

## Original Article

# Interactive effects of family socioeconomic status and body mass index on depression in school-aged children

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Depression is an important health problem in children and the onset of depression is occurring at a younger age than previously suggested. The associations of being overweight and low socioeconomic status in childhood depression have been well documented; nevertheless few studies have addressed the combined effects of socioeconomic status and body weight, with depression in school-age children. We intended to examine if the relationship between socioeconomic status and childhood depression could be modified by abnormal body weight. A cross-sectional study was performed with a total of 559 subjects from 29 elementary schools in Taiwan. A depression scale was used to determine the depression status. Children receiving governmental monetary assistance for after-school class were categorized as being in the lower socioeconomic group. Data for depression-related demographic characteristics, family and school variables were collected. Children in the lower socioeconomic status group have a higher prevalence of depression (23.5%) than those in higher socioeconomic status groups (16.4%). Being overweight demonstrates the opposite effect on depression risk in the different socioeconomic groups. In lower socioeconomic families, the risk of depression in overweight children is three times higher than that for normal weight children; whereas in higher socioeconomic families, overweight children have a lower risk for depression than normal weight children. We concluded that a qualitative interactive effect existed between being overweight and socioeconomic status with childhood depression. More attention should be paid to overweight children from lower socioeconomic status families to prevent depression in school-age children.

**Key Words:** depression, socioeconomic status, body mass index, interaction, elementary school

## INTRODUCTION

Overweight and depression are two pressing issues among school-aged children. Recent studies suggest that depression in children may have negative impacts on their growth and development, school performance and family relationships, and an important precursor to psychopathology.<sup>1,2</sup> Depression in adults may originate from their childhood family environment. In particular, children in families of low socioeconomic status that experience family disruption or parental divorce, or that have a history of mental disorders may be at an increased risk of developing depression in later life.<sup>3,4</sup> A review of the literature shows that the average age for the onset of depression is increasingly younger than previously estimated.<sup>5,6</sup> In Taiwan, according to data from the National Survey 1999, 30.5 % of adolescents aged 12-18 reported they had experienced depressive symptoms.<sup>7</sup> Research was conducted in 2007 to measure depression symptoms in 2,227 third to sixth grade primary school children from 21 schools in four different areas. It was found that the prevalence of depression symptoms in those children was approximately 24%, with 4.2% having a major depression disorder.<sup>8</sup>

In the US, the prevalence of childhood obesity was estimated to be 20%-25% and was even higher in minority youth.<sup>9</sup> In Taiwan, the prevalence of overweight and obe-

sity in elementary school children was 15.5% and 14.7% in boys, and 14.4% and 9.1% in girls.<sup>10</sup> Relations between body weight concerns and depression among Chinese and Western children were presented in previous studies.<sup>9,11,12</sup> Being overweight increased a child's risk for subsequent co-morbidities,<sup>10</sup> and was suggested to aggravate the risk of depression.<sup>12,13</sup>

According to a nationwide survey in England, obesity and overweight problems existed in children of lower socio-economic families.<sup>14</sup> Low family income and socioeconomic status were significantly associated with childhood depression through stressful life events, family environment and neighborhood characteristics.<sup>4,15</sup>

Besides family socioeconomic status and child body weight, previous studies have shown that risk factors for depression in children and adolescents involve multiple and complex factors including personal characteristics, family and school environments.<sup>16</sup>

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Personal characteristics comprise of gender, body weight, and sleeping behavior.<sup>9</sup> Family environment factors of socioeconomic status (SES), parental household types, parenting style, family climate and the depression history of parents<sup>5,17,18</sup> are usually mentioned in childhood depression research. Of the school environment factors, peer relationships, support and academic performance have all been shown to affect children's mental health and to relate to depression.<sup>19</sup> In another study, children who had relatively few friends tended to experience depressive symptoms.<sup>20</sup>

Although higher BMI and lower SES were individually reported to correlate with depression in children, the combined effects of BMI and SES factors on depression risk in pre-adolescent children are seldom mentioned. The goal of this research was to investigate the relationship between depression status and body mass index in connection with family and school associated factors for children of different socioeconomic status in Taiwan.

In particular, we hypothesized that overweight children in lower socioeconomic families are at a higher risk for depression.

## MATERIALS AND METHODS

### Subjects

To investigate the depression status of elementary school children, a total of 36 elementary schools in Miaoli County whose students attended government-assisted after-school programs in 2009 were contacted and 29 schools agreed to join the study. From these after-school programs a total of 1,643 students in grades three to six were involved. The 29 schools located evenly at the west side of 10 most populous towns in the County, whereas the residual 8 towns were mostly located on the less populous mountain areas of the east side of the County. For attending the class, governmental financial assistance was offered to children who were handicapped, or from aborigine families, or from low income families. This study was approved by the Institute Review Board, Tri-Service General Hospital, National Defense Medical Center. Before the studies, parents were informed of the study content and given the opportunity to refuse their children to participate and children could refuse their participation at any time. Surveys and physical measurement of height and weight were measured by instruments with trained assistants and completed during after-school class hours. Finally 559 questionnaires were completed and analyzed.

### Measurement of depressive symptoms

The "Depression Screen Scale for Children and Adolescents" developed by Kao-Pin Chang for domestic children and adolescents<sup>8</sup> was used to measure the depression status of the children. The scale was developed from the *Diagnostic and statistical manual of mental disorder*, 3<sup>rd</sup> and 4<sup>th</sup> edition by the American Psychiatric Association, *Reynolds Child Depression Scale* (RCDS), *Children's Depression Inventory* by Kovacs (CDI) and *Beck Depression Inventory* (BDI). There were 34 items in Chang's scale covering five factors including: 1) depression-dysphoric mood; 2) hopelessness; 3) low-self esteem; 4) somatic and psychomotor complaints; 5) conduct-social problems. Subjects were asked to indicate how frequently

he or she had experienced the listed items during the past two weeks and each item was scored from 0-4. Substantial internal consistency of the scale was indicated by a Cronbach's alpha of 0.94. Scores greater than 33 was classified as being a possible depression disorder. The cut-off point corresponded to 94.9% of scores of the hospital outpatients in Chang's study.<sup>8</sup>

### Measurement of independents variables

The SES in this study was divided into the higher and the lower categories. The participant's SES was defined by whether he or she was eligible to apply for government financial assistance for the class. Children who received the assistance were grouped as in lower SES and vice versa. Teachers helped students to fill out questions on whether they were receiving government assistance and evaluated the socioeconomic status. Based on a review of the literature, a questionnaire was designed to measure three main factors: personal characteristics, family and school variables. These variables were assessed by a questionnaire containing thirty-nine items. Personal demographic characteristics were measured, including age, gender, and nocturnal sleep duration on weekdays (including bedtime and wake-up time). Body mass index (BMI) was calculated as weight/height<sup>2</sup> in kg/m<sup>2</sup>. The children's BMIs were classified into normal, underweight and overweight groups based on the Department of Health criteria, Taiwan, ROC Normal weight was defined as a BMI between the 5<sup>th</sup> and 84<sup>th</sup> percentile for age and sex, overweight was defined as a BMI  $\geq$ 85<sup>th</sup> percentile, and underweight as a BMI <5<sup>th</sup> percentile.<sup>10</sup>

Family-related variables were measured with self-stated items to define the household: living with both parents or with a single parent; feeling that the family climate was harmonious, common or quarrelsome; whether the child-parent relationship was close or not; and whether the parenting style was authoritative or not.<sup>21</sup> The measurement scales for children's perception of parenting styles and family climate were primarily designed for use in assessing adolescents, and not designed as such for use with young children. Hence respondents normally required a longer time to complete the questionnaire and parental assistance was often required during the process. In our study, the subjects were elementary school children and may have had difficulties in completing a time-consuming questionnaire or failed to fully comprehend the questions asked. We therefore adopted a more simplified scale designed by Chang KP<sup>8</sup> where children were asked about their perception of the parenting style they experienced at home: 1) authoritative, annotated as respectful of child's opinions with clear boundaries; 2) authoritarian, annotated as strict disciplinarian; 3) permissive, annotated as indulgent without discipline; or 4) neglectful, annotated as emotionally uninvolved; while family climate was categorized as harmonious or not harmonious. In Chang's own study, the simplified scales played a vital role in recognizing depression in elementary school children. According to the results, the depression scores for children who perceived themselves to experience an authoritative parenting style was significantly lower than the other groups. Meanwhile, children reporting to have a harmonious family climate at home scored

lower in the scale. School variables were measured by his/her academic performance based on teachers' assessments and were divided into three categories, the first, middle and lower third. Peer relationships were measured by self-report as being "close" or "not close".

### Statistical analysis

The analysis was conducted by using SPSS 18.0 software. Chi-Square tests were used for accessing the associations between categorical variables and depression status, *t*-test and ANOVA tests were used for the comparison of continuous variables such as age, and sleep duration in the grouped data.

For the analysis of depression, with a cut-off point of 33, the measured score was divided into two groups, 'at risk' of depression (>33) and 'not at risk' (<=33), with independent variables using a binary logistic regression method to assess the relationship with other possible factors. In the multivariate analysis, dichotomized depression scores of single binary (0,1) outcome were used to fit the logistic regression model to determine associations

between the presence of potential risk or protective factors. The odds ratio for depression with a 95% confidence interval was calculated. In all tests that were conducted, *p* values <0.05 was considered statistically significant.

Covariates were put in the adjusted multivariate model including personal, family and school variables. In order to examine the interaction of the significant variables with SES and BMI; and to identify if an interaction effect existed, a univariate analysis of variance (ANOVA) in a general linear model was used. The BMI modification effects on SES groups for depression risk were calculated by stratification and multivariable logistic regression method.

## RESULTS

### Description of the sample

The total sample in this study consisted of 559 children including 276 boys and 283 girls, with a mean age of 9.68, ranging from 7-12 years old, as shown in Table 1. Among them, 119 children (21.3%) received government assistance and hence were categorized into the lower SES

**Table 1.** Demographic characteristics of children in the study

Variable	n = 559	%	Mean±SD <sup>†</sup> (range)
Depression score			18.3±16.6 (0-96)
≤33	459	82.1	
>33	100	17.9	
Children variables			
Mean age (year)	559		9.68±1.16 (7-12)
Mean sleep duration (hour)	559		8.59±0.99 (5-11.5)
Gender			
Female	283	50.6	
Male	276	49.4	
BMI			
Normal	328	58.7	
Underweight	94	16.8	
Overweight	137	24.5	
SES status			
Higher	440	78.7	
Lower	119	21.3	
Handicapped	8	1.4	
Aborigine	7	1.3	
Low-income	104	18.6	
Family variables			
Household type			
Both parent	485	86.8	
Single parent	74	13.2	
Mother ethnicity			
Taiwanese	425	76	
Foreigner	134	24	
Parenting Style			
Authoritative	511	91.4	
Not authoritative <sup>‡</sup>	48	8.6	
Family climate			
Harmonious	189	33.8	
Not harmonious	370	66.2	
School variables			
Peer relationship			
Close	294	52.6	
Not close	265	47.4	
Academic performance			
First two thirds	398	71.2	
Last third	161	28.8	

BMI = body mass index grouped according to Department of Health, Taiwan, ROC, <sup>†</sup>SD=Standard deviation.

<sup>‡</sup>Not authoritative group combined the categories of authoritarian, permissive and neglectful.

group. Of the BMI results, 137 children (24.5%) were overweight and 94 children (16.8%) were underweight. Average nocturnal sleep duration in school days was 8.59 hours. The sample was measured for depressive symptoms using the Depression Screening Scale for Children and Adolescents in Taiwan by Chang and scores greater than the cut-point of 33 were used to identify children at risk of depression. According to the scale, the mean score for the Depression Screening Scale was 18.3 (SD=16.5) and there were 100 students (17.9 %) categorized as having a depressive status.

### *Characteristics of children in different socioeconomic groups*

Characteristics of children in different SES groups are presented in Table 2. These include depression status, personal characteristics, family variables (household type, mother's ethnicity, parenting style, and family climate); and school variables (academic performance and peer relationship). The average age of the lower SES group was 10.1 years which was 0.5 years older than those of the higher SES group. The average Depression Screening Scale scores for the lower SES group were significantly higher than the higher SES group with 20.96 and 17.6 respectively. The ratio of students with depression status in the lower SES group was higher than in the higher SES group, with the former being 23.5% and the later being

16.4%. There were clear differences in several family variables between lower SES and the higher SES, for example: one in three children (33.6%) in the lower SES group were from single-parent families as opposed to 7.7% of those from the higher SES group; one-third (32.8%) of lower SES families have immigrants mothers in comparison to one in five (21.6%) for the higher SES group. Of the parenting styles, in lower SES group, 13.4% fell in the category of not authoritative compared to 7.3% for the higher SES group. The difference was also reflected in the school variables, a significant 42% of the lower SES group was considered to be at the bottom of the class (lower-third in academic performance) compared to only 25% from the higher SES group. Since there were several characteristics found to be distinguishable between the two groups we analyzed the depression risk in the logistic regression model with the two groups separated.

### *Comparison of depression in different SES groups*

In Table 3 the figures showed that nocturnal sleep duration was significantly linked with depression regardless of the socioeconomic status, as students with longer sleep duration in both lower SES group and in the higher SES group were less depressive at 0.61 and 0.65 respectively. Therefore sleep duration could be deemed as a protective factor against depression. Analysis on the depression-

**Table 2.** Relation of child characteristics between two different SES groups

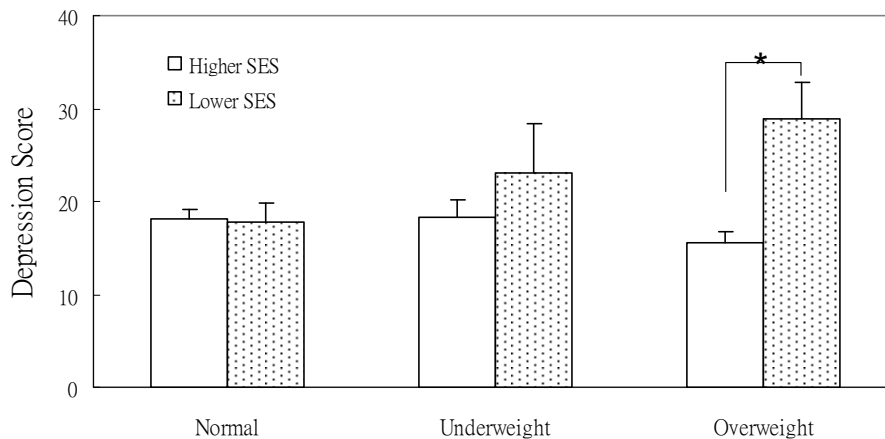
Variable	Higher SES group (n= 440)	Lower SES group (n=119)	p-value
Depression score, mean (SD)	17.6 (15.5) <sup>†</sup>	21.0 (20.2) <sup>†</sup>	0.04
≤33	368 (83.6)	91 (76.5)	0.07
>33	72 (16.4)	28 (23.5)	
Children variables			
Mean age (year)	9.57 (1.16)	10.1 (1.19)	<0.01
Mean sleep duration (hour)	8.62 (0.92)	8.47 (1.24)	0.24
Gender			
Female	219 (49.8)	64 (53.8)	0.44
Male	221 (50.2)	55 (46.2)	
BMI			
Normal	252 (57.3)	76 (63.9)	0.41
Underweight	78 (17.7)	16 (13.4)	
Overweight	110 (25.0)	27 (22.7)	
Family variables			
Household type			
Both parent	406 (92.3)	79 (66.4)	<0.01
Single parent	34 ( 7.7)	40 (33.6)	
Mother ethnicity			
Taiwanese	345 (78.4)	80 (67.2)	0.01
Foreigner	95 (21.5)	39 (32.8)	
Parenting Style			
Authoritative	408 (92.7)	103 (86.6)	0.03
Not authoritative‡	32 ( 7.3)	16 (13.4)	
Family climate			
Harmonious	145 (33.0)	44 (37.0)	0.41
Not harmonious	295 (67.0)	75 (63.0)	
School variables			
Peer relationship			
Close	239 (54.3)	55 (46.2)	0.12
Not close	201 (45.7)	64 (53.8)	
Academic performance			
First two thirds	329 (74.8)	69 (58.0)	<0.01
Last third	111 (25.2)	50 (42.0)	

Values reflect n(%) unless otherwise noted. BMI = body mass index grouped according to Department of Health, Taiwan, R.O.C.,  
<sup>†</sup>SD=Standard deviation; test was used in categorical data, while independent t-test used in continuous data.

**Table 3.** Characteristics associated with depression in univariate and multivariate analysis of different SES groups

Characteristics	Higher SES group (N=440)		Lower SES group (N=119)	
	Univariate OR (95% CI)	Multivariate OR (95% CI)	Univariate OR (95% CI)	Multivariate OR (95% CI)
<b>Children variables</b>				
Age	-	1.15 (0.92-1.45)	-	0.81 (0.52-1.27)
Sleep duration	-	0.61 (0.46-0.80)**	-	0.65 (0.42-0.99)*
<b>Gender</b>				
Female	1	1	1	1
Male	1.28 (0.73-2.00)	1.29 (0.74-2.26)	1.01 (0.43-2.36)	0.58 (0.22-1.62)
<b>BMI</b>				
Normal	1	1	1	1
Underweight	0.75 (0.38-1.50)	0.81 (0.39-1.70)	3.20 (1.00-10.5)*	3.82 (1.00-15.2)*
Overweight	0.46 (0.23-0.92)*	0.45 (0.22-0.92)*	3.14 (1.16-8.49)*	3.48 (1.12-10.8)*
<b>Family variables</b>				
<b>Household type</b>				
Both parent	1	1	1	1
Single parent	1.10 (0.44-2.77)	0.84 (0.31-2.25)	1.69 (0.71-4.03)	2.02(0.72-5.69)
<b>Mother ethnicity</b>				
Taiwanese	1	1	1	1
Foreigner	1.05 (0.57-1.92)	0.94 (0.48-1.83)	0.96 (0.39-2.38)	1.66 (0.57-4.81)
<b>Parenting Style</b>				
Authoritative	1	1	1	1
Not authoritative‡	0.94 (0.35-2.54)	0.68 (0.23-2.04)	1.58 (0.50-5.02)	1.70 (0.40-7.23)
<b>Family climate</b>				
Harmonious	1	1	1	1
Not harmonious	1.73 (0.96-3.10)	1.49 (0.80-2.79)	3.45 (1.20-9.88)**	3.60 (1.12-11.6)*
<b>School variables</b>				
<b>Peer relationship</b>				
Close	1	1	1	1
Not close	3.03 (1.77-5.18)**	3.24(1.84-5.70)**	0.99 (0.42-2.31)	1.12 (0.40-3.45)
<b>Academic performance</b>				
First two thirds	1	1	1	1
Last third	1.27 (0.73-2.23)	1.22(0.66-2.26)	1.27 (0.54-2.97)	1.10 (0.42-2.85)

\* :  $p < 0.05$ , \*\* :  $p < 0.01$

**Figure 1.** Interaction of family socioeconomic status and child body mass index on depression score in children, \*  $p < 0.05$ 

related factors showed that BMI had the opposite effect in the two SES groups with regard to childhood depression. Overweight children in the higher SES group were less depressive than those with a normal BMI by 0.45. Conversely, in the lower SES group, children who were classified as overweight or underweight were 3.8 and 3.5 times more likely to be at risk of depression compared to those with a normal BMI, respectively. As far as family climate factors are concerned, children experiencing a not-harmonious atmosphere at home had a 3.5-times higher risk of depression.

#### **Interaction effect of BMI and SES variables on depression**

In Figure 1, the results revealed the different effects of an abnormal BMI: underweight and overweight, on the depression scores in the two SES groups. Overweight children in the lower SES group had an alarmingly high depression score; conversely in the higher SES group, overweight children had the lowest depression score. Statistic analysis of ANOVA showed that significant interactions existed between children's BMI and SES for depression scores. Further analysis of SES and BMI for depression adjusted for sex and age are shown in Table 4.

**Table 4.** Interaction of family socioeconomic status and child BMI on depression risk

SES	BMI	N	Depression %	Crude OR (95% CI)	AOR <sup>§</sup> 95% CI
Higher	Total	440	16.4	1	1
Lower		119	23.5	1.58 (0.96-2.58)	1.53 (0.92-2.52)
Higher	Normal	252	19.4	1	1
Lower		76	15.8	0.77 (0.40-1.55)	0.79 (0.39-1.61)
Higher	Underweight	78	15.4	1	1
Lower		16	37.5	3.30 (1.01-10.4) *	5.56 (1.39-22.3) *
Higher	Overweight	110	10.0	1	1
Lower		27	37.0	5.29 (1.95-14.4) **	5.35 (1.91-15.0) **

<sup>§</sup>Adjusted for subject's sex and age, \*  $p < 0.05$ , \*\*  $p < 0.01$

Abnormal BMI, underweight and overweight, seemed to have different impacts on depression in the two SES groups. In the normal weight BMI group, there was no significant difference between children in higher and lower SES families on depression risk, whereas in the underweight BMI group, children with lower SES were found 5.56-fold as likely to be depressive. Similarly, in the overweight BMI group, children with lower SES were 5.35 times more depressive than children with higher SES. This showed the heterogeneity in the BMI effects on depression in the different SES groups, and that a qualitative interaction existed between BMI and SES with regard to depression in children.

## DISCUSSION

The hypothesis in this study was that overweight children of lower SES families were the group at higher risk for depression than overweight children of higher SES families and normal weight children in either higher or lower SES families. Our stratification analysis results supported this hypothesis and highlighted the heterogeneous effects of BMI on depression risk in the different SES families. In this study, a higher prevalence of depression was found among children in lower SES families than in the higher SES group, and results showed the different effects of BMI on childhood depression in the different SES groups. The difference was not obvious in two SES groups between children with normal BMI, whereas an overweight BMI aggravated depression in children from lower SES.

Why are the overweight children more likely to have depressive symptoms in lower SES families compared to those in higher SES? A possible source for the interactions observed between lower SES and being overweight in childhood depression is that both of these factors are associated with the family environments such as family income, parenting style and the parent-child relationship. In our cases, children experiencing harmonious family climate were significantly less depressive in the lower SES group. Other reports also suggested that the associations of a child's BMI and depression status may be mediated by family related factors.<sup>4,22</sup> Lower SES and being overweight may share the same 'family related originality' for the cause of depression and could be better described as multiplicative effect via the same pathway with regards to childhood depression. On the other hand, the physiological role of obesity was also explained partially on a depression mechanism. Reports have shown that leptin, identified as an anti-obesity regulatory hormone, may serve as the vital link between depression and

obesity.<sup>23</sup> Genetic evidence revealed the dual role of leptin: as an anti-obesity hormone with a function to negatively feedback adiposity signals to control energy homeostasis; and as an antidepressant agent.<sup>23,24</sup> The function of leptin provides an alternative explanation for the higher depression rate in overweight children of lower SES families. Meanwhile we also found that underweight children of lower SES families were at higher risk of depression than those of higher SES families irrelevant of children's weight. Both overweight and underweight children in lower SES families appeared to be at a greater risk of developing depression than others and this finding may be interpreted by the negative effect of abnormal weight on self-esteem.<sup>12,25</sup> Our results further strength this assumption in children of lower SES families.

Studies in England underlined the prevalent issue of childhood obesity and overweight in socioeconomic strata.<sup>14</sup> One international cross-sectional survey in 35 countries also revealed that overweight issues were higher among children from less affluent families.<sup>26</sup> Abnormal overweight problems in children could be underestimated without taking their SES into account, and in our own findings overweight children in lower SES families are at greater risk for depression compared to all other groups. Equally, overweight children in higher SES groups were found to be twice as less likely to suffer from depression than others (Table 3). Despite this interesting finding, one should keep in mind that overweight issues could be a health hazard to the children's physiological well-being in high SES families. As shown in Table 2, several family environment factors in the two SES groups were significantly different including 'single-parent status' and 'ethnic origin of the mother'. Single parent families have been associated with both childhood obesity and an increased risk of depression in children.<sup>21,27,28</sup> Of the lower SES group, one in three (33.6%) children came from single-parent families whereas only 7.2% of children of higher SES group were from single-parent families. Hence there is an obvious association between single parents and lower SES, which in turn may be one crucial mediator for childhood depression. In addition, the mother's ethnicity was another significant characteristic deserving further attention in the lower SES group. In the lower SES group, 39 out of 119 children (33%) had immigrant mothers, whereas only 95 out of 440 children (22%) had immigrant mothers in the higher SES group. Most of the immigrant mothers in Taiwan come from South-East Asia or Mainland China, marital immigration families in Taiwan usually are accompanied with low

socioeconomic status in rural areas. Children from low-income or immigrant families have been reported to have a significantly higher risk for mental disorders.<sup>29,30</sup> In immigrant families, acculturation and low-income were the major risk factors for childhood depression. As in our results, single-parents and families with immigrant mothers were two major characteristics among children in lower SES families. Although single-parenthood and the mother's ethnicity were not independently associated with depression in the adjusted multivariate analysis, it might be partially explained by Taiwanese government pay more attention on the issues of marital immigrants and single-parent family and concerned about their social support systems recently. More social supports are available for them including: financial assistance, medical aid and mental consultation by government or non-government organization than before. As reported in Chou's study<sup>31</sup>, comparison of quality of life and depression between female married immigrants and native married women in Taiwan, married immigrants had better mental quality of life and lower depression rate than native married women.

Sleep was another important factor found to be associated with childhood depression in both SES groups. Our data suggests children with longer sleep duration were less likely to be depressive. This is in accordance with the findings of other recent studies.<sup>32</sup> Notably, children in both groups had a relatively short sleep duration, with an average of 8.6 hours compared to the recommended 10 hours of sleep for this age group.<sup>33</sup> Previous studies provided evidence that short sleep duration was one of the risk factors for early adolescent obesity and depression<sup>32,34</sup>. Although it's not clear as to the consequences of this inter-relationship among depression, obesity and sleep duration, it is clear that sufficient sleep duration is required for physiologic development and good mental health. Parental-set regular bedtimes could help regulate children's mental health.

Subjects in this study were recruited from after-school classes in rural areas of Miaoli County where the proportion of lower SES families may be higher than in urban areas. The risk factors presented here are not necessarily applicable in municipal areas where the degree of urbanization and family backgrounds might not be the same. Selection bias may occur where students who didn't attend the after-school program were not included. Notwithstanding these limitations, our study showed the strong relation between depression and BMI in elementary school children associated with families of different socioeconomic strata. There is an obvious qualitative interaction between overweight and family SES in childhood depression. This result might be partially attributed to the characteristics that a higher proportion of children of lower SES come from single-parent or immigrant mother families. In conclusion, narrowing the gap between different SES groups and recognizing overweight problem in children will help to reduce the risk in childhood depression. Further analysis could facilitate a more in-depth understanding of overweight and depressed children in lower SES families, so as to narrow down populations at risk, and provide appropriate intervention and

prevention programs for controlling overweight and depression in younger children.

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#### AUTHOR DISCLOSURES

The authors declare that they have no conflict of interests.

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## Original Article

# Interactive effects of family socioeconomic status and body mass index on depression in school-aged children

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## 學齡兒童的家庭社經狀況與身體質量指數對憂鬱的交互影響

近年來，憂鬱發生的年齡層逐漸下降，憂鬱也成為兒童心理健康的一個重要課題。與兒童憂鬱攸關的重要因素，如體重、家庭社經地位等陸續被提出，然而對於體重與社經地位兩者對兒童憂鬱的交互作用則較少被研究，本篇研究主要目的為檢驗社經地位對兒童憂鬱的影響是否會隨著兒童體重的不同而改變。研究設計為橫斷式研究，樣本來自台灣苗栗縣 29 所小學，3-6 年級共計 559 位學童，分別收集人口學、家庭與學校相關之變項，兒童憂鬱情形以「兒童及青少年憂鬱篩選量表」測量。接受政府課後安親班補助的學童定義為較低社經地位者。結果發現家庭社經地位較低之學童，相對於較高社經地位學童，有較高之憂鬱比率(23.5%比 16.4%)。學童過重的因素對於憂鬱風險，在不同社經地位間則呈現迥異的修飾效果，在家庭社經地位較低的學童，體位過重者憂鬱的風險為正常體位學童的 3 倍；但在較高社經地位家庭的學童，體位過重反而呈現出對憂鬱風險的保護作用。由結果可看出學童體位過重與家庭社經地位間呈現出一質性的交互作用，在低社經地位家庭中，學童體位過重者為憂鬱的高風險族群，需要更加注意其心理健康的發展。

**關鍵字：**憂鬱、社經狀況、身體質量指數、交互作用、小學