 minutes per week more transportation activity than fathers in lower density areas, while non-fathers in higher density areas reported 8 minutes less than non-fathers in lower density areas. In higher-density areas, fathers reported about 20 minutes more transportation activity per week than men without children (See Figure 4.1a, attached.).

For women, both mothers and women without children displayed increasing trajectories across number of private recreation facilities. For mothers, the greatest change in trajectory occurred from zero to one facility and for non-mothers from one to 2 or more facilities. Mothers in locations with 2 or more facilities reported 29.3 minutes more transportation activity per week than mothers in locations with zero facilities. Non-mothers, reported 27.9 minutes more

transportation activity per week in locations with 2 or more compared to zero facilities (See Figure 4.1b, attached.).

Both mothers and women without children displayed increasing trajectories across low to high categories of the Walkability Index. The greatest change in trajectory occurred from the low to the medium category for mothers and from the medium to the high category for non-mothers. Mothers in areas with a high Walkability Index reported 33.6 minutes more of transportation activity each week than mothers in locations with a low Walkability Index. Non-mothers in locations with a high Walkability Index reported 55.7 minutes more transportation activity per week than non-mothers in locations with a low Walkability Index (See Figure 4.1c, attached.).

Sitting Time

For park count, mothers' sitting time was lower in areas with 2 or more parks, 408 minutes less sitting time per week, compared to mothers in areas with 0-1 park. Non-mothers showed a less prominent decrease in trajectory (63 minutes of sitting time per week) from locations with 0-1 to those with 2 or more parks (Figure 4.1d, attached.).

DISCUSSION

Of 96 tests of interactions conducted for the present study, only four were significant ($p \leq .10$), indicating parent status moderated the association between environmental variables and two self-reported physical activity outcomes. Two of the interactions supported and two did not support the hypotheses of the present study, indicating weak evidence for moderation. The main finding was that environmental supports for physical activity documented in many previous studies [19, 21-25], generally applied to parents as well as non-parents.

With respect to transportation activity, living in a location with higher residential density appeared more beneficial for fathers than for non-fathers. This was not consistent with expectations that parental demands might weaken the association of Net residential density and parent transportation activity. Fathers showed the expected positive association with Net residential density, as documented in numerous studies [19, 23, 24, 28, 32-34]. The inverse

association for non-fathers was unexpected but suggests that other data sets should be re-examined for subgroup-specific effects.

For women, the number of private recreation facilities association with transportation activity did not support the hypothesis that convenience of park and recreation facilities would have stronger associations with self-reported transportation activity for parents than non-parents. Mothers and non-mothers who lived in areas with no private recreation facilities and those who lived in areas with 2 or more private recreation facilities reported similar amounts of transportation activity. The primary difference was that in areas with only one facility, mothers reported more transportation activity than non-mothers, indicating they will use whatever facilities may be nearby. This is consistent with findings that a higher number of private recreation facilities is associated more transport activity [24, 26-31].

For mothers, the Walkability Index association with transportation activity supports the hypothesis of a weaker association for parents. Transportation activity at the medium Walkability Index level was higher for mothers, but non-mothers' activity surpassed that of mothers at the highest walkability level. In areas with a 'high' walkability score, both mothers and non-mothers engaged in more transportation activity compared to women in areas with a lower walkability score. This was consistent with numerous findings that walkability was associated with increased time spent in physically active travel [34, 47]. Thus, the interaction was based on a minor effect that mothers seemed to respond more to medium levels of walkability and responses by non-mothers was greater and occurred at the highest level.

Mothers who lived in a location with two or more parks spent much less time sitting than mothers in areas with one or no parks, or non-mothers with either level of park access. For non-mothers, the difference in sitting time by park level was relatively small. This finding supports the hypothesis that, for parents, convenience of parks would have a stronger association with self-reported sedentary behavior than for non-parents [31, 36]. It is also logically consistent with Tilt's findings that adults with children living at home walked most frequently to parks compared to other destinations [36].

Strengths and limitations.

The use of both objective and self-report measures of physical activity and the built environment strengthens the study. Objective and self-reported built environment measures allowed consideration of participant perceptions along with verified physical attributes of the community. Accelerometers are valid objective indicators of physical activity [54], and the validated IPAQ allowed examination of multiple physical activity domains.

Accelerometry, and the activity count thresholds used to characterize MVPA, likely underestimated activities like lifting and carrying infants and other child-related activities involved with park play and transportation activity (e.g., walking or biking while carrying a child or pushing a stroller while walking, helping children use playground equipment), which might especially impact the accuracy of accelerometers with parents of young children (41% of fathers and 43% of mothers had a child aged 0-5 years). Use of self-reported data to calculate BMI was a limitation.

To enhance policy relevance of findings and allow comparison of results with those of other studies, cut points for categories of environmental variables were based on criteria reported in prior literature, when possible. For example, net residential density cut points were calculated based on LEED criteria for neighborhood development (2009) [63], and consistent with Clifton's findings on density and walk trips using National Household Travel Survey data [64]. Retail floor area ratio (FAR) cut points were based on those used in other NQLS analyses [61], as were those for walkability index [47].

The NQLS study was not designed to investigate physical activity and parent status per se, but there were sufficient participants to allow meaningful comparisons by sex and multiple physical activity domains with built environment variables. Information about whether physical activity involved or was the result of a child in the household (i.e., I coach the team or walk while my child practices his/her sport) was not available.

Variability in socioeconomic status and walkability ensured a heterogeneous mix of participants and neighborhood characteristics compared to studies that did not use similar

sampling procedures. The study sample was largely White, fairly well educated, and participants were somewhat more affluent than non-participants, which limits the generalizability of findings.

Implications

Although few participants were without access to parks or services of any kind (93.8% had a park within 1500 meters of their home), parents in the present study were at a distinct disadvantage with regard to environmental features shown to facilitate physical activity. The small number of significant interactions between environmental attributes and parent status, however, indicate that parents and non-parents appear to be affected similarly by neighborhood environments. Of interest was the finding that two significant interactions suggested mothers may respond to environmental features associated with transportation activity at lower levels than do non-parents. This pattern was seen for private recreation facilities and the walkability index.

Previous studies that found lower activity levels among parents than non-parents attributed the differences primarily to time demands that reduce parent time for physical activity [11, 44-46]. A major barrier to physical activity among parents documented in the present study was that parents were more likely to live in neighborhoods with lower walkability and less access to recreation facilities. This may be the result of parent selection of neighborhoods for education (better schools for their children), convenience to work [41, 42], or due to financial limitations, with less priority on opportunities for physical activity. All of these issues may be addressed to some degree with informational approaches for physical activity interventions to increase parent awareness about available facilities and physical activity options in their neighborhoods; educate them about the value of living in more activity-supportive neighborhoods; or teach strategies for overcoming environmental barriers to engaging in physical activity. Changes in family income and educational priorities for residential location are not likely to be made with informational approaches. More broadly-targeted ecological approaches that employ environmental and policy level change tactics, and that are more likely to stimulate changes in community norms and physical activity resources, may make it easier for parents at such a disadvantage to make beneficial changes to their health [67, 68].

Future studies to identify parent-specific information related to transportation activity destinations and activity options might be useful in forming physical activity promotion strategies. Studies that provide insight into parent selection of neighborhoods for their families might help to pinpoint targets for environmental interventions.

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Chapter 4, in part is currently being prepared for submission for publication of the material. Parenthood as a Moderator of the Relation of Walkability and Park Proximity Variables to Adult Physical Activity. Candelaria, JI, Sallis, JF, Conway, TL, Saelens, BE, Frank, LD, Slymen, DJ, Cain, KL, Chapman, JE, Learnihan, V. The dissertation author was the primary investigator and author of this material. The NQLS study was supported by grant HL67350 from the National Heart, Lung, and Blood Institute.

Table 4.1 Descriptive statistics for built environment variables stratified by child status- Men

Men	Adults no children <18 years old living in home N=547		Adults with children <18 years old living in home N=418		t	p
	Mean	SD	Mean	SD		
Private recreation facilities count within 1km participant buffer	3.1	4.1	1.6	2.3	7.3	<0.001
Park count within/intersect buffer	3.9	3.1	2.6	2.5	7.1	<0.001
Distance in meters of closest park (any size)	504.3	500.3	673.5	639.7	-4.5	<0.001
Walkability index	.78	3.9	-1.0	2.6	8.6	<0.001
Net Residential Density - housing units per residential acre	14.8	17.8	7.7	6.8	8.5	<0.001
Intersection Density (#/sq km)	65.1	31.6	51.9	23.6	7.4	<0.001
Retail Floor to land Area Ratio	0.5	0.4	0.3	0.3	7.4	<0.001
Mixed Use	0.24	0.2	0.18	0.2	4.6	<0.001
Aesthetics NEWS	3.1	0.6	3.1	0.6	-1.4	.2
Pedestrian Safety NEWS	2.9	0.5	2.9	0.4	-1.1	.3
Crime NEWS	3.4	0.6	3.5	.6	-3.0	<.01
Walking and cycling facilities NEWS	2.9	0.6	2.9	0.7	-0.2	.8

Table 4.2 Descriptive statistics for built environment variables stratified by child status - Women

Women	Adults no children <18 years old living in home N=504		Adults with children <18 years old living in home N=405		t	p
	Mean	SD	Mean	SD		
Private recreation facilities count within 1km participant buffer	3.4	4.6	1.6	2.5	7.4	<0.001
Park count within/intersect buffer	3.8	2.9	2.8	2.5	5.7	<0.001
Distance in meters of closest park (any size)	509.2	476.6	640.6	564.1	-3.7	<0.001
Walkability Index	.8	3.4	-.7	2.6	7.2	<0.001
Net Residential Density - housing units per residential acre	14.1	14.8	9.4	8.1	6.1	<0.001
Intersection Density (#/sq km)	63.9	28.8	54.0	24.6	5.6	<0.001
Retail Floor to land Area Ratio	0.5	0.4	0.3	0.3	5.3	<0.001
Mixed Use	0.3	0.2	0.2	0.2	5.9	<0.001
Aesthetics NEWS	3.1	0.6	3.1	0.6	-0.1	.9
Pedestrian Safety NEWS	2.9	0.5	2.9	0.5	0.1	.9
Crime NEWS	3.3	0.7	3.3	0.6	-0.6	.5
Walking and cycling facilities NEWS	3.0	0.7	2.8	0.7	3.2	<.01

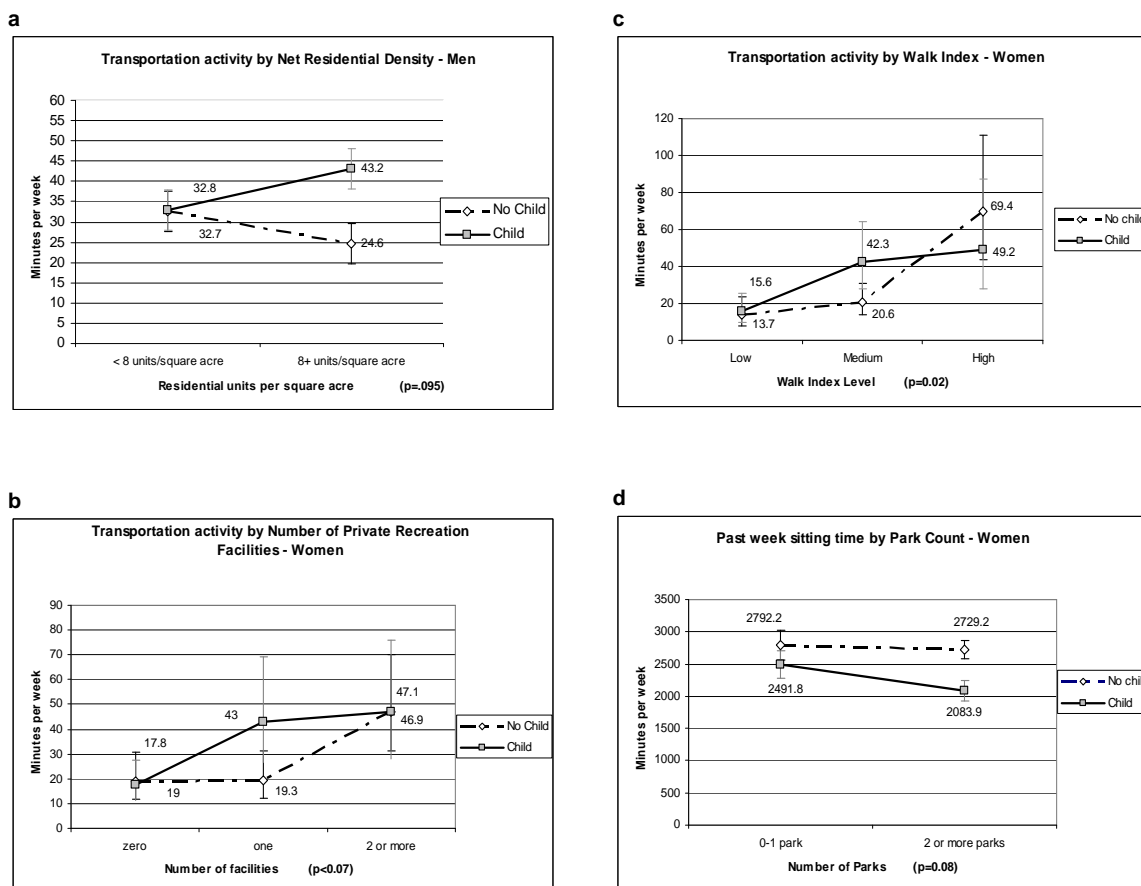


Figure 4.1 a-d Adjusted mean values for physical activity by parenthood status

All models were adjusted for education, ethnicity, site, marital status, age, income-by-walkability quadrant, neighborhood clustering, and BMI. Past 7 day sitting was not adjusted for neighborhood clustering because no clustering was present (ICC = 0)

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CHAPTER 5
DISCUSSION AND SIGNIFICANCE

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Intent of the dissertation research

This dissertation research responded to needs identified by other researchers to better understand environmental and other factors that influence different domains of physical activity (leisure, transportation, occupational, and household) and sedentary behavior, and variations in physical activity at different life stages [1]. The present studies were meant to contribute to filling gaps in the literature on fatherhood and physical activity, impact of the number and age of children on parent physical activity, and how parenthood might interact with psychosocial and environmental factors to impact physical activity [1, 2] in the context of the Ecological Model of Active Living. A better understanding of the ecological factors that prevent or enable parents to engage in physical activity may help to pinpoint modifiable targets for future interventions.

Main findings

The first paper examined components of the intrapersonal level of the Ecological model, assessing the effect of parenthood on physical activity (objective accelerometer and self-reported leisure, transportation, household, and occupational domains) while controlling for demographic (education, ethnicity, marital status, age) and biological factors (BMI), and environmental features (site and neighborhood). Having a child in the household was not related to parents' MVPA, but mothers reported more total physical activity than women without children. For both mothers and fathers, self-reported household activity was higher and sitting time lower than for non-parents, which may contribute to the lack of differences found for MVPA. Both men and women with children aged 0-5 reported the highest levels of household activity and the lowest sitting time, with household physical activity generally higher and sitting time lower with more children. Considering the potential impact of child-rearing on parent time demands [2-6], there was little difference in parents' objectively measured MVPA compared to non-parents. There was no evidence that leisure, transport, or occupational activity varied by parenthood. These findings did not support the hypothesis that parents would demonstrate lower levels of physical activity than non-parents. In fact, parents reported more household activity and less sitting time than those

without children, patterns that indicate lower health risks. Parents with children aged 6-17 reported more sitting and less household activity than parents of younger children, making the former priority targets for physical activity and sedentary behavior interventions, and lending credence to the concept that parent physical activity fluctuates with life stage and resource changes [6, 7].

The second paper explored interpersonal aspects of the Ecological Model to assess whether parent status moderated the association between six psychosocial variables and physical activity outcomes. In general, the findings were not consistent with expectations that parental obligations diminish the relation of psychosocial factors to parents' physical activity. It is possible that the psychosocial questions used for the NQLS study did not capture the parent-specific issues. For example, common barriers to physical activity for parents (lack of free time and social support, fatigue, childcare, and familial commitments [2, 5]) might show up as lack of time, energy, and company, three of 15 items on the barriers scale, resulting in a low barrier score even though "time" may be the most critical issue barring physical activity. In a similar manner, an "ethic of care" factor (parent perceptions of being a good parent) described by Miller, may not affect parent scores on the enjoyment and benefits scales of this study, but may play a role in whether or not parents engage in physical activity [8].

Significant interactions indicated that social support was generally a stronger correlate of physical activity for parents than non-parents, across multiple physical activity outcomes and for both sexes. The results of the present study corroborate the importance of social support-based interventions [9-12] and imply that such interventions may be particularly effective for parents. Social support may provide practical assistance (care for children) that may help busy parents overcome time constraints, and for women, reduce barriers by improving perceptions of personal safety and self-efficacy for physical activity with a physical activity partner [13]. By contrast, self-efficacy was more strongly related to overall physical activity for non-parents than for parents, which was the best evidence in support of the original hypotheses that parental demands may undermine high self-efficacy to be active. Though self-efficacy is a consistent correlate of physical

activity [14], it may not be sufficient to help parents overcome their barriers. For younger women or mothers in the present study, it is possible that physical activity schedules or goals were disrupted by parental obligations [1, 15, 16]. It could also be that, because self-efficacy is a cognitive construct, it may be more subject to disruption than social support, which may be more observable or concrete (e.g., having someone to watch your child while you exercise).

The third paper examined components of the environmental level of the Ecological Model to assess whether parent status moderated the association between eight objectively measured built environment measures and four reported built environment NEWS subscale variables and physical activity outcomes. Chapter 4 findings demonstrated weak evidence for moderation and did not support the hypotheses. The results indicated that the environmental supports for physical activity documented in many previous studies [17-22] generally applied to parents as well as non-parents, with both affected similarly by neighborhood environments.

Two significant interactions suggested mothers may respond to environmental features associated with transportation activity at lower levels than do non-parents. This pattern was seen for private recreation facilities and the walkability index, with activity higher for mothers in locations with only one recreation facility or with a medium walkability score, while for non-mothers higher activity was found in locations with 2 or more facilities and the highest walkability score. This finding may indicate that, given a minimal level of environmental supports, mothers will take advantage of these resources. A major barrier to physical activity among parents documented in the third paper was that parents were more likely to live in neighborhoods with lower walkability and less access to recreation facilities. Both men and women with children differed significantly on every objective built environmental variable compared to men and women without children, with parents living in places found to be less supportive of physical activity. This distinct disadvantage of parents is notable because different intervention approaches are implied for communities with limited compared to ample resources for physical activity. Because mothers appeared to take advantage of minimal levels resources, it is important to ensure that recreation facilities and walkability are adequate in neighborhoods with children.

Strengths and limitations

The NQLS study was not designed to investigate physical activity and parent status *per se*. However, the expertise and effort invested in mapping the built environmental features of the NQLS study communities and the substantial sample recruited provide valuable opportunities for these parent-related sub-analyses. While limited to applying responses to adult-specific information to parents, for each paper, specific parenting-related physical activity behaviors were identified for future study.

There were sufficient participants with and without children to allow meaningful comparisons by subgroups, including number and age of children in paper one, level of psychosocial variable in paper 2, and environmental variable level in paper 3. The diminished cell sizes resulting from categorization of psychosocial and environmental variables in papers 2 and 3 eliminated the possibility of exploring effects by age and number of children for those studies.

The use of both objective and self-report measures of physical activity strengthens this study compared to previous studies using only self reports. Accelerometers are considered objective indicators of PA [23], and the validated IPAQ allowed examination of how children may influence adults in multiple physical activity domains. Objective and self-reported built environment measures allowed consideration of participant perceptions along with verified physical attributes of the community. However, accelerometry, and the activity count thresholds used to characterize MVPA, likely underestimates parental activity involving lifting, carrying, pushing, or playing with children for physical activity domains, which would especially impact the accuracy of accelerometers with parents of young children (41% of fathers and 43% of mothers had a child aged 0-5 years). Use of self-reported data to calculate BMI was also a limitation.

Cut points for categories of environmental variables were based on criteria reported in prior literature, when possible. For example, net residential density cut points were calculated based on LEED criteria (2009) for neighborhood development [24] and consistent with Clifton's findings on density and walk trips using National Household Travel Survey data [25]. Retail floor

area ratio (FAR) cut points were based on those used in other NQLS analyses [26], as were those for walkability index [27]. This procedure enhances policy relevance of findings and allows comparison of results with those of other studies.

That the study sample was largely White, fairly well educated and that participants were somewhat more affluent than non-participants limits the generalizability of findings.

Implications for future research

The findings of this dissertation research generated questions that might be explored in future research. These include questions about both specific parenting-related physical activity behaviors and those related to potential interventions.

In Chapter 2, limitations of accelerometry with regard to potentially underestimating parent activity were described which might especially impact its accuracy with parents of young children. When assessing physical activity for parents of younger children, additional questions to assess the amount of carrying, pushing, training of and cleaning up after a small child might capture physical activity that an accelerometer might miss. Results of Chapter 2 indicated that, due to reduced household activity and increased sitting time, individuals with school-age children and adults with no children may be prime targets for interventions to reduce sedentary behavior. Future studies are needed to verify these findings. The potential moderating role of parental employment should also be examined, because worksites could be an effective intervention venue to reach parents with children transitioning to school age.

For Chapter 3, specific parenting-related physical activity information that might help to better understand the parenting-psychosocial variable associations could be gleaned from questions related to how often a respondent has care available for their children so that they can be physically active. Parent-specific questions to determine how a child might impact a parent's self-efficacy for, enjoyment of and barriers to regular physical activity would also be useful (ie., "When I walk, how guilty do I feel that I have left my child with - - -; How frequently does my child cry or complain when I take him/her with me to walk). With regard to psychosocial factors, research is needed to obtain information on gender-specific social support behaviors that

promote physical activity among adults with children in the home. Special attention should be given to research that measures separate effects of the impact of child care availability and physical activity practices that involve parent and child, as well as controlled studies to test related interventions.

For Chapter 4, specific questions related to whether parent physical activity involved or was the result of a child in the household would be useful to pinpoint intervention options. For example does the parent engage in transportation activity with the child (i.e., walks to school, parks, stores with the child; coach the team or walk while child practices his/her sport; carries the child in a backpack or pushes them in a stroller) and are built environmental supports in place to allow this to happen. Research is needed to understand if and how children are involved in parent activity. For example, do parents coach a team, walk children to school, or take advantage of sports practice time by walking to or during practice?

Finally, the study sample characteristics limited the generalizability of findings. Future research should target populations with more socioeconomic and ethnic variability to explore whether demographic diversity moderates physical activity effects of living with children.

Conclusions

In summary, the present studies examined the effects of parenthood on physical activity in the context of the Ecological Model of Active Living. In general, parents and non parents had similar levels of physical activity and responded similarly to psychosocial and environmental factors. Key differences were found for each the individual, interpersonal, and environmental levels of the Ecological model that could be helpful in developing interventions targeted to parents and merit further investigation with other populations. At the individual level, findings did not support the hypothesis that parents would engage in less physical activity than non-parents. Parents reported higher levels of household activity and less sitting time than non-parents. Compared to parents with young (aged 0-5) children, non-parents and parents with school-aged children reported less household activity and more sitting time, indicating the latter may be appropriate targets for physical activity interventions. At the interpersonal level, expectations that

parental obligations would diminish the relation of psychosocial factors to parents' physical activity were not realized. Social support was found to be a stronger correlate of physical activity for parents than non-parents, implying that social support-based interventions may be particularly effective for parents. At the environmental level, findings demonstrated weak evidence that parent status moderated the association between built environment measures and physical activity outcomes. Evidence of a parental disadvantage in access to recreation facilities and walkable neighborhoods supports the use of more broadly-targeted policy approaches to ensure parent access to environmental features that support physical activity.

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