University of Texas at El Paso
DigitalCommons@UTEP

Open Access Theses & Dissertations

2009-01-01

Prenatal Physical Activity Patterns And Determinants In An Urban Ecuadorian Population

Erika Gonzalez Beltran
University of Texas at El Paso, egonzalez31@miners.utep.edu

Follow this and additional works at: https://digitalcommons.utep.edu/open_etd

 Part of the Public Health Education and Promotion Commons

Recommended Citation
Gonzalez Beltran, Erika, "Prenatal Physical Activity Patterns And Determinants In An Urban Ecuadorian Population" (2009). *Open Access Theses & Dissertations*. 2687.
https://digitalcommons.utep.edu/open_etd/2687

This is brought to you for free and open access by DigitalCommons@UTEP. It has been accepted for inclusion in Open Access Theses & Dissertations by an authorized administrator of DigitalCommons@UTEP. For more information, please contact lweber@utep.edu.

PRENATAL PHYSICAL ACTIVITY PATTERNS AND DETERMINANTS IN AN URBAN ECUADORIAN POPULATION

ERIKA GONZALEZ BELTRAN, B.S.

Department of Public Health Sciences

APPROVED:

_____
Mary Margaret Weigel, Ph.D.

_____
Maria Duarte-Gardea, Ph.D., RD, LD

_____
Candyce Berger, Ph.D., MSW

_____
Patricia D. Witherspoon, Ph.D.
Dean of the Graduate School

Copyright ©

By

Erika Gonzalez Beltran

2009

Dedication

It is an honor to dedicate my thesis project and master's degree to the people that supported me the most in this long journey. To my parents Rosa Emma Beltran Espinoza and Arturo Gonzalez Kuehne, thank for always being on my side and give me the necessary foundations to strive and achieve my goals. Thank you for always believing in me and be a living example that hard work gives great results. I want also to dedicate this work to my beloved son Julian Aggelos Moraros-Gonzalez, who has been there for me and has lived the many sacrifices that this great effort involved. Julian, thanks for being my motivation and inspiration. Parents and son, with all my love I truly tell you that we have achieve this goal together. Thank you.

Spanish translation.

Es un honor el dedicar mi proyecto de tesis y maestría a las personas que más me han apoyado en esta larga travesía. A mis padres Rosa Emma Beltrán Espinoza y Arturo González Kuehne, gracias por estar siempre a mi lado y darme las bases necesarias para luchar y lograr mis metas. Gracias por siempre creer en mí y ser un ejemplo vivo de que el trabajo arduo da grandes frutos. Dedico también este trabajo a mi amado hijo Julian Aggelos Moraros-Gonzalez, quien ha estado a mi lado y ha vivido los múltiples sacrificios que este gran esfuerzo conlleva. Julian, gracias por ser mi motivación e inspiración. Padres e hijo, con todo mi amor de verdad les digo que esto lo hemos logrado juntos. Gracias.

PRENATAL PHYSICAL ACTIVITY PATTERNS AND DETERMINANTS IN AN URBAN ECUADORIAN POPULATION

by

ERIKA GONZALEZ BELTRAN, B.S.

THESIS

Presented to the Faculty of the Graduate School of

The University of Texas at El Paso

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF PUBLIC HEALTH

Department of Public Health Sciences

THE UNIVERSITY OF TEXAS AT EL PASO

December 2009

Acknowledgments

I would like to gratefully acknowledge the help, support, and expertise provided to me by my professor and advisor Dr. Meg Weigel. Her invaluable support guided me and encouraged me to work hard and exceed my own expectations. Also, I would like to extend my appreciation to the members of my committee, Dr. Maria Duarte-Gardea and Dr. Candyce Berger for their support, guidance, time, and expert input. As well, I would like to thank each and every one of the professors in the Master of Public Health Program because their commitment and input guided me during my studies.

Funding for the study was provided to Dr. Weigel by a grant from the International Development Bank through the Ecuadorian Foundation on Science and Technology (FUNDACYT PBID 234).

Abstract

Background & Significance. Evidence has accumulated over the past two decades suggesting that healthy pregnant women who engage in regular moderate physical activity (PA) may reduce their risk for certain adverse pregnancy and postnatal health outcomes. The U.S. Department of Health and Human Services (DHHS)/Centers for Disease Control and Prevention (CDC) recently issued the 2008 Physical Activity Guidelines for Americans which recommends at least 150 minutes/week of moderate-intensity aerobic PA for pregnant women. The American College of Obstetricians and Gynecologists (ACOG, 2002) recommends 30 min of moderate-intensity PA, specified as derived from recreational or leisure activities on most or all days of the week. The World Health Organization (WHO) does not yet published prenatal PA recommendations. Recent findings suggest that U.S. and European women decrease their PA during the second and third trimesters of gestation. However, most of these focused on recreation-derived PA and so may have underestimated the amount of moderate PA from other sources. Published information on the prenatal PA patterns and predictors in Latin American populations is scant. The population prevalence of overweight/obesity throughout Latin America has been rising rapidly among women. Likewise, type 2 diabetes, hypertension, cardiovascular conditions, and other preventable chronic conditions are becoming increasingly more prevalent in Latin American populations. Thus, the examination of prenatal PA patterns and their determinants in Latin America and other less developed countries is important. These may be distinct due to differences in sociodemographic characteristics, lifestyle and environmental conditions. Data on these are needed to help develop country-specific as well as international prenatal PA recommendations.

Objectives and Hypotheses. The major objectives of the current study were to examine the trimestral PA patterns of urban Ecuadorian women, identify major prenatal PA predictors, and compare reported physical activity with DHHS/CDC (2008) and ACOG (2002) recommendations. It was hypothesized that PA would be similar during 1st and 2nd trimesters but decrease in the 3rd trimester because of increased body mass making movement more difficult. Another a priori hypothesis was that women with more children and those employed outside the home will have higher overall PA but less recreation-derived PA compared to other pregnant women Also, physical activity would be reduced in women affected by morning sickness and other common early prenatal complaints. It was also hypothesized that women will not meet the ACOG (2002) recommendation for moderate-intensity leisure time physical activity but will accumulate an equivalent amount from other activities and will meet the DHSS/CDC (2008) recommendations for pregnant women from the Physical Activity Guidelines for Americans.

Methods. The prospective cohort study was conducted in the prenatal clinics of a municipal hospital in Quito, Ecuador. A cohort of 849 apparently healthy women was followed from the 1st through 3rd trimesters. Data on sociodemographic, reproductive/obstetric, lifestyle, common somatic symptoms, and living conditions were collected using a structured questionnaire with open- and closed-ended questions that was administered during the 1st and 2nd trimesters. Repeated 24-hour PA recall data were collected from subjects at their 1st, 2nd, and 3rd trimester. The recall instrument was designed to capture a full range of activities encountered in daily life such as sleeping, resting, housework, childcare, employment, transportation, recreational, and other activities. Subjects were asked to recall the reported context, intensity, and duration of time in 15-minute increments spent engaged in different types of activities during

the prior 24-hour period. The intensity or metabolic equivalents (METs) of the different reported activities were obtained from the updated Compendium of Physical Activities which provided an estimate of overall energy expenditure per 24-hour period. Metabolic equivalent hours (MET-hours), a measure of both intensity and duration of specific activities were calculated. These were time/24 hours spent sleeping and resting (0.9 METs) or in very low-intensity activities (1.0-1.9 METs), low-intensity activities (2.0-2.9 METs), moderate-intensity activities (3.0-5.9 METs), and high-intensity activities (> 6 METS). Descriptive, bivariate and multivariate analytical methods were used to examine the data.

Results. Most subjects were aged < 30 years, married, and had completed at least some middle or high school education. Four-tenths were primiparas and only 45% said their current pregnancy was planned. Fewer than 10% reported periconceptual use of tobacco (1.4%) or alcohol (9.8%). Common early prenatal somatic complaints included morning sickness (77%), fatigue (90.1%), dizziness (45.7%), increased irritability (79.6%), breast tenderness (79.4%) and uterine heaviness (79.6%). No statistically significant differences were identified for total mean MET's across trimesters 1-3 (37.4 $\pm$ 4 vs. 37.4 $\pm$ 3.9 vs. 37.0 $\pm$ 4; F=1.1; 3.3). However, mean MET's expenditures from specific activity categories differed. For example, the amount spent sleeping/resting were higher in the 1st trimester compared to 2nd and 3rd trimesters (9.3 $\pm$ 2.0 vs. 8.9 $\pm$ 1.6 vs. 9.0 $\pm$ 1.7; F= 9.3; P=0.002). In contrast, the contribution of very low intensity activities increased from the 1st to 3rd trimester (10.4 $\pm$ 4.4 vs. 11.3 $\pm$ 4.4 vs. 11.8 $\pm$ 4.3; F=17.6; P= 0.001) while those from low intensity activity decreased (14.3 $\pm$ 7.4 vs. 14.1 $\pm$ 6.9 vs. 13.2 $\pm$ 7.1; F= 4.8; P=0.03) suggesting that women were less physically active as pregnancy progressed. No statistically significant trimestral differences were recorded for moderate and high intensity

activities which were less frequent. Seventy percent of women's daily time across all three trimesters was spent in resting/sleeping or in self-care, eating, bathing, dressing, watching TV, reading, and other very low and low intensity activities. Household-related activities (~16-17%) conducted within the home (e.g., cleaning, cooking), time spent on buses or other transportation (~6%), household activities performed outside the home such as shopping (2.4%), outside employment (~2-3%), and caregiving (~1.1-1.8%) accounted for most of the remainder of time. It was noteworthy that very few women engaged in moderate-vigorous intensity leisure PA during the 1st (8/849), 2nd (3/420), or 3rd trimesters (0/398). Predictors identified for total MET's for all three trimesters were maternal age, marital status, occupation, and no. of dependents living inside the home. Maternal education, dizziness, and morning sickness were significant predictors of total MET's only during the first trimester. Neither body mass index, other somatic symptoms, other sociodemographic characteristics, nor lifestyle indicators were significant MET expenditure predictors. None of the study women met the ACOG (2002) recommendations for pregnant women due to the reduced recreational opportunities but 40%, 45%, and 44%, respectively met DHHS/CDC (2008) recommendations during the 1st, 2nd, and 3rd trimesters by accumulating moderate intensity PA from other activities.

Conclusion. Overall level of PA and activity energy expenditure remained relatively constant over gestation but the amount contributed by different activity categories varied by trimester. Most daily MET expenditures were contributed by lower intensity activities. Only a small handful of women engaged in any recreational PA during the first two trimesters and none during the final trimester. However when contribution of other moderate-intensity activities is taken into account, around 40% of women were able to meet the DHHS/CDC (2008) prenatal PA

recommendations. It is unclear why so few women engage in leisure time activity but could be due to lack of time due to other responsibilities or the lack of a culture of PA for women in Ecuadorian society. Future studies should be conducted to explore this issue.

Table of Contents

List of Tables

List of Figures

Chapter 1: Background and Significance

Physical Activity and Health

Physical activity is defined as any body movement that works the muscles and uses more energy than what is used when resting. It is also defined as bodily movement that enhances health (NHLBI, 2009). Physical activity is essential for development, growth, and maintenance of physiologic function of numerous tissues, cells, and signaling pathways. Regular physical activity increases muscle mass and decreases body fat mass (de Sales Tavares, et al., 2009). Moreover, it has major effects on glucose tolerance and insulin action by increasing expression of the glucose transporter (GLUT4) and the translocation of its proteins to the surface of myocytes, where they facilitate glucose entrance and metabolism. Similarly, regular physical activity promotes the lowering of basal concentrations of plasma triglycerides and lipoproteins (Brooks, et al., 2004; Saftlas, et al., 2004). These changes are attributable to increases in muscle capillarity, the expression of lipoprotein lipase, muscle fatty acid transporters, and an elaboration of the muscle mitochondrial reticulum where fatty acids are oxidized (de Sales Tavares, et al., 2009).

Regular physical activity is reported to provide other benefits such as energy, enhanced mood, and a general sense of well-being. These benefits appear to be a result of the increased production and secretion of endorphins or the expression of neural growth factors. Physical activity may also lower the level of anxiety, ostensibly through decreasing sympathetic nervous system activity and enhancing the ability to clear lactic acid (Brooks, et al., 2004). New research has added to our understanding of the biological mechanisms by which physical

activity provides health benefits and the physical activity profile (context, frequency, intensity, and duration) that is associated with enhanced health and quality of life (Haskell, et al., 2007).

The Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM) issued a public health recommendation in 1995 stating that, "every U.S. adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferable all, days of the week". In 2008, the U.S. Department of Health and Human Services issued the Physical Activity Guidelines for Americans which establishes that adults need to do two types of physical activity each week to improve health – aerobic and muscle – strengthening activities. For substantial health benefits, adults need to do at least 150 minutes each week of moderate-intensity aerobic activity, 75 minutes each week of vigorous-intensity aerobic activity, or an equivalent mix of moderate- and vigorous- intensity aerobic activity. Likewise, muscle strengthening should be done two or more days a week.

For instance, an adult walking at 3 miles per hour (mph) on a flat, hard surface expends approximately 3.3 Metabolic Equivalents (METs). Jogging/running on a similar surface at 5 mph would result in an expenditure of approximately 8 METs. The present physical activity guidelines are based on this. A typical man or woman would meet the minimum moderate-intensity recommendation by walking for 150 minutes per week at 3 mph. Doing this, they would accumulate ~495 METs/min. To meet the minimum vigorous-intensity recommendation, they would need to jog at 5 mph for 75 minutes per week to accumulate ~ 600 METs/min. The minimum recommendation of physical activity for a healthy adult is 450-750 METs/min/week of moderate and/or vigorous intensity activity (Haskell, et al., 2007).

Measuring Physical Activity

Several different methods (self-report, movement sensors, heart rate, indirect calorimetry, Doubly Labeled Water, room calorimetry) exist for calculating approximate energy expenditure from physical activity. One of the most widely used is the MET collected using self-reported physical activity. One MET represents an individual's energy expenditure while sitting quietly (i.e. 1 kcal/kg/hour). Metabolic Equivalents are measured as the ratio of the work metabolic rate to the resting rate (Ainsworth, 2002).

Metabolic Equivalents are widely used in epidemiological studies. They have the advantage of providing a common measurement tool of physical activity across diverse populations. Metabolic Equivalent values provided in Ainsworth's updated Compendium of Physical Activities are sufficiently accurate for generally healthy adults aged 18-65 years (Haskell, et al., 2007). The Compendium was developed to facilitate the coding of physical activities obtained from records, logs, and surveys, as well as to be able to compare physical activity intensity levels across epidemiological studies. It provides a five-digit coding system that represents the specific activities performed in various settings (Ainsworth, et al., 2000).

Physical Activity and Pregnancy

Physical Activity and Pregnancy Outcome

Evidence is accumulating indicating that moderate physical activity is beneficial for most healthy women during pregnancy. Until a few decades ago, pregnant women were advised to reduce their activities and even stop working, especially in the third trimester. However, the results of recent studies suggest that exercise may be important for reducing the risk for pre- and

post-natal complications such as gestational diabetes, pregnancy induced hypertension (Schlussel, et al., 2008; Ning, et al, 2005; Butler, et al., 2004) and preterm delivery (Borodulin, et al., 2008). It may also reduce the risk for delivering a low birth weight baby. For example, Takito and associates (2005) reported that women (n=152) who walked at least 50 minutes during the 1st trimester of pregnancy had only four-tenths (Adjusted Odds Ratio [AOR] = 0.43; 95% Confidence Interval [CI], 0.19, 0.96) the risk of delivering a low birth weight baby compared to those who walked less or did not walk. However, pregnant women that expended more than 2 and a half hours in a standing position in the 2nd trimester incremented the risk of delivering a low birth weight baby (AOR = 3.23; 95% CI, 1.30, 7.99).

De Sales Tabares and associates (2009) conducted a prospective cohort study (n=118) in Campina Grande, Brazil and found that there was no significant association between physical activity and birth weight. Yet, physical activity was associated with maternal gain weight only during the 2nd trimester of pregnancy (p=0.045). Additionally, Bovbjerg and Siega-Riz (2009) conducted a secondary data analysis of 2230 women at risk of primary cesarean section who participated in the 2004 and 2005 North Carolina Pregnancy Risk Assessment Monitoring System (PRAMS). The authors reported that 23% of women who met the ACOG (2002) physical activity recommendations had cesarean section. The results suggest that among women delivering at term, frequency of exercise does not appear to be associated with delivery mode.

Moreover, regular exercise appears to help maintain cardiovascular fitness levels throughout pregnancy and can facilitate postpartum recovery (Schmidt, et al., 2006). It also increases oxygenation capacity, decreases blood pressure, and prevents thromboses and varicose veins (Rodriguez Domingues & Barros, 2007).

Physical Activity Patterns during Pregnancy

The evidence from a number of epidemiological studies strongly suggests that recreational, occupational, and overall physical activity declines during the 2nd and 3rd trimesters. A retrospective cohort study conducted in Pelotas, Brazil (n=4471) reported that 14.8% (95% CI, 13.7, 15.8) of women engaged in some type of leisure time physical activity prior to pregnancy compared 12.9% (95% CI, 11.9, 13.9) during pregnancy. Specifically, in the 1st trimester, 10.4% (95% CI, 9.5, 11.3) of all mothers engaged in some type of physical activity, 8.5% (95% CI, 7.6, 9.3) in the 2nd trimester, and 6.5% (95% CI, 5.7, 7.2) in the 3rd trimester. Walking was the most frequent type of reported leisure time physical activity, i.e., 70% in the 1st trimester, 82.6% in the 2nd trimester, and 89.5% in the 3rd trimester (Rodriguez-Domingues & Barros, 2007). However, the analysis only measured recreational physical activity.

Donahue and associates (2009) analyzed data from the Pregnancy Risk Assessment Monitoring System (PRAMS) (n=4069) from Maine, North Carolina, and Washington State and found that the majority of women did not achieve the amount of physical activity recommended in (moderate-intensity physical activity for a minimum of 30 minutes on five days each week) the three months prior to pregnancy. In this study, 39.2% of all women practiced a recreational activity less than one day per week, 46.7% one to four days per week, and 14.1% five to seven days per week. Bovbjerg and Siega-Riz (2009) found that only 7% of pregnant women met the American College of Obstetricians and Gynecologists (ACOG, 2002) recommendations for physical activity during the 3rd trimester.

Another prospective cohort study conducted in Campina Grande, Brazil (n=118) reported a decrease in physical activity after the 1st trimester. Participants were followed from

the 16th week of gestation to delivery using face to face interviews. Physical activity was categorized as outside job activities, household related activities, walking, and inactivity. Household related activities were the most common followed by outside job activities and walking. At week 16 of gestation, 14.8% of women were sedentary (physical activities with ≤1.5 METs) and 85.2% practiced low-intensity physical activity (physical activities with 1.5-2.9 METs). At week 24 of gestation, 98.3% of women were sedentary, 0.9% practiced moderate-intensity physical activities, and 0.9% low-intensity physical activities. By the 32nd week of gestation, all women reported being sedentary, (de Sales Tavares, et al., 2009). Althogh the Pelotas' study assessed only recreational physical activity and the Campina Grande study acounted for all types of physical activity, both studies showed a progressive decrease of the physical activity over the course of gestation. Additionally, a cross sectional study (n=553) conducted in Oslo reported that 39% fo women in their 3rd trimester of pregnancy were sedentary for four hours or more during weekdays. Also, 81% practiced regular exercise before pregnancy, decreaseing to 69.2% during the 1st trimester, and 45.2% at 36 weeks of gestation (Hasskstad, et al., 2007).

Borodulin and associates (2008) analyzed data from the National Pregnancy, Infection, and Nutrition Study (PIN3 and PIN Postpartum), a cross sectional study, from the University of North Carolina Hospitals. The telephone based survey data were collected on 471 pregnant women at gestation weeks 17-22 and 27-30. The authors identified a declining pattern of physical activity with the majority of women reporting some physical activity during the 2nd (24.7 METs-hours/day) and 3rd (19.1 METs-hours/day) trimesters, rebounding at three (25.7 METs-hours/day) and 12 (26.7 METs-hours/day) months post-partum. Additionally, the major

components of physical activity during pregnancy were household-related physical activities (64%), caregiving-related physical activities (26%), and recreational physical activities (31%).

Fell and associates (2008) conducted a secondary data analysis of a prospective cohort study (n=1737) in Canadian women with less than 20 weeks of gestation. They found that household/family care-related physical activities decreased (Δ=-0.20; 95% CI, -0.21, -0.18) from the year before pregnancy to early pregnancy. Active living (Δ=-0.30; 95% CI, -0.33, -0.28) and sports/exercise (Δ=-0.71; 95% CI, -0.75, -0.70) also decreased.

A cross sectional study carried out in Massachusetts collected 445 physical activity recalls from 250 participants in their 1st, 2nd, and 3rd trimesters of pregnancy. The results revealed that the total energy expenditure was similar during the 1st (33.4 METs-hours/day) and 2nd (33.8 METs-hour/day) trimesters of pregnancy. Although it was slightly lower during the 3rd trimester (32.6 METs-hour/day), this difference was not statistically significant. Compared to the first two trimesters, household and care-giving activities were the largest contributors to energy expenditure, respectively providing 24%-40% of the total energy expenditure. The total energy expenditure coming from those activities increased from 6.8 METs-hour/day in the 1st trimester to 12.5 METs-hour/day in the 3rd trimester (Schmidt, et al., 2006).

Another retrospective cohort study conducted in Massachusetts (n=1213) reported that the physical activity in pregnant Latina (Puerto Rican descent) women during early pregnancy had a strong association with household activity (r=0.62). The association of physical activity with outside job related activities was r=0.35, with sports/excersice (r=0.29), and with active living behaviors (r=0.49) (p<0.001) (Chasan-Taber, et al.2007). However, such correlation decreased during mid pregnancy. A third study conducted in Massachusetts (n=2686) found that

leisure time physical activity declined during pregnancy from 9.6 hours/week in pre-pregnancy to 6.9 hours/week in mid-pregnancy, and 8.0 hours/week in the post-partum period. Aditionally, 12.6% of women reported to be insuficiently active (<150 min/week) during pre-pregnancy and that proportion increased to 21.6% during pregnancy (Pereira, et al., 2007).

Maternal Predictors of Prenatal Physical Activity Patterns

Recent studies conducted in the United States and Europe suggest that certain factors such as maternal educational level, job type, marital status, number of children in home, parity, etc. can influence prenatal physical activity and intensity patterns. For example, Rodrigues-Domingues and Barros (2007) found a positive association between leisure time physical activity and family income, maternal schooling, employment, and physical activity advice ($p<0.001$). They also found a negative association with an increaed number of pregnancies ($p<0.001$).

Chasan-Taber and associates (2007) found a positive association between maternal age (Ptrend = 0.04) and parity (Ptrend <0.0001) with household-related physical activities in Latina women. The authors also reported a possitive assocition of maternal age (Ptrend = 0.02) with occupational-related physical activites and a negative association of parity (Ptrend = 0.05) with occupational-related physical activites in the same population. Women with the highest level of participation in occupational-related physical activity during pregnancy were more likely to be older, college educated, have higher income, and have fewer children.

Moreover, Schmidt and associates (2006) reported that higher Body Mass Index (BMI) was not associated with leisure time physical activity and any high levels of any type of energy expenditure. On the other hand, women having one or more children increased ~11 times

(OR=11.6; 95% CI 4.1, 32.3) the odds of increasing household physical activity. Other characteristics such as age and ethnicity showed increased odds for high levels of moderate- and vigorous-intensity energy expenditure, but they were no longer significant after adjustment.

Fell and associates (2008) reported that among active women, being younger than 35 years of age, not having university or college education, having a BMI≥30, and having ≥1 previous viable pregnancy were associated with discontinuing sports/exercise acctivities during pregnancy. Haakstad and associates (2007) reported that women with college or university education exercised more regurlarly during the 1st and 2nd trimester of pregnancy.

PRAMS data analyzed by Donahue and associates (2009) indicated that maternal educational level (≤ 12 years) was associated with pre-pregnancy self-reported physical inactivity (Proportional Odds Ratio [POR]=1.81; 95% CI, 1.42, 2.32), as was obesity (POR=1.35; 95% CI, 1.02, 1.79) and previous number of live births (≥ 3; POR=1.66; 95% CI, 1.14, 2.43). In addition, a prospective cohort study in Boston (n=2686) that assessed only recreational physical activity showed that young women had an increased odds (OR=1.58) of decreasing physical activity with the birth of the first or second child (OR = 1.58; 95% CI, 1.07, 2.32). The authors also reported that each 5 kg of weight (OR = 1.31; 95% CI, 1.05, 1.58) remained from pre-pregnancy to 6 months post-partum increased the risk of becoming insufficiently active (<150 min/week of leisure time physical activity), as well as each year of age (OR = 1.08; 95% CI, 1.02, 1.14) (Pereira, et al., 2007). The study results reported that at post-partum important barriers to physical activity were women working 35-44 hours/week (OR = 3.25; 95% CI, 1.46, 7.21), women working ≥45 hours/week (OR = 5.12; 95% CI, 1.96, 13.37), and not having child care services available (OR = 1.73, 95% CI, 0.99, 3.02).

Fatigue, time constraints, and health-related barriers (64%-79%) were reported to have negative effects on the time reported in recreational activities during the 2nd and 3rd trimesters of pregnancy in a cross sectional study of 160 participants of Southern Ontario, Canada (Cramp & Bray, 2009). Other barriers to recreational activities were identified in a study conducted by Evenson and associates. Such study counted with two separate methodologies that at the end complemented each other. The first methodology was a prospective cohort study (n=4471) of the PINS from the University of North Carolina Hospitasl and the second included the use of 13 focus groups (2-8 participants with 20-37 weeks of gestation or more) investigating perceived barriers to physical activity in pregnant women. The participants were identified as Hispanic, Non-Hispanic African American, or Non-Hispanic White. The major barriers to leisure time physical activity identified in the PINS study by the women were health-related (52.1%) and corraborated by the focus groups such as tiredness or lack of energy. The second major barrier was intrapersonal and no health related (32.7%) such as lack of motivation and time. The rest of the barriers accounted only for 15.8% combined and were reported in the focus groups as lack of social support, weather or season, and transportation and work or school conflicts. It is important to mentioned that for Hispanics, lack of social support was a relevant issue discussed in the focus groups (Evenson, et al., 2008).

Broadly speaking, national and international studies indicate that physical activity patterns in pregnant women vary between sedentary to light, depending upon the group studied, and that it tends to decline during the 2nd and 3rd trimesters. The most frequent predictors of prenatal physical activity are women's education, type of job, parity, number of children living at home, and certain physical symptoms characteristic of pregnancy such as tiredness. The most

important physical activities for pregnant women are outside job related activities, household-related activities, indoor and recreational activities (walking) representing the largest part of women's activities.

Physical Activity Recommendations during Pregnancy

The ACOG developed the first exercise guidelines for pregnant women in 1985. Those guidelines were based on limited data and were conservative. They included upper limits of 140 beats per minute for maternal heart rate and recommended that sessions of strenuous activity be limited to 15 minutes. The guidelines also noted the potential need to individualized physical activity recommendations (DHHS, 2008). Currently, the ACOG recommends that pregnant women participate in 30 minutes of moderate intensity physical activity on most days of the week in the absence of medical/obstetrical complications. However, the ACOG does not recommend participation of pregnant women in high contact sports or those characterized by a high risk of falling (i.e., hockey, soccer, basketball, gymnastics, horseback riding, and downhill skiing) because of the potential of putting the life and health of the mother and the fetus at risk (ACOG, 2002).

The DHHS/CDC (2008) through its Physical Activity Guidelines Advisory Committee (PAGAC) took the first step in developing Federal Physical Activity Guidelines for Americans. A review of the evidence led the PAGAC to conclude that healthy women during pregnancy and the postpartum period can benefit from the increased cardiorespiratory and metabolic fitness provided by moderate-intensity types of physical activity without increasing the risk for miscarriage, low birth weight, or preterm delivery. The DHHS/CDC (2008) through the

Physical Activity Guidelines for Americans recommends that healthy women should get at least 150 minutes per week of moderate-intensity aerobic activity, such as brisk walking, during and after pregnancy.

However, these recommendations only apply to the U.S. population. The World Health Organization (WHO) adopted the U.S. recommendations and guidelines for physical activity as a stopgap measure until the ratification of international recommendations now under development. To the best of knowledge, recommendations for prenatal physical activity have not been published for any Latin American government for their populations, including Ecuador.

Rationale

Little is known about maternal physical activity patterns and predictors in Latin American countries, with the exception of Brazil. This is an important area of inquiry because populations in such countries may show patterns that are quite distinct from those of their developed contries counterparts due to differences in lifestyle and socio-demographic characteristics (e.g., income, job type, fertility rate). A review of the literature on physical activity patterns and determinants during pregnancy depicts a complex web of multiple interacting factors that may contribute to differences in physical activity patterns in pregnant women residing in more (MDC) and less developed countries (LDC).

Pregnancy is an important stage of life where maternal weight gain must be controlled to avoid excess weight gain. Excess weight gain during pregnancy through unhealthy eating habits and lack of physical activity may contribute to the development of post-partum obesity, resulting

in the long term in the development of chronic non-communicable diseases such as diabetes, hypertension, cardiovascular disease, and some types of cancer.

National and regional data published by the Pan American Health Organization (PAHO) and other organizations indicate that most countries in the Americas region are currently undergoing an accelerating nutritional and epidemiologic transition fostered by population-wide changes including physical activity and other factors. The population prevalence of female overweight/obesity has doubled or tripled throughout the region, along with a concomitant rise in obesity-related chronic diseases (Waters, W. F., 2006; Bernstain, A., 2008).

Identifying trimestral physical activity patterns and their determinants in women from Latin American countries, such as Ecuador, is important because this may help us to develop appropriate recommendations/guidelines for such populations and also to target programs to those women at risk of obesity and chronic disease. This can also help with policy development for pregnant women by health and workforce agencies.

Chapter 2: Study Aims, Objectives, and Hypotheses

Study Aims

The overall aims of the present study are to describe the trimestral physical activity patterns in a sample of Ecuadorian women to identify major predictors of prenatal physical activity and compare their physical activity with those recommended by the ACOG (2002) and the DHHS/CDC (2008) Physical Activity Guidelines for Americans.

Specific Study Objectives

The specific study objectives are:

1) To describe physical activity patterns by context (inside household, transportation, outside home, outside employment, care-giving, and recreational), intensity (number of hours spent in each reported activity multiplied by its MET intensity), and duration (hours spent in each reported activity/day) for each trimester;

2) To identify socio-demographic (maternal age, education, income, occupation, marital status, and number of dependants in home), health (parity, maternal BMI, NVP during 1st trimester, and medical/obstetric problems developed), and behavioral (alcohol, tobacco, vitamins and minerals supplements, and medications taken) factors that have a higher impact in physical activity by trimester; and

3) To compare physical activity patterns in urban Ecuadorian pregnant women to the recommendations from the ACOG (2002) and the DHHS/CDC (2008) Physical Activities Guidelines for Americans.

Working Hypotheses

It was hypothesized that physical activity patterns will be similar during 1st and 2nd trimesters but decrease in the 3rd trimester because of increased body mass making movement more difficult. Another a priori hypothesis is that women with more children and those employed outside the home will have higher overall physical activity energy expenditure but less recreation-derived physical activity compared to other pregnant women. Also, physical activity will be reduced in women affected by morning sickness and other common early prenatal complaints. It is also hypothesized that women will not meet the ACOG (2002) recommendation for moderate-intensity leisure time physical activity but will accumulate an equivalent amount from other activities and will meet the DHSS (2008) recommendations for pregnant women from the Physical Activity Guidelines for Americans.

Chapter 3: Methods

Overview of the Study Protocol

The prospective cohort study was conducted at the Hospital Patronato Municipal San Jose (HPMSJ), a public municipal hospital located in Quito, Ecuador. The HPMSJ serves mainly a working lower middle class urban population. The study was approved by the HPMSJ Institutional Committee and by the Universidad San Francisco de Quito Ethics Committee. The Principal Investigator on the project was Dr. Weigel. It was funded by a grant from the International Development Bank through the Ecuadorian Foundation on Science and Technology (FUNDACYT PBID 234). A cohort of 849 healthy women where followed from the 1st to 3rd trimesters of pregnancy during 1998-2000. The purpose of the main study was to investigate the role of maternal diet, lifestyle, and other factors on pregnancy outcome.

Description of the Study Population

According to the WHO, non-communicable chronic diseases cause 60% of all deaths in the world. This figure could rise to 73% of all deaths by year 2020. Most of the individuals that live in the Americas region, practice very little leisure time physical activity and as they age, leisure time physical activity practices decrease. Women and low income individuals tend to practice less leisure time physical activity than high income populations (Hernandez, et al., 2003).

According to the Ministerio de Salud Publica and the Instituto Nacional de Estadistica y Censo (2004), the ten leading causes of death for the Ecuadorian population in 2004 were: other heart diseases (7.3%), pneumonia (5.5%), cerebrovascular diseases (5.4%), diabetes mellitus

(4.9%), hypertensive diseases (4.5%), violence (4.2%), ischemic heart disease (4.2%), conditions from the perinatal period (3.5%), transport accidents (3.4%), and liver diseases (3.0%). For all ten leading causes of death, half of them are chronic non-communicable diseases which are associated with obesity, unhealthy eating habits, and lack of physical activity. Among females, data indicates that diabetes appears to be an important cause of morbidity. Furthermore, diabetes development is closely associated with obesity which is a growing health problem in Ecuador due to globalization and its impact on socioeconomics, urbanization, occupational structure, diet, and physical activity (Waters, 2006).

The 2004 Demographic and Maternal and Infant Health Survey (ENDEMAIN) revealed a prevalence of 40.4% of overweight and 14.6% of obesity in reproductive-age women (PAHO/WHO, 2006). This trend is occuring more frequently in developing countries like Ecuador as a consequence of high-calorie diets rich in fat, sugar, and refined grains (Bernstein, 2008).

The 2003 World Health Survey of Ecuador reported a mean/media total physical activity (leisure time and overall) energy expenditure of 2,373 METs/minutes/week among females of reproductive age (see Figure 1) (PAHO/WHO, 2003). This report was the result of a national questionnaire with a multistage cluster sample that included urban and rural populations. The DHHS/CDC (2008) recommendations of 150 minutes of moderate-intensity physical activity translate to 450 – 750 METs/minutes/week (Haskell, et al., 2007). The World Health Survey did not specify intensity of the total physical activity for the Ecuadorian population.

Subject Selection

Potential participants were eligible if they were in the 1st trimester of pregnancy, planned to have all prenatal care and delivery at the HPMSJ, and had resided in the Quito metropolitan area (elevation: ~2,900 meters above sea level) for at least six months prior to conception. Exclusion criteria for the study included a medical history or physical examination findings indicating the presence of a major chronic or infectious disease and use of medications known to adversely affect pregnancy outcome.

Data Collection

Data were collected at the first prenatal visit which was at 1st trimester, during the 2nd trimester, and 3rd trimester. Gestational age was determined using the last menstrual period and an early pregnancy ultrasound examination, where available. A perinatologist corroborated these data by physical examination of newborns using the Capurro (1978) evaluation score, a method that uses somatic and neurological criteria to establish infant maturity.

A structured questionnaire was administered in face-to-face interviews by a trained interviewer to collect data on maternal socio-demographic, reproductive, and obstetric characteristics. The questionnaire also included questions on living conditions, early pregnancy symptoms, nausea and vomiting, and lifestyle behaviors including peri-conceptual use of alcohol, tobacco, vitamin-mineral supplements, anti-emetic medications, and other drugs as well. Questionnaire was administered at 1st and 2nd trimesters.

Physical Activity

Physical activity was assessed using repeated 24-hour physical activity recalls which were conducted during the 1st, 2nd and 3rd trimesters of gestation. The 24-hour physical activity instrument allowed the research team to gather data on a full range of usual daily life activities related to sleeping or resting, household activities, occupational activities, transportation, recreation, exercise and other sport activities. The instrument collected data on the context, intensity, and duration of time in 15-minute increments spent engaged in different types of activities during the prior 24-hour period. Metabolic equivalents (METs) of reported activities were obtained from the Compendium of Physical Activities (see Table 1).

Maternal Anthropometry

Maternal standing height was measured without shoes to the nearest millimeter at the first and subsequent prenatal visits using a Seca stadiometer (Colombia, MD, USA). Maternal weight during pregnancy was measured at weeks 5-8, 9-12, 13-16, 17-20, 21-24, 25-28, 29-32, 33-36, 37-41 and during the immediate postpartum period. A Beam balance (Seca, Colombia, MD) was used to assess maternal weight, and was calibrated after use with each participant. The measurement was performed with participants wearing only a standard hospital gown and no shoes. Maternal weight and height was used to calculate BMI (kg/m^2) and to track any change over the course of pregnancy.

Data Analysis and Interpretation

Data were entered and analyzed using a SPSS database (SPSS-version 14, Chicago, IL). Descriptive statistics were presented as frequencies and percentages for categorical variables, and as means and ±SD for continues variables. Trimestral physical activity patterns were described by context (type of activity), intensity (number of minutes spent in each reported activity multiplied by its MET intensity), and duration (number of minutes spent in each reported activity). Both bivariate and multivariate analyses were used to examine the study hypotheses.

Repeated measures ANOVA were used to assess mean differences between groups in order to describe physical activity patterns. Logistic regression analysis was used to examine major predictors of physical activity by trimester. Multiple logistic regression analysis was used for predictors indentified as significant ($p<0.05$) in the logistic regression model.

Chapter 4: Results

Table 2 displays the sociodemographic, reproductive/obstetric, lifestyle and other characteristics of the 849 study subjects. The majority were under the age of 30 years. Most women reported being legally married or in a common law union by the time of their initial prenatal visit interview. They lived with an average of 3.5 other persons, most of whom were their spouses and children. One-fifth had completed $\leq$ 9 years of formal education, nearly 50% had attended at least some high school, and close to one-third had some type of post-secondary technical training or other education (e.g., cosmetology, secretarial school, accounting technician).

The majority of the study subjects were housewives. Another one-fifth said that they were employed in a blue collar/trade occupation, one-tenth held white collar/professional positions, and the remainder were students. Their principal means of transportation was the Quito public bus or trolleybus system. Subjects who had an outside employment reported that on average they spent almost one hour/day getting to and from work. Only one-third of the study women lived in homes that they owned. Instead, most were renters, lived with family or friends or worked in exchange for a place to live. Almost all reported having electricity, piped-in water or indoor toilets in their homes.

Nearly six-tenths of subjects were multiparas, having had an average of two prior pregnancies. Only 45% reported that their current pregnancy had been planned. Fewer than 10% reported that they had either consumed alcoholic beverages or tobacco during the periconceptual period. Many women experienced “morning sickness”, increased fatigue, dizziness, and a number of other somatic complaints characteristic of early pregnancy.

Maternal Activity Energy Expenditure

Table 3 shows the proportion and average duration of time spent by subjects in activity energy expenditure categories during each of the three trimesters. Women spent an average of around ten hours per day sleeping and/or resting. They averaged approximately 7-7.5 hours/day over the course of pregnancy performing very low-intensity energy expenditure activities while sitting with little or no arm movement such as eating, reading, watching television, listening to the radio or music, sewing, and feeding their infants. They also spent an average of 5.5 hours per day engaged in low-intensity energy expenditure activities which required some movement while standing. These included activities such as light cleaning, washing and drying dishes, ironing, personal care, shopping, and office work to name a few.

Table 3 also indicates that fewer than half of the women participated in any type of moderate-intensity energy expenditure activities during any given trimester of pregnancy. These types of activities were characterized by moderate arm movements while standing or vigorous arm movements while seated. Examples include heavy cleaning, washing loads of clothes by hand, moderately brisk walking, and moderate-intensity recreational dancing or other sports. Less than 1% of the subjects participated in any type of high-intensity recreational (e.g., vigorous sports), occupational (e.g., ambulatory street vendor) or other activities (e.g., very heavy cleaning, carrying heavy tubs of water) during any trimester.

The results of the repeated measures ANOVA that compare changes in maternal total and categorical activity energy expenditure over the course of gestation are displayed in Figure 2. No statistically significant differences were identified for total mean METs during trimesters 1-3 (37.4 ± 4 vs. 37.4 ± 3.9 vs. 37.0 ± 4; $F=1.1$; $P > 0.05$). However, MET expenditures derived

from three specific activity categories differed. For example, METs expended in basal types of activities such as sleeping and resting were significantly greater in the 1st trimester compared to 2nd and 3rd trimesters (9.3 $\pm$ 2.0 vs. 8.9 $\pm$ 1.6 vs. 9.0 $\pm$ 1.7; F= 9.3; P=0.002). In contrast, the METs contributed by very low-intensity activities increased from the 1st to 3rd trimesters while those from low-intensity activity decreased suggesting that women were less physically active as pregnancy progressed. No statistically significant trimestral differences were recorded for moderate- and high-intensity energy expenditure activities.

Maternal Participation in Physical Activity Categories by Trimester

Figure 3 shows the results of the repeated measures ANOVA indicating the percent of time spent by women in specific categories of physical activity over the course of gestation. These included household-related activities conducted inside the home (e.g., cooking, cleaning, clothes washing), household activities performed outside the home (e.g., shopping), transportation-related activities such as going to and from work, church, shopping, health-care related visits, visits with friends and families, those related to outside employment, care-giving (e.g., child care) and recreational types of physical activities (e.g., recreational dancing, aerobics). As is shown, around 60% of women's daily physical activity was accumulated by performing in-home household activities and approximately 20% in transportation-related activities. Household activities performed outside the home, outside employment, and care-giving accounted for most of the remainder of time. It was noteworthy that very few women engaged in any recreation-related physical activities over the course of pregnancy.

As Figure 3 indicates, the percent of time that women spend performing inside household activities was decreased in the 1st compared to latter two trimesters although this

difference did not achieve statistical significance. In contrast, the percent of time they spent conducting activities outside the home related to household duties and paid employment steadily decreased over the course of pregnancy. They also spent significantly less time carrying out care-giving activities during the last two compared to 1st trimester. No statistically significant between-trimester differences were recorded in the percent of time that women spent in transportation nor recreational physical activities.

Figure 4 shows the repeated measures ANOVA results which also included the category of "other activities" in addition to those physical activities displayed in Figure 3. As it shows, 70% of women's time was spent in resting/sleeping, self-care, eating, bathing, dressing, watching TV, reading, and other sedentary types of activities. These remained constant across the three trimesters.

Maternal Predictors of High Activity Energy Expenditure

First Trimester

Table 4 displays the results of the logistic regression and multiple logistic regression analyses examining maternal predictors of high (upper quartile) overall and moderate-high intensity activity energy expenditures. The simple bivariate results revealed that maternal age $\geq$25 years, blue-collar occupation, multiparity, and the absence of NVP symptoms ("morning sickness") were associated with high total MET expenditure during the 1st trimester. All of these variables were retained in the multiple logistic regression model excepting multiparity whose contribution was no longer evident (Table 3). However, none of the other sociodemographic, reproductive/obstetric, lifestyle, living conditions, somatic symptoms or any of the other

maternal characteristics measured in the study were associated with high overall activity energy expenditure in the 1st semester.

Table 4 also shows the results of the logistic regression analyses investigating the association of maternal characteristics with moderate-high intensity activity expenditures. As shown, maternal age ≥25 years, multiparity, and the NVP symptom absence were associated with 1st trimester MET expenditures that were in the moderate-high intensity upper quartile. However, none of these associations remained significant in the final multiple logistic regression model. None of the other subject characteristics predicted 1st trimester moderate-high activity energy expenditure.

Second Trimester

The maternal characteristics identified as associated with high overall (upper quartile) intensity activity energy expenditures during the 2nd trimester of gestation in the logistic regression analyses were age ≥25 years, blue-collar occupation, multiparity, absence of NVP symptoms, and middle school education (Table 4). As Table 4 also indicates, three of these retained marginal associations (i.e., multiparity, blue collar occupation, NVP symptoms absence) with high maternal upper activity energy expenditure in the final multiple logistic regression model. However, the contributions of maternal age and education were no longer apparent. The maternal predictors of elevated maternal moderate-high intensity activity energy expenditures in the logistic regression analyses were maternal age ≥ 25 years, multiparity, and middle school education (Table 4). The multiple regression analysis results, however, retained only multiparity

in the final model. None of the other subject characteristics were associated with either overall or moderate-high activity energy expenditure in the 2nd trimester.

Third Trimester

As Table 4 shows, age ≥ 25 years, multiparity, and blue collar occupation were the sole factors identified in the initial logistic regression analyses as associated with 3rd trimester total activity energy expenditure in the highest quartile. The results of the multiple logistic regression analysis retained only one of these, multiparity, in the final model. No maternal factors were identified as associated with moderate-high activity energy expenditure during the 3rd trimester of gestation.

Prenatal Physical Activity Recommendations

Table 5 shows the average number of minutes that the pregnant study subjects spent performing both overall and recreation-derived moderate-high intensity activity during pregnancy. It also displays the proportion of women by trimester who met the DHHS/CDC (2008) for 150 minutes/week of moderate-intensity (equivalent of 21.4 minutes/day) from types of activities. It also shows the proportion of women who met the ACOG (2002) prenatal recommendations for physical activity which considers only recreational activity.

As the table shows, the average amount of time that women engaged in any type of moderate-high intensity physical activity ranged from between 52-59 minutes/day during pregnancy, depending upon the trimester. However, the amount of time the subjects accumulated by participating in recreational activities of moderate-high intensity averaged less

than one minute in the 1st trimester and less than two minutes in the 2nd. None reported performing any type of recreational activities at this intensity level during the 3rd trimester.

The proportion of the women in the study who met the DHHS/CDC (2008) minimum recommendations for prenatal physical activity from all sources ranged from 39-43% in the 1st through 3rd trimesters. In contrast, only 1% or fewer, depending on the trimester, met the ACOG (2002) prenatal recommendations which consider only moderate-high intensity recreational activity.

Chapter 5: Discussion

This study is the first to describe prenatal physical activity patterns and identify their determinants in urban Ecuadorian women. The physical activity data confirmed that prenatal physical activity patterns in urban Ecuadorian women are distinct from other populations in MDC, since most studies showed a decreased pattern. The study results showed that prenatal physical activity remained constant over the course of gestation. No statistically significant difference was found for total mean METs during trimesters 1-3. These prenatal physical activity patterns are possibly due to cultural characteristics of the study population. However, this factor was not studied in the present study, nor reported in other studies.

Prenatal physical activity patterns in this study were consistent with those found by Schmidt and associates (2006). They reported no significant difference on METs-hours/day expended by trimester either. On the other hand, several studies (Fell, et al., 2008; Haakstad, et al., 2007; Pereira, et al., 2007; Borondulin, et al., 2009; de Sales Tabares, et al., 2009) showed a decreasing physical activity pattern (leisure time physical activity and/or total physical activity) through the course of gestation. The majority of those studies were not conducted in Hispanic populations and only few were conducted in Latin American countries.

Even though we were unable to find significant differences in total METs, women spent more time in activities such as sleeping or resting. Evenson and associates (2008) reported that a major barrier to leisure time physical activity was tiredness or lack of energy (52.1%). Our study population reported the same complaint (90.1%). No other symptoms or complaints were associated to physical activity. In addition, most women spent their time in very low and low intensity activities. Very low intensity activities increased over the course of gestation making

women more and more sedentary. Our findings are consisted with those found by de Sales Tabares and associates (2009) who found that all study Brazilian women were sedentary by 32nd week of gestation. Haakstad and associates (2007) also found that 39% of pregnant women in Norway spent 4 or more hours/day in sedentary activities during the weekdays, increasing in the weekends and holydays.

Physical activity is defined as any body movement that works the muscles and uses more energy than what is used when resting. This definition includes leisure time physical activity and other activities such as inside and outside household, transportation, outside employment, care-giving, and other activities. This study described prenatal physical activity by inside household, transportation, outside home, outside employment, care-giving, and recreational activities. The data showed that women spent most of their time in inside household activities. Not all studies look at physical activity by its different modes. Rather, they look only for leisure time physical activity. This is an important area of inquiry because as suggested by the present study and others (Schmith, et al., 2006; Chasan-Taber, et al., 2007; Borondulin, et al., 2009; de Sales Tabares, et al., 2009), a great proportion of women spend most of their time on inside household activities during pregnancy. On the contrary, studies just looking at leisure time physical activity may be missing important information about other activities that may increase total activity energy expenditure.

Many factors hinder the participation of women in physical activity such as workload in the home and care-giving activities, low income, limited mobility to travel to recreational facilities, as well as cultural expectations that restrict the participation of women in certain physical activities, especially during certain periods of life such during pregnancy. Pregnant

women who were 25 years or older, had a blue-collar occupation, multiparity, and did not report NVP symptoms were associated with high total MET expenditure. Only multiparity remained significant in 2nd and 3rd trimesters after the multiple regression model. The findings from several studies are consistent with our findings, reporting as major predictors maternal age (Fell, et al., 2008; Pereira, et al, 2007; Schmith, et al., 2006; Chasan-Taber, et al., 2007), occupation (Pereira, et al., 2007; Chasan-Taber, et al., 2007), and multiparity (Fell, et al., 2008; Donahue, et al., 2009; Pereira, et al., 2007; Schmidt, et al., 2006; Chasan-Taber, et al., 2007). None of the referenced studies assessed NVP symptoms. Is noteworthy to mention that multiparity, maternal age, and not having outside employment were highly associated with indoor household activities.

Latin American countries, including Ecuador, do not have their own physical activity recommendations. The accelerated nutritional and epidemiological transition has caused an increase in overweigh/obesity and chronic disease prevalence. The PAHO (2006) reported that women from LDCs practice less leisure time physical activity because of the lack of opportunities, time, and culture. This study confirmed that pregnant Ecuadorian women did not meet the ACOG (2002) prenatal physical activity recommendations but that about 39-43% of women met the DHHS/CDC 2008 minimum recommendations for prenatal physical activity. Studies that compared prenatal physical activity patterns to the ACOG recommendations found a similar pattern (Donahue, et al, 2009; Pereira, et al., 2007; Bovbjerg & Siega-Riz, 2009).

The strengths and limitations of this study should be considered when interpreting its results. The strengths of the study include a relatively large sample size and a prospective design where the cohort was monitored closely beginning in early pregnancy through the immediate

postpartum period. Repeated measures were used to collect the questionnaire, physical activity, and anthropometric data and we controlled for potential confounders.

The limitations of the study were the use of self-reports to collect some of the data which could affect the results; but, the use of repeated measures using the same instrument helped to minimized recall bias. Physical activity patterns in Ecuador might not be generalizable to other populations since the study sample was composed of an urban hospital-based population of women who sought out prenatal care during the first trimester of gestation. Maternal experiences could differ for rural groups with different incomes, nutritional status, physical activity patterns, access to health care, genetic backgrounds, and other characteristics.

In conclusion, overall level of physical activity and activity categories expenditure remained relatively constant over gestation but the amount contributed by different categories varied by trimester. Most daily MET expenditures were contributed by lower intensity activities. However, when contribution of other moderate-intensity activities is taken into consideration, around 40% of women were able to meet the DHHS (2008) prenatal physical activity recommendations. It is unclear why so few women engaged in leisure time activities but could be due to a lack of time due to other responsibilities or the lack of a culture of physical activity for women in Ecuadorian society. Future studies should be conducted to explore this issue.

References

American College of Obstetricians and Gynecologists. (2002). ACOG Committee Opinion Exercide During Pregnancy and the Postpartum Period. *Obstetrics Gynecology* , 99 (1):171-173.

Ainsworth, B. E. (2002, January). *Prevention Research Center Norman J Arnold School of Public Health, University of South Carolina.* Retrieved July 12, 2009, from The Compendium of Physical Activity Tracking Guide: http://prevention.sph.sc.edu/tools/docs/documents_compendium.pdf

Ainsworth, B.E., Haskel, W. L., Whitt, M. C., Irwin, M. L., Swartz, A. M., Strath, S. J., O'Brien, W. L., Bassett, D. R., Schmitz, K. H., Emplaincourt, P. O., Jacobs, D. R., & Leon, A. S. (2000). Compendium of Physical Activities: an update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise,* 32 (9):S498-S516.

Bernstein, A. (2008). Emerging patterns in overweight and obesity in Ecuador. *Temas de Actualidad,* 24 (1):71-74.

Bovbjerg, M. L. & Siega-Riz, A. M. (2009). Exercise During Pregnancy and Cesarean Delivery: North Carolina PRAMS, 2004-2005. *Birth,* 36 (3):200-207.

Borodulin, K. M., Evenson, K. R., Wen, F., Herring, A. H., & Benson, A. M. (2009). Physical Activity Patterns During Pregnancy. *BMC Women's Health,* 9 (32):1-7.

Brooks, G. A., Butte, N. F., Rand, W. M., Flatt, J.-P., & Caballero, B. (2004). Chronicle of the Institute of Medicine physical activity recommendation: how a physical activity recommendation came to be among dietary recommendations. *The American Journal of Clinical Nutrition* , 79:921S-930S.

Butler, C. L., Williams, M. A., Sorensen, T. K., Frederick, I. O., & Leisenring, W. M. (2004). Relation between Maternal Physical Activity and Plasma Lipids in Early Pregnancy. *Americal Journal of Epidemiology* , 160 (4):350-359.

Capurro, H., Konichezky S., Fonseca, D., Caldeyro-Barcia, R. (1978) A Simplified Method for Diagnosis of Gestational Age in the Newborn Infant. *Journal of Pedicatrics,* 93: 120-122.

Chasan-Taber, L., Schmidt, M. D., Pekow, P., Sternfeld, B., Manson, J., & Markenson, G. (2007). Correlates of Physical Acitity in Pregnancy among Latina Women. *Maternal Child Health Journal,* 11:353-363.

Cramp, A. G., & Bray, S. R. (2009). A Prospective Examination of Exercise and Barrier Self-Efficacy to Engage in Leisure-Time Physical Activity During Pregnancy. *The Society of Behavioral Medicine*, 37 (3):325-334.

de Sales Tavares, J., de Oliveira Melo, A. S., Ramos de Amorim, M. M., de Oliveira Barros, V., D'Aquino Benicio, M. H., Takito, M. Y., et al. (2009). Associacao entre o padrao de atividade fisica materna, ganho ponderal gestacional e pero ao nascer em uma coorte de 118 gestantes no municipio de Campina Grande, nordeste do Brasil. *Revista Associacion Medica do Brasil* , 55 (3):335-341.

de Sales Tavares, J., de Oliveira Melo, A. S., Ramos de Amorim, M. M., Oliveira Barros, V., Takito, M. Y., D'Aquino Benicio, M. H., et al. (2009). Physical activity patterns in pregnant women attending the family health program of Campina Grande-PB. *Revista Brasileira Epemiologica* , 12 (1):10-19.

Donahue, S. S., Zimmerman, F. J., Starr, J. R., & Holt, V. L. (2009). Correlates of Pre-Pregnancy Physical Inactivity: Results from the Pregnancy Risk Assessment Monitoring System. *Maternal Child Health Journal* [Epub ahead of print].

Evenson, K. R., Moos, M. K., Carrier, K., & Siega-Riz, A. M. (2008). Perceived Barriers to Physical Activity Among Pregnant Women. *Maternal Chiald Health Journal,* 13:364-375.

Fell, D. B., Joseph, K. S., Armson, A. B., & Dodds, L. (2008). The Impact of Pregnancy on Physical Activity Level. *Maternal Child Health Journal,* 13 (5):597-603.

Haakstad, L. A. H., Voldner, N., Henriksen, T., & Bø, K. (2007). Physical Activity Level and Weight Gain in a Cohort of Pregnant Norwegian Women. *Acta Obstetricia et Gynecologica,* 86: 559-564.

Haskell, W. L., Lee, I.-M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., et al. (2007). Physical Activity and Pyblic Health. Updated Recommendation for Adults From the American College Sports Medicine and the American Heart Association. *Circulation Journal of the Americal Health Association* , 1-14.

Hernandez, B., de Haene, J., Barquera, S., Monterrubio, E., Rivera, J., Shamah, T., et al. (2003). Factores asociados con la actividad fisica en mujeres mexicanas en edad reproductiva. *Revisata Panamericana de Salud Publica* , 14 (4):235-245.

Magnus, P., Trogstad, L., Owe, K. M., Olsen, S. F., & Nystad, W. (2008). Recreational Physical Activity and the Risk of Preeclampsia: A Prospective Cohort Study of Norwegian Women. *Americal Journal of Epidemiology* , 168 (8):952-957.

Ministerio de Salud Publica/Instituto Nacional de Estadistica y Censo (2005). Indicadores basicos de salud. Ecuador 2004. Quito MSP/INEC.

Ning, Y., Williams, M. A., Butler, C. L., Muy-Rivera, M., Frederick, I. O., & Sorensen, T. K. (2005). Maternal recreational physical activity is associated with plasma leptin concentrations in early pregnancy. *Human Reproduction* , 20 (2):382-389.

Organizacion Panamericana de la Salud/Organizacion Mundial de la Salud. (2006). *Situacion de Salud-Ecuador 2006.* Organizacion Panamericana de la Salud.

Pan American Health Organization/World Health Organization. (2003). *World Health Organization*. Retrieved July 23, 2009, from World Health Organization InfoBase: Data for Saving Lives: http://apps.who.int/infobase/reportviewer.aspx?rptcode=ALL&surveycode=101704c1&dm=21#pgstring3

Pereira, M. A., Rifas-Shiman, S. L., Kleinman, K. P., Rich-Edwards, J. W., Peterson, K. E., & Gillman, M. W. (2007). Predictors of Change in Physical Activity During and After Pregnancy: Project Viva. *American Journal of Preventive Medicine* , 32 (4):312-319.

Rodriguez Domingues, M., & Barros, A. J. (2007). Leisure-time physical activity during pregnancy in the 2004 Pelotas Birth Cohort Study. *Revista Saude Publica* , 41 (2):173-180.

Saftlas, A. F., Logsden-Sackett, N., Wang, W., Woolson, R., & Bracken, M. B. (2004). Work, Leisure-Time Physical Activity, and Risk of Preeclampsia and Gestational Hypertension. *American Journal of Epidemiology,* 160 (8): 758-765.

Schlussel, M. M., de Souza, E. B., Reichenheim, M. E., & Kac, G. (2008). Physical activity during pregnancy and maternal-child health outcomes: a systematic literature review. *Review* , 24 (4):S531-S544.

Schmidt, M. D., Pekow, P., Freedson, P. S., Markenson, G., & Chasan-Taber, L. (2006). Physical Activity Patterns during Pregnancy in a Diverse Population of Women. *Journal of Women's Health* , 15 (8):909-918.

U.S. Department of Health and Human Services (2008). Physical Activity Guidelines Advisory Committee Report, 2008 to the Secretary of Health and Human Services. *Nutrition Reviews,* 67 (2):114-120.

U.S. Department of Health and Human Services (2008). Physical Activity Guidelines Advisory Committee Report, 2008 to the Secretary of Health and Human Services. Washington, D.C., 1-683.

Takito, M. Y., D'Aquino Benicio, M. H., & Dias de Oliveira Latorre, M. d. (2005). Maternal posture and its influence on birthweight. *Revista de Saude Publica* , 39 (3):1-7.

Waters, W. F. (2006). Globalization and local response to epidemiological overlap in 21st century Ecuador. *Globalization and Health,* 2 (8):1-13.

Glossary

Aerobic activities. Activity in which the body's large muscles move in a rhythmic manner for a sustained period of time. Aerobic activity, also called endurance activity, improves cardio-respiratory fitness. Examples include walking, running, and swimming, and bicycling.

Body Mass Index (BMI). A key index for relating a person's body weight to their height. The body mass index (BMI) is a person's weight in kilograms (kg) divided by their height in meters (m) squared.

Endorphins. One of the body's own painkillers, an opioid (morphine-like) chemical produced by the body that serves to suppress pain.

First trimester of pregnancy. The first trimester is a time of basic cell differentiation. It is said to truly end at the mother's first perception of fetal movement (quickening) which usually occurs around the end of the third month.

Gestational diabetes. Condition in which women without previously diagnosed diabetes exhibit high blood glucose levels during pregnancy.

Glucose transporter (GLUT4). Insulin-regulated glucose transporter found in adipose tissue and striated muscle (skeletal and cardiac).

Leisure-time physical activity. Exercise, sports, recreation, or hobbies that are not associated with activities as part of one's regular job duties, household, or transportation.

Lipoprotein lipase. Enzyme that hydrolyzes lipids in lipoproteins, such as those found in chylomicrons and very low-density lipoproteins (VLDL), into three free fatty acids and one glycerol molecule. It requires Apo-CII as a cofactor.

Lipoproteins. Classes of conjugated proteins consisting of a protein combined with a lipid. The normal functioning of higher organisms requires movement of insoluble lipids, such as cholesterol, steroid hormones, bile, and triglycerides, between tissues. To accomplish this movement, lipids are incorporated into macromolecular complexes called lipoproteins.

Low birth weight. An infant born weighing less than 5.5 pounds (2500 grams).

Low-intensity aerobic activity. On an absolute scale, physical activity that is done at less than 3.0 times the intensity of rest. On a scale relative to an individual's personal capacity, low-intensity physical activity is usually a 3 or 4 on a scale of 0 to 10.

Metabolic Equivalent (MET). MET refers to metabolic equivalent, and 1 MET is the rate of energy expenditure while sitting at rest. It is taken by convention to be an oxygen uptake of 3.5 milliliters per kilogram of body weight per minute. Physical activities frequently are classified by their intensity using the MET as a reference.

Metabolic rate. Basal Metabolic Rate (BMR) is the number of calories your body burns at rest to maintain normal body functions. It is the amount of calories per day your body burns, regardless of exercise. It changes with age, weight, height, gender, diet and exercise habits.

Moderate-intensity aerobic activity. On an absolute scale, physical activity that is done at 3.0 to 5.9 times the intensity of rest. On a scale relative to an individual's personal capacity, moderate-intensity physical activity is usually a 5 or 6 on a scale of 0 to 10.

Multipara. A woman who has had 2 or more pregnancies resulting in potentially viable offspring.

Muscle-strengthening activities. Physical activity, including exercise that increases skeletal muscle strength, power, endurance, and mass.

Myocytes. A muscle cell.

Physical activity. Any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level.

Pregnancy induced hypertension. High arterial blood pressure, in adults, usually defined as pressures exceeding 140/90. Though in certain patient the rate of rise over mid trimester is more accurate in diagnosis. This is not necessarily a chronic condition.

Preterm delivery. Labor that occurs earlier in pregnancy than normal, either before the fetus has reached a weight of 2000 to 2500 g or before the 37th or 38th week of gestation.

Resting rate. Resting metabolic rate (RMR) is the energy required to perform vital body functions such as respiration and heart rate while the body is at rest. About 50 to 75% of one's daily energy expenditure can be attributed to resting metabolic rate.

Second trimester of pregnancy. The second trimester is a period of rapid growth and maturation of body systems. A second-trimester fetus born prematurely may be viable, given the best hospital care possible.

Sympathetic nervous system. A part of the nervous system that serves to accelerate the heart rate, constrict blood vessels, and raise blood pressure.

Third trimester of pregnancy. The third trimester marks the final stage of fetal growth, in which systems are completed, fat accumulates under the soon- to-be-born baby's skin, and the fetus at last moves into position for birth. This trimester ends, of course, with the birth itself.

Total energy expenditure. The amount of energy spent, on average, in a typical day (kcal/day).

Vogorous-intensity activity. On an absolute scale, physical activity that is done at 6.0 or more times the intensity of rest. On a scale relative to an individual's personal capacity, vigorous-intensity physical activity is usually a 7 or 8 on a scale of 0 to 10.

Tables and Figures

Table 1. Metabolic equivalent hours (MET-hours) for specific activities for 24 hours

Physical Activity	MET-hours
Sleeping and resting	0.9 METs
Very light-intensity	1.0-1.9 METs
Light-intensity	2.9 METs
Moderate-intensity	3.0-5.9 METs
High-intensity	>6 METs

Source: Adapted from Ainsworth, 2002

Table 2. Sociodemographic, Reproductive, Lifestyle and Other Characteristics

Subject Characteristics	**No. (%)** $\bar{x}$ **± S.D.**
Sociodemographic Characteristics	
Ethnicity (Mestizo)*	844 (99.4)
Maternal age	
≤ 20 years	118 (11.8)
20-24 years	272 (32.0)
25-29 years	220 (25.9)
30-34 years	154 (18.1)
≥ 35 years	85 (10.0)
Marital status	
Legally married	595 (70.1)
Common law union	147 (17.3)
Single	99 (11.7)
Divorced, separated, widowed	8 (0.9)
Formal education (yrs. completed)	
≤ 6 years	55 (6.5)
7-9 years	125 (14.7)
10-12 years	410 (48.3)
Post-secondary technical or other training/education	259 (30.5)
Job-Related Characteristics	
Occupation	
Housewife	528 (62.2)
Blue collar/trades	181 (21.3)
White collar/professional	91 (10.7)
Student	49 (5.8)
Hours required for transportation to/from work (1-3 hrs/day)	0.91 ± 0.44
Principal means of transport (n=836)	
Bus or trolleybus	674 (80.6)
Car	51 (6.1)
Walking	74 (8.9)
Taxi	29 (3.5)
Motorcycle	3 (0.04)
Bus and car	5 (0.06)
Housing Characteristics	
Number of other persons presently living in home	3.49 ± 1.7
Housing	
Own house or apartment	287 (33.8)
Rent house or apartment	451 (53.1)

Other (live with relatives, friends, or employer [domestic servant])	107 (12.6)
Home characteristics	
Electricity	845 (99.5)
Piped in water	833 (98.1)
Inside toilet	733 (86.3)
Reproductive Characteristics	
Age at menarche	13.1 $\pm$ 1.5
Parity (primipara)	363 (42.8)
Interbirth interval	4.4 $\pm$ 3.4
Current pregnancy planned	382 (45.0)
Lifestyle Characteristics	
Any periconceptual cigarette smoking	12 (1.4)
Any periconceptual alcohol use	83 (9.8)
Common Somatic Symptoms	
Early pregnancy nausea & vomiting (“morning sickness”)	656 (77.3)
Nausea only	181 (21.3)
Nausea and vomiting	475 (55.9)
Increased fatigue	765 (90.1)
Dizziness	388 (45.7)
Increased irritability	676 (79.6)
Breast tenderness	674 (79.4)
“Heavy” uterus	676 (79.6)
Increased olfactory sensitivity	644 (75.9)

Table 3. Maternal Physical Activity by Trimester

Activities	**No. (%) who engaged in PA categories**	**DURATION Hours/Day Spent in MET Categories** **Mean ± SD**
First Trimester (n=849)		
Sleeping/resting (0.9 MET's)	849 (100.0)	10.4 ± 2.3
Very low intensity activities (1.0-1.9 MET's)	849 (100.0)	7.1 ± 3.0
Low intensity activities (2.0-2.9 MET's)	842 (99.2)	5.6 ± 3.1
Moderate intensity activities (3.0-5.9 MET's)	339 (39.9)	0.87 ± 1.65
High intensity activities (≥ 6 MET's)	8 (0.09)	0.02 ± 0.37
Total		24.0
Second Trimester (n= 420)		
Sleeping/resting (0.9 MET's)	420 (100.0)	9.8 ± 1.8
Very low intensity activities (1.0-1.9 MET's)	420 (100.0)	7.6 ± 2.9
Low intensity activities (2.0-2.9 MET's)	417 (99.3)	5.6 ± 2.8
Moderate intensity activities (3.0-5.9 MET's)	189 (45.0)	0.98 ± 1.7
High intensity activities (≥ 6 MET's)	1 (0.02)	0.004 ± 0.8
Total		24.0
Third Trimester (n=398)		
Sleeping/resting (0.9 MET's)	398 (100.0)	9.99 ± 1.9
Very low intensity activities (1.0-1.9 MET's)	398 (100.0)	7.6 ± 2.9
Low intensity activities (2.0-2.9 MET's)	394 (99.0)	5.4 ± 2.8
Moderate intensity activities (3.0-5.9 MET's)	173 (43.5)	0.96 ± 1.6
High intensity activities (≥ 6 MET's)	3 (0.08)	0.006 ± 0.08
Total		24.0

Table 4. Association of Subject Characteristics and High Level* of Activity Energy Expenditure (MET Hours/Day) During Pregnancy

		Total Energy Expenditure				Moderate and Vigorous Energy Expenditure		
Participant Characteristics	No. (%)	Unadjusted OR (95% C.I.)	Adjusted OR** (95% C.I.)	*P* value	No. (%)	Unadjusted OR (95% C.I.)	Adjusted OR *** (95% C.I.)	*P* value
First Trimester (n=849)								
Age (years)								
≤ 24 years	151 (32.9)	1.00 (Reference)	1.00 (Reference)	< 0.0001	91 (23.3)	1.00 (Reference)	1.00 (Reference)	0.29
≥ 25 years	61 (15.6)	2.64 (1.89, 3.70)	2.25 (1.55, 3.29)		135 (29.4)	1.37 (1.00, 1.86)	1.20 (0.85, 1.69)	
NVP (Morning Sickness)								
Present	147 (22.4)	1.00 (Reference)	1.00 (Reference)	0.004	163 (24.8)	1.00 (Reference)	1.00 (Reference)	0.50
Absent	65 (33.7)	1.76 (1.24, 2.50)	1.70 (1.18, 2.45)		63 (32.6)	1.47 (1.03, 2.08)	1.42 (1.00, 2.02)	
Parity								
Primipara	73 (20.1)	1.00 (Reference)	1.00 (Reference)	0.51	83 (22.9)	1.00 (reference)	1.00 (Reference)	0.16
Multipara	139 (28.6)	1.59 (1.15, 2.20)	1.13 (0.78, 1.64)		143 (29.4)	1.41 (1.03, 1.93)	1.28 (0.91, 1.81)	
Occupation								
Blue-collar	73 (40.3)	2.57 (1.81, 3.65)	2.35 (1.63, 3.28)	< 0.0001				
Other	139 (20.8)	1.00 (Reference)	1.00 (Reference)					

*****In the upper quartile of trimester-specific energy expenditure
**Adjusted for age, parity, NVP, occupation
***Adjusted for age, parity, NVP

Table 4 (cont). Association of Subject Characteristics and High Level* of Activity Energy Expenditure (MET Hours/Day) During Pregnancy

	Total Energy Expenditure				Moderate and Vigorous Energy Expenditure			
Participant Characteristics	No. (%)	Unadjusted OR (95% C.I.)	Adjusted OR** (95% C.I.)	*P* value	No. (%)	Unadjusted OR (95% C.I.)	Adjusted OR*** (95% C.I.)	*P* value
Second Trimester (n=420)								
Age (years)								
≤ 24 years	34 (18.7)	1.00 (Reference)	1.00 (Reference)	0.22	42 (23.1)	1.00 (Reference)	1.00 (Reference)	0.44
≥ 25 years	71 (29.8)	1.85 (1.16, 2.95)	1.38 (0.83, 2.32)		77 (32.4)	1.59 (1.03, 2.47)	1.21 (0.75, 2.00)	
Parity								
Primipara	32 (18.0)	1.00 (Reference)	1.00 (Reference)	0.047	34 (19.1)	1.00 (Reference)	1.00 (Reference)	0.006
Multipara	73 (30.2)	1.97 (1.23, 3.16)	1.70 (1.01, 2.85)		85 (35.1)	2.29 (1.45, 3.60)	2.04 (1.23, 3.67)	
Education								
Middle school	24 (35.3)	1.83 (1.05, 3.18)	1.65 (0.93, 2.93)	0.91	27 (39.7)	1.86 (1.08, 3.20)	1.74 (0.99, 3.02)	0.05
Other	81 (23.0)	1.00 (Reference)	1.00 (Reference)		92 (26.1)	1.00 (Reference)	1.00 (reference)	
NVP (Morning sickness)								
Present	28 (35.4)	1.00 (Reference)	1.00 (Reference)	0.049				
Absent	77 (22.6)	1.88 (1.11, 3.19)	1.72 (1.00, 2.94)					
Occupation								
Blue Collar	28 (34.1)	1.76 (1.04, 2.96)	1.71 (1.00, 2.93)	0.049				
Other	77 (22.8)	1.00 (Reference)	1.00 (Reference)					

*****In the upper quartile of trimester-specific energy expenditure; **Adjusted for age, parity, education, NVP, and occupation;
***Adjusted for age, parity, and education

Table 4 (cont). Association of Subject Characteristics and High Level* of Activity Energy Expenditure (MET Hours/Day) During Pregnancy

Total Energy Expenditure

Participant Characteristics	No. (%)	Unadjusted OR (95% C.I.)	Adjusted OR** (95% C.I.)	*P* value
Third Trimester (n=398)				
Age (years)				
≤ 24 years	27 (15.3)	1.00 (Reference)	1.00 (Reference)	0.06
≥ 25 years	72 (32.4)	2.65 (1.61, 4.35)	2.12 (1.25, 3.62)	
Parity				
Primipara	29 (17.1)	1.00 (Reference)	1.00 (Reference)	0.002
Multipara	70 (30.7)	2.15 (1.32, 3.51)	1.66 (0.98, 2.81)	
Occupation				
Blue-collar	28 (34.1)	1.79 (1.06, 3.03)	1.65 (0.96, 2.84)	0.072
Other	71 (22.5)	1.00 (Reference)	1.00 (Reference)	

***** In the upper quartile of trimester-specific energy expenditure

** Adjusted for age, parity, and occupation

Table 5. Comparison of Prenatal Activity by Trimester to Recommendations

Trimester	Mean no. of mins./day spent in moderate-vigorous intensity PA (from all activities)	Mean no, of mins/day spent in moderate-vigorous intensity PA (from recreational activities only)	Met 2008 US DHHS/CDC recommendations*	Proportion who met ACOG recommendations **	Met ACSM recommendations**
Trimester 1 (n=849)	52.3 ± 99.0	0.8 ± 8.4	330 (38.9%)	11 (1.3%)	11 (1.3%)
Trimester 2 (n=420)	59.0 ± 100.1	1.5 ± 19.1	182 (43.3%)	3 (0.07%)	3 (0.07%)
Trimester 3 (n=398)	57.4 ± 95.3	0.00 ± 0.00	169 (42.5%)	0 (0.0%)	0 (0.0%)

* Moderate-vigorous PA from all activities

** Moderate-vigorous PA from recreational activities only

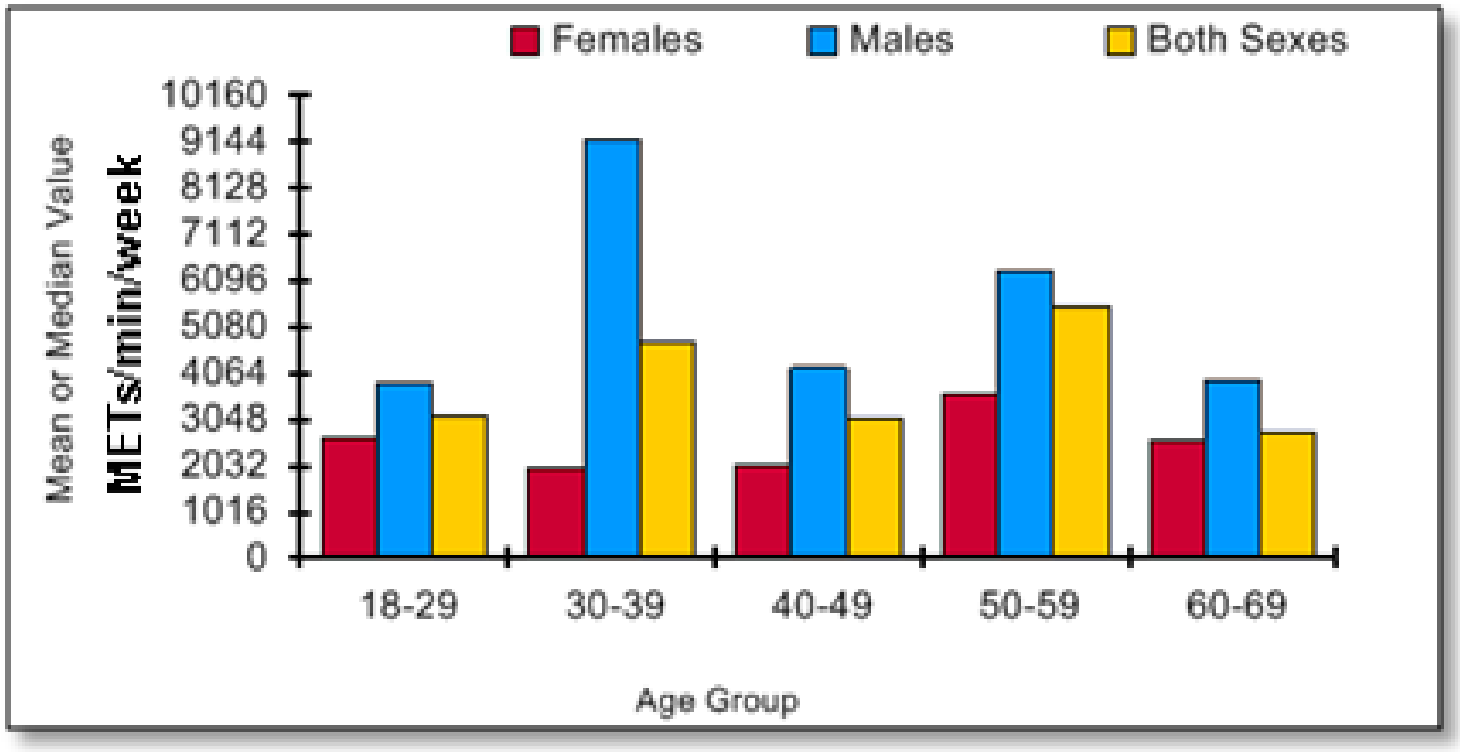

Figure 1. Total Physical Activity Mean/Median METs/minutes/week in Ecuador by Age (n=1293)

Source: World Health Organization/Pan American Health Organization, 2003

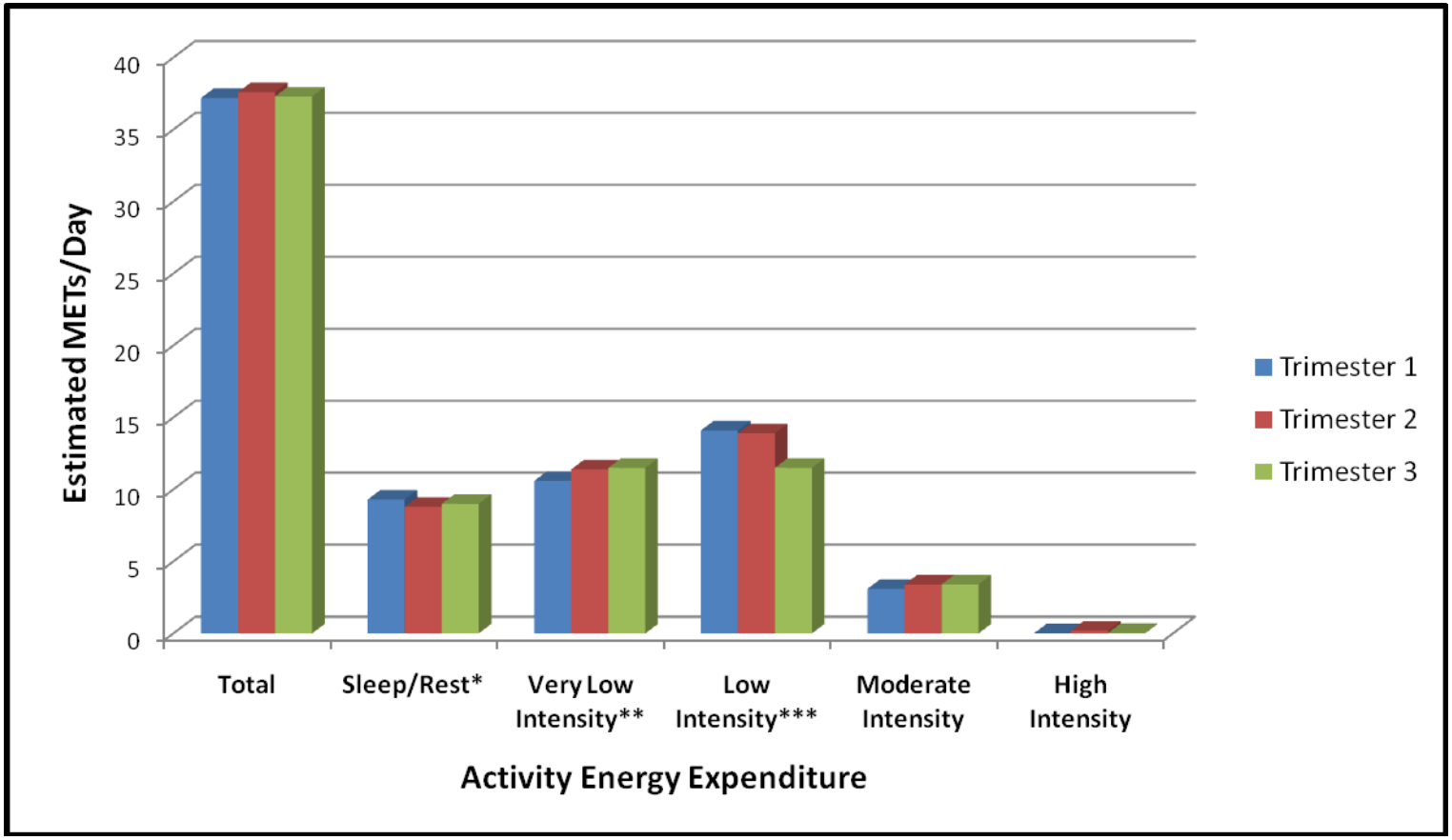

Figure 2. Comparison of Maternal Changes in Activity Energy Expenditure (Total and by Category) During Pregnancy (n=398)

***** F= 9.3, P=0.002 ****** F=17.6, P=0.001 ******* F=4.8, P=0.03

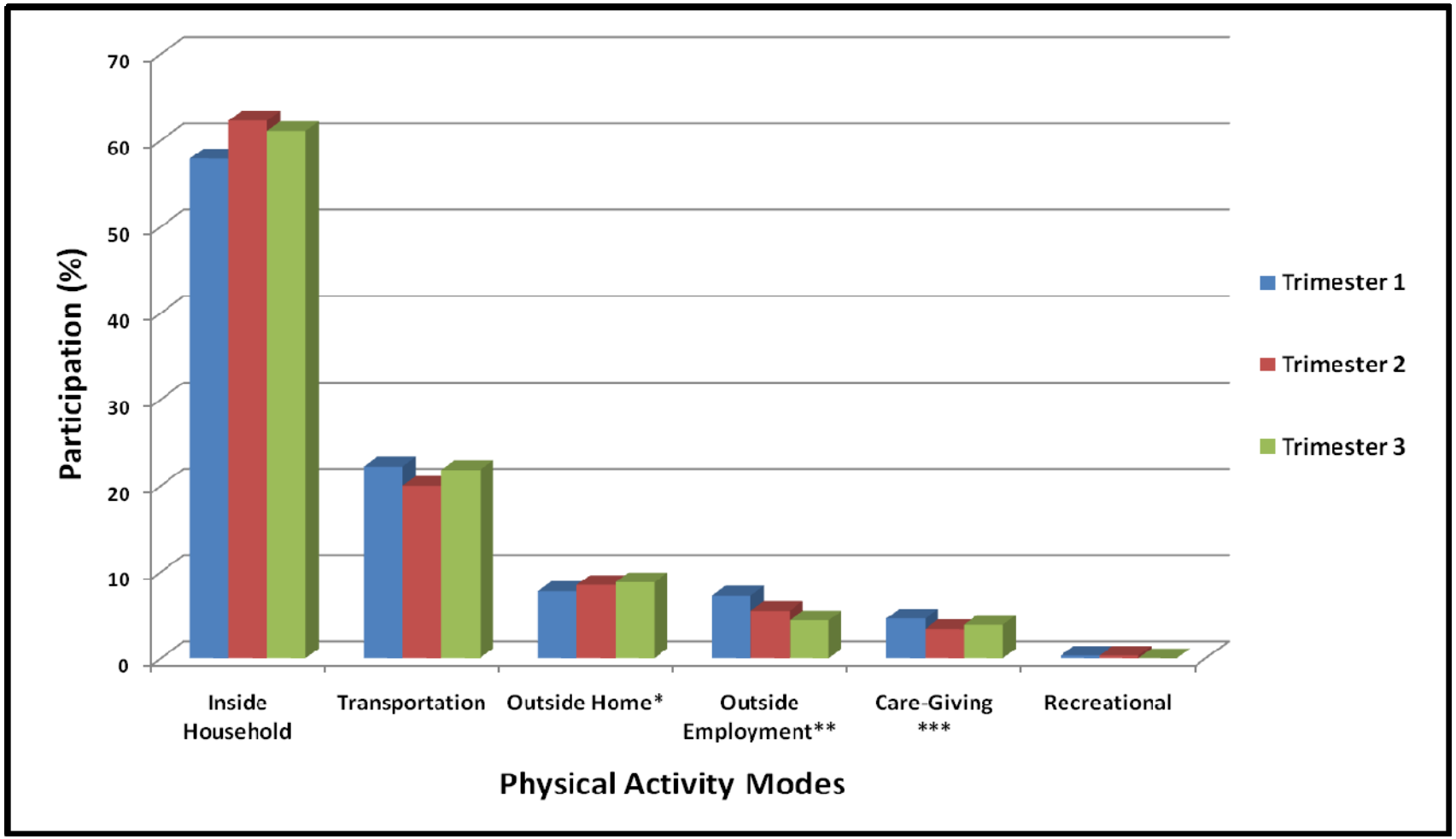

Figure 3. Comparison of Maternal Participation (%) in Different Physical Activity Modes (n=398) During Pregnancy

***** F=4.1, P=0.045; **F=5.1, P=0.025; ***F=91.8, P=0.0001

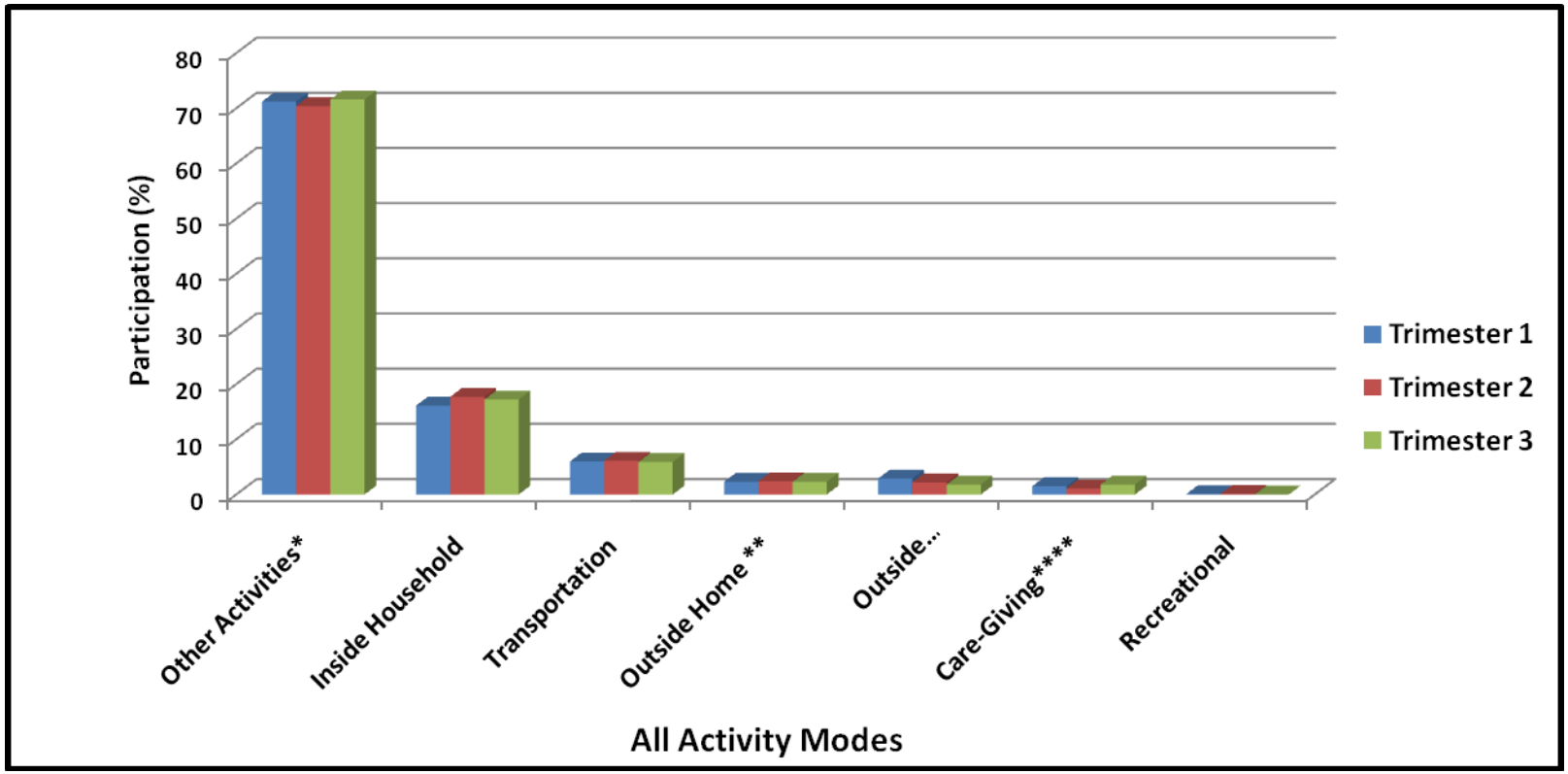

Figure 4. Comparison of Maternal Participation (%) in Different Activity Modes (n=398) During Pregnancy

***** Includes activities such as sleeping, resting, eating, watching TV, self-care, etc.; ** F= 4.1, P=0.045; *** F=5.1, P=0.025, **** F=91.8, P=0.0001

Curriculum Vita

Erika Gonzalez Beltran was born in Ciudad Juarez, Chihuahua, Mexico. The second daughter of Arturo Gonzalez Kuehne and Rosa Emma Beltran Espinoza and mother of Julian Aggelos Moraros-Gonzalez, she graduated from the Universidad Autonoma de Ciudad Juarez, Chihuahua in the fall of 2005 obtaining the degree of Bachelor's of Science in Human Nutrition and Food Sciences. Her undergraduate thesis title was Apo-lipoprotein E Polymorphisms and Lipid Profiles in Obese Children of Ciudad Juarez. After completion of her bachelor's degree, Erika obtained the Certificate as Diabetes Educator by the Asociacion Mexicana de Diabetes en Chihuahua, S.A. in summer of 2006. Erika worked with the Universidad Autonoma de Ciudad Juarez as an instructor in the Nutrition Department for fall 2006 and spring 2007, leaving the position to pursue the Master of Public Health at the University of Texas at El Paso. While pursuing a master's degree, she worked with El Paso Diabetes Association on her Practicum during the summer and fall of 2008. On spring of 2009, Erika had the opportunity to join the Pan American Health Organization U.S.-Mexico Regional Border Office as a Consultant and Project Assistant for two important projects on chronic disease control and prevention.