

## ***Depression, Family Support, and Body Mass Index in Mexican Adolescents***

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### **Abstract**

The relationship between depressive symptomatology and elevated Body Mass Index (BMI), and between family support and low BMI is controversial. There are unanswered questions about the relationship between these three variables. We tested the hypothesis that positive family support mediates the association between depression and bodyweight responsible for overweight and obesity in Mexican youth. We explored if family support correlated with depression and if depressive symptomatology correlated with obesity. Our results indicate that the relationship between depression and family support was significant ( $r = -0.44$ ,  $p = 0.004$ ). A significant relationship between depression and BMI was found only in women. When family support is included into the equation, the effect of depression on BMI disappeared. This observation indicates family support is a partial mediator between depression and obesity in adolescents. Our results are important and prompt an extended analysis of likely causative links between psychosocial parameters and health descriptors.

*Keywords:* BMI, Depression, Family Support, Mexico, Youth

### **Depresión, apoyo familiar, y Índice de Masa Corporal en adolescentes mexicanos Resumen**

La estrecha correlación entre sintomatología depresiva y elevado Índice de Masa Corporal (IMC), y entre apoyo familiar y bajo IMC demostrada por algunos estudios es debatible. Nuestra hipótesis es que, durante la juventud, los aspectos positivos del apoyo familiar actúan como mediadores en la asociación entre depresión y peso corporal, siendo responsables del elevado IMC. Exploramos si el apoyo familiar correlaciona con depresión y si sintomatología depresiva se correlaciona con obesidad. La relación entre depresión y apoyo familiar fue significativa ( $r = -0.44$ ,  $p = 0.004$ ). La relación entre depresión e IMC fue significativa exclusivamente en mujeres. Cuando el apoyo familiar fue incluido en la ecuación, el efecto de depresión sobre IMC se redujo a niveles no significativos. Esto indica que el apoyo familiar es un mediador parcial entre depresión y obesidad juvenil. Exponemos la necesidad de realizar análisis adicionales para discernir vínculos entre parámetros psicosociales e indicadores de salud.

*Palabras clave:* IMC, depresión, apoyo familiar, México, juventud

Excess bodyweight is a condition that affects health and life expectancy and is spreading in human popula-

tions (Haslam & James, 2005). As the obesity epidemic continues to surge around the world, researchers attempt to identify the primary factors associated with obesity. The correlational relationship between obesity in youth and the onset of serious health problems in adulthood, such as heart disease and diabetes, has been demonstrated (Baker, Olsen, & Sorensen, 2007). However, connections between obesity in youth and important psychological and environmental correlates, such as depression and family support, have not been adequately established.

Depression is a psychological condition that lowers

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mood and causes sadness, anxiety, and loss of interest in human activities (Ainsworth, 2000). It is a normal human condition but is also the result of medical conditions, drug treatments, and psychiatric syndromes. Family support entails tangible entities that are provided by family members to an individual, including emotional and instrumental support, care-giving effort, decision-making, and even financial assistance. Several studies have shown that a correlational association exists between depressive symptomatology and elevated body mass index (BMI), depression and family support, and between family support and BMI (Gerald et al., 1994). BMI is calculated using the weight and height of human individuals and is used as a heuristic proxy by the World Health Organization to determine weight trends and obesity levels (WHO Expert Consultation, 1995). The very few studies that have examined these parameters provide conflicting results, some supporting and other negating correlational relationships. Additional research should be conducted, particularly focusing on a Mexican population.

Here we focus on Mexican adolescents. Our rationale for selecting this group was primarily the fact that although obesity rates are skyrocketing around the world, Mexico has been especially affected by the epidemic. Recent reports have found that about one out of every three Mexicans over 16 are overweight, and, at the same time, they have nutritional deficiencies due to poor dietary choices (Celis de la Rosa, 2003). In terms of family support, the 2000 National Youth Survey found that not only do most young adults spend most of their time with their family but they also look to family members for support and would consider their relationship to be close (Encuesta Nacional de Juventud, 2000). However, adolescents consider inter-family communication to be poor, especially with their fathers, and feel that their parents do not understand them or listen to their feelings (Encuesta Nacional de Juventud, 2000; Villasenor Farias, 2003). This simultaneous dependence and conflict could increase depression levels and BMI and alter the effect of family support as the mediator of the relationship between depression and obesity.

Before taking steps to tackle the obesity epidemic in any region of the world, it is important to understand the association between depression and BMI. Luppino et al. (2010) conducted a systematic review and meta-analysis of longitudinal studies, which examined this association -- the first meta-analysis of its kind. In their analysis of 15 studies, they found bidirectional associations between these two factors: obese individuals were 55 percent more likely to become depressed, and those who were depressed were 58 percent more likely to become obese (Luppino et al., 2010). This report

adds to an already existing pool of cross-sectional and longitudinal studies supporting a positive correlation between depression and BMI (Hasler et al., 2005; Revah-Levy et al., 2011).

Next, it is important to analyze the relationship between family support and depression. In sharp contrast to the conflicting findings regarding associations between depression and BMI, a negative correlation between family support and depressive symptoms among adolescents has been consistently demonstrated. Weinman et al. (2003) examined 110 adolescents attending a U.S. family planning clinic and determined that there was indeed a significant correlation between family support and depressive symptoms. These initial results were supported by a study of adolescents in Florida (Christman et al., 2009). Participants aged 17-19 were assessed using the Beck Depression Inventory, a set of 21-items assessing levels of depression, and the Modified Perceived Social Support (PSS) from Family (Fa) and Friends (Fr) Scale, a 50-item assessment questionnaire. Results showed that high levels of family support were significantly correlated with decreased depression at a level that was unparalleled by even high levels of friend support.

There is limited published literature examining the relationship between family support and BMI. Wiczinski et al. (2009) found suggestive evidence for this association: in their sample of almost 3,000 German participants, social support seemed to buffer what they refer to as "obesity-related impairments." Other studies indicate an indirect association between the two variables. A correlation between family support and physical activity (PA) among adolescents has been consistently demonstrated (Kohl & Hobbs, 1998; Sallis, Prochaska, & Taylor, 2000). Similarly, growth curve analyses from a longitudinal investigation of 421 adolescent girls in South Carolina ascertained that family support for physical activity (measured using five items that assessed encouragement, participation, transportation and watching of PA by family members) was independently related to physical activity levels (Dowda et al., 2007). These findings are significant since it has been shown that physical activity and obesity are negatively correlated (Riebe et al., 2009).

Although the relationship between depression and BMI has been established, important questions involving families and wellness remain unanswered. Here we examined whether family support can act as a protective factor in this association by sampling a population of adolescents from a university campus in Mexico.

## Research Hypotheses

Based on literature and what is known about depression, one would expect BMI to be associated with depression among adolescents. For example, a cultural ideal of thinness for women has been proposed to cause body dissatisfaction, eating disorders and depression at higher rates in women than in men (McCarthy, 1990). The onset of eating disorders and depression in these cases has been reported to be higher before puberty and generally associated with Western societies and urban settings. The correlated epidemiology of depression and eating disorders is also linked to body image perception in men (Olivardia et al., 2004). Culture therefore impacts the body and mind interface. Eating disorders are expected to affect overweight and obesity incidence. For example, the prevalence of binge eating disorder (2-5%) increases up to 30% in individuals seeking weight control treatment and can be treated by cognitive behavior therapy and psychotherapy (de Zwaan, 2001). Finally, the social fabric of family and society are also expected to affect overweight/obesity incidence and correlated psychological conditions, very much as family support affects physical activity among adolescents. Since it is unknown whether family support plays any role in the links of BMI and depressive symptomatology, here we aim to test three specific hypotheses:

- (1) Depressive symptoms will be positively correlated with obesity.
- (2) Family support will be negatively correlated with depression.
- (3) Family support will mediate the association between depression and obesity.

## Method

### Participants and procedures

Information was obtained from a larger sample of applicants at the Unidad Académica Multidisciplinaria Zona Huasteca of the University of San Luis Potosí in Mexico. La Universidad Autónoma de San Luis Potosí is the largest public university serving the state of San Luis Potosí, one of the 31 states of Mexico. The university was the first to gain constitutional autonomy and receives students from all 58 municipalities of the state. Of the state's population in 2011, 48.7% were males, 30.4% were less than 15 years of age, and 63.8% resided in populations with more than 2,500 inhabitants (INEGI, 2011). The median age of the state was 25 years (below the national average of 26). A total of 10.7% of the population speaks indigenous languages (above the national average of 6.7%), indicating a high

indigenous component in the makeup of the state's population and possibly of the student body of the university. Only 15% of the population has college education (similar to the national average of 16.5%). We consider our sample to represent this 15% transect of the state's population and note that the number of registered students seeking undergraduate degrees at the university in 2010-2011 was 24,776, 51.1% of whom were males (Informe UASLP, 2010-2011).

Out of the approximately 10 applicants who applied for admission every day during a period of 5 months (February to June, 2010), 2 were recruited as research participants each day. Consent forms approved by the Institutional Review Board (IRB) both in Mexico and in the United States were signed. Individuals were randomly assigned to complete one of two versions of a questionnaire. Form "A" asked questions regarding medical history and related topics, and Form "B" focused on psychosocial aspects. Only data collected from Form "B" was utilized in this study. Questionnaires were administered in a classroom setting with a coordinator who was available to answer any questions. Participants were given as much time as they needed to respond to the survey. The analytic sample consisted of 102 applicants aged 16 to 25 (mean age: 18.17 years) (Table 1).

### Measures

**Demographic Measures.** Questions regarding sex, age, indigenous ancestry, and other demographic information were asked on the first pages of the survey. Participants were considered as having indigenous ancestry if they answered "yes" to at least one of the following questions: "*Usted se considera indígena?*" (Do you consider yourself indigenous?), "*Su padre o madre se considera indígena?*" (Does your father or mother consider themselves indigenous?), "*Su abuelo o abuela paterna se considera indígena?*" (Does your paternal grandfather or grandmother consider themselves indigenous?), "*Su abuelo o abuela materna se considera indígena?*" (Does your maternal grandfather or grandmother consider themselves indigenous?).

**Depression.** Depressive symptomatology was measured using the 10-item version of the Center for Epidemiologic Studies Depression Scale (CESD-10; Kohout et al., 1993). The CESD-10 is a valid and reliable self-administered questionnaire assessing the frequency of depressive symptoms experienced during the past week on a scale from 1 = "Rarely or none of the time (less than 1 day)", 2 = "Some or a little of the time (1-2 days)", 3 = "Occasionally or a moderate amount of time (3-4 days)", 4 = "All of the time (5-7 days)." Positive items are reverse coded and respondent answers are converted into point values (0 to 3). Points from the 10 items were averaged; possible scores range from 0-3.

**Body mass index (BMI)/** BMI is calculated by dividing weight in kilograms by height in meters squared, and can be used to classify individuals as underweight, normal weight, overweight, or obese. The cut-off points set by the World Health Organization are as follows: Underweight = <18.5, normal weight = 18.5-24.99, overweight: 25-29.99, obese = >30 kg/m<sup>2</sup> (WHO Expert Consultation, 1995). BMI was used as a continuous variable in our analyses, but cutoffs were used for descriptive purposes in the tables.

**Family Support.** Family support was measured using an abbreviated version of the family support subscale from the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet, Dahlem, Zimet, & Farley, 1988). The measure has been translated into Spanish (European) and validated (Mantuliz & Castilo, 2002). To measure family support in the present study, two of the four family-related items were administered (*Puedo hablar con mi familia sobre mis problemas [I can talk with my family about my problems]*, *Mi familia esta dispuesta a ayudarme a tomar decisiones [My family is willing to help me make decisions]*). Each item was rated on a 7-point scale (from *very strongly disagree* to *very strongly agree*) and an overall score created by averaging.

### Plan of Analysis

All statistical analyses were performed using IBM SPSS Statistics 19. Significance levels were set at 0.05,

but marginal significance was noted due to the small sample size. Preliminary analyses were conducted by running simple correlations. As prior literature reported gender differences in the associations between the study variables, we conducted analyses by gender. Mediation analyses were conducted following the procedures laid out by Baron and Kenny (1986). They maintained that the following criteria must be met in order to establish mediation: first, the independent variable must affect the mediator; second, the independent variable must affect the dependent variable; third, the mediator must affect the dependent variable (Baron & Kenny, 1986). These analyses were conducted controlling for age and indigenous ancestry.

### Results

#### Sample

The analytic sample consisted of 102 Mexican adolescents with ages ranging from 16 to 25, 53% of whom were female and 38% of whom were of indigenous ancestry (Table 1). The majority (64%) of the sample was of normal weight; 8% was underweight, 16% overweight and 12% obese. The proportion of overweight and obese males was slightly larger than that of females. About 12% of respondents showed elevated symptoms of depression, mostly females.

Table 1.  
*Characteristics of study sample (N = 102)*

Measure	Male	Female	Total
Sample Size	48	54	102
Age (years)*	18 ± 2, (16-25)	18 ± 1, (16-25)	18.17 ± 1.49, (16-25)
BMI (kg/m <sup>2</sup> )*	25.13 ± 5.03, (15.88-40.40)	23.33 ± 4.89, (16.28-38.80)	24.18 ± 5.02, (15.88-40.40)
Underweight	2 (4.17%)	6 (11.11%)	8 (7.84%)
Normal Weight	26 (54.17%)	33 (61.11%)	59 (57.64%)
Overweight	10 (20.83%)	6 (11.11%)	16 (15.69%)
Obese	7 (14.58%)	5 (9.26%)	12 (11.76%)
Indigenous (yes)	17 (35.42%)	19 (35.19%)	36 (38.24%)
Depression*	3.63 ± 2.49, (0-11)	6.65 ± 4.26, (0-18)	5.19 ± 3.81, (0-18)
Depressed (CES-D score >10)	1 (2.08%)	11 (20.37%)	12 (11.76%)

\*Mean ± SD, (Minimum - Maximum)

### Preliminary Tests of Study Hypotheses

Analyses conducted to test the first hypothesis that depressive symptoms will be positively correlated with BMI, revealed no significant association (see Table 2). However, there were significant correlations between gender and both depression and BMI, indicating that

sex played an important role in the interplay of variables. Indeed, in analyses conducted separately for men and women, the association between depression and BMI was marginally significant among women but not men (Table 3).

Table 2  
*Bivariate Correlations*

Variable (scale alpha)	1	2	3	4	5	6
1. Sex						
2. Age	-.01					
3. Indigenous ancestry	.00	.17*				
4. BMI	-.18*	.15	-.05			
5. Depression	.40**	.10	.22*	.01		
6. Family support	-.03	.04	-.08	-.07	-.28**	

\* Correlation is significant at the 0.05 level (1-tailed).

\*\* Correlation is significant at the 0.01 level (1-tailed).

Similar results were found when testing the second hypothesis that family support is negatively correlated with depression. The correlation was significant in the overall sample (Table 2) but when examined within

gender it was significant among women but not men (Table 3). On the basis of these results we confined and test our hypotheses exclusively among females.

Table 3  
*Bivariate Correlations by Gender*

Variable (scale alpha)	1	2	3	4	5
1. Age	-	.05	.03	.19	.09
2. Indigenous ancestry	.27*	--	-.06	.20	-.09
3. BMI	.27*	-.049	--	-.18	.00
4. Depression	.06	.31*	.25*	--	-.18
5. Family support	.00	-.08	-.16	-.40**	--

Note. Values for males displayed above the diagonal, and for females below.

\* Correlation is significant at the 0.05 level (1-tailed).

\*\* Correlation is significant at the 0.01 level (1-tailed).

An interesting finding was a correlation between indigenous ancestry and depression (Table 2) that was also confined to women (Table 3). This finding that links ethnicity to depression is weakened by the low sample size of the indigenous population, hampering sub-group analysis.

### Tests of Mediation

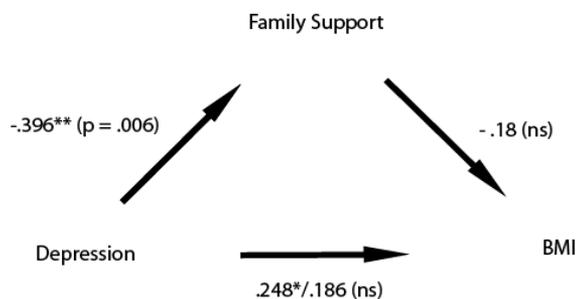
We hypothesized that family support mediates the association between depression and obesity. Mediation analyses were conducted on the sub-sample of women following the procedures laid out by Baron and Kenny

(1986), controlling for age and indigenous ancestry. Results of these analyses are displayed in Figure 1. We first tested whether the independent variable, depression, affects the dependent variable, BMI. Analyses showed that this relation was marginally significant. Next, we tested whether the independent variable, depression, affects the mediator, family support. Analyses showed that this relationship was significant. Finally, we tested whether the mediator affects the dependent variable in a third equation that included depression and family support as predictors of BMI. Although the coefficient between depressive symptoms and BMI dropped to

non-significance, the association between family support and BMI was not significant. Subsequent Sobel test calculations indicated that the indirect effect was not significant.

Figure 1.

*Direct relations among depression, Body Mass Index (BMI), and family support and the model of the mediating effect of family support on the relation between depression and BMI among women (n = 54).*



Note. Controlled for age and indigenous ancestry.

\*  $p < .10$

\*\*  $p < .01$

## Discussion

Our study focuses on the relationship between three variables -- depression, elevated BMI, and family support. While a careful longitudinal analysis established an association between depressive symptoms during childhood and obesity in adulthood (Hasler et al., 2005), the important correlation has been contested in subsequent studies or deemed much more complex. In contrast, a correlation between family support and depressive symptoms (Weinman et al., 2003) seems well established (Christman et al., 2009). This lays a foundation for our hypothesis that family support mediates the association between depression and obesity.

Our rationale for selecting Mexican indigenous adolescents for our study was the lack of existing research done on this population and the skyrocketing rates of obesity in Mexico, which has been especially affected by the epidemic. Interesting cultural issues arise, such as the fact that although adolescents look to family for support, they consider inter-family communication to be poor and feel that their parents are not receptive (Encuesta Nacional de Juventud, 2000; Villasenor Farias, 2003). This perception of conflicting family dependence relationships could increase depression levels and BMI and mediate the association between depression and obesity. It is important to keep this cultural context in mind when reviewing results.

Our study indicates that in the overall sample there

was no significant association between depressive symptoms and BMI. These results are not consistent with findings reported by Hasler et al. (2005) but match observations from longitudinal analyses (Wardle et al., 2006). Moreover, when conducting analyses separately for men and women, we found that the correlation between depression and BMI was marginally significant for women and not men (Table 3), indicating that gender is important in the depression-BMI relationship.

As expected, family support was negatively correlated with depression, although this association was significant only for women. This confirms previous analyses of comparable adolescent populations in the United States (Weinman et al., 2003; Christman et al., 2009). A recent study in Latino/a youth examined how patterns of social support can lead to healthy outcomes, but did not find a gender difference (de Guzman, Jung & Do, 2012). Future studies could evaluate what is the role of immediate family in social support networks to foster positive practices of physical health behaviors, including nutrition habits and practices.

There is no single explanation for the novel finding that family support partially mediated the effect of depression on BMI among Mexican adolescent females. The notion that family support improves mental health, disrupting a link between depression and obesity is not startling. However, why this partial mediation occurs exclusively among women is unknown. One possible explanation is that adolescent women stay at home longer before moving out, keeping them closer to their families and the support which improves psychological wellbeing. Indeed, a vast number of Mexican families are maintained united in Mexico and women marry young (average 18.8 years of age) and generally expand families in number of members and not in number of family units. The “Encuesta Nacional de la Dinámica Demográfica” identified that 10 million families included all children (‘nuclear’ families with an average of 4.8 family members) and 2.6 million families included children and other family members (‘extended’ families with an average of 6 members), with nuclear families representing 73.3% of the population of the country (INEGI, 1999). These families represent the vast majority of the population, 88.1 million. Families show overall equilibrium in male-female composition and have a makeup of 24.6% and 23.8% of children 0-9 years of age and 10-19 years of age, respectively. There is however a bias towards increases in family makeup of females of 15 years of age and above. For example, within the age range of 15-19 years, families are composed of 5.4% males and 5.7% females, and the trends become more and more pronounced with ranges of increasing age. The trend is more marked in extended than nuclear families and suggests that

females tend to remain in families longer than men, even if they are ready for work. More importantly, only 4 out of 100 children remain in the original family unit after 30 years of age and families have a considerable number of members 20-59 years of age (44.9%). In fact, extended families are enriched in both young and elderly. More importantly, presence of females 15 years and above increases significantly in members of the family that are non-children, indicating an important role of sisters-in law and sisters in the Mexican family. This indicates that families are fluid but in many cases maintain unity through elders and women. While further investigation should be conducted to determine what lifestyles of Mexican women could possibly be responsible for the findings of family mediation we report here, census data from Mexico clearly suggests a differential family impact on women materializing already at numerical level. Although there are not many studies on gender differences in the developmental trajectory of Mexican adolescents, a recent study of the general population found that they find jobs, leave home, marry, start a family, and simply mature at an earlier age than what is the norm in other cultures (Fierro Arias, & Moreno Hernández, 2007). However, examining a women-only analysis gives further insight into this gender difference.

The limitations of this study include population-related and methodological aspects. Primarily, our sample size was relatively small, consisting of only 102 participants. Only 38% of our sample was indigenous. This hampered our ability to perform subset analyses. The correlation between indigenous ancestry and depression in Mexican women represents an interesting and potentially significant association that should be explored in an expanded population. Also, the measure of family support was derived from only two family-related items from the MSPSS. Ideally, more items should be used to develop a composite score. Finally, the cross-sectional design of this study limits our ability to determine the pathways of association between factors. To overcome these limitations we are planning to extend these studies to a larger population of adolescents sampled from the same Mexican state. The high percentage of indigenous ancestry, in this subpopulation of San Luis Potosí, is a unique feature that could be used to test how culture and genetics affects the complex dynamics between depression, families and obesity.

Given that obesity rates are increasing at alarming rates not only in Mexico but around the world, our findings reinforce the need to carefully re-examine the association between body weight and social, psychological and cultural factors that impinge on the mental and physical wellbeing of human populations. This is

critical for immigrant populations that are increasing at fast pace, but especially for the Mexican immigrant population of the United States. The Mexican population of the United States has explosively expanded in recent years, mostly by illegal immigration, and is affecting the population makeup of many states. The Hispanic population is concentrated in the Southwest of the United States and in Illinois, Florida, and North Carolina, but is notably increasing in the Southeast. United States health systems like many others will need to adjust to the challenge of addressing the obesity epidemic and the specific impact that cultural and ethnic factors have on health and family wellness.

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