Original Research Article

Determinants of Overweight in Taiwanese Adolescents

ABSTRACT

Aims: The prevalence of overweight adolescents in Taiwan has dramatically increased in recent years. A survey shows that 66.6% of adolescents do not get the recommended amount of vegetables and fruit (i.e., two portions of fruit and three portions of vegetables per day each week). The purpose of this study was to explore relationships between individual understanding of activity and nutrition, healthy lifestyle beliefs, perceived difficulty of efficacy in reaching health goals, mental health variables, and healthy lifestyle behavior on BMI in Taiwanese adolescents.
Study design: This is a theoretically-based and cross-sectional research study.
Place and Duration of Study: Data were conducted from two middle schools in Taiwan between Sep 2011 to November 2011.
Methodology: We used a convenience sampling to recruit 453 adolescents with a mean age of 13.42 years. The instruments used were demographics, Beck Youth Inventory II (Depression, Anxiety, Self-concept), Healthy Lifestyle Belief Scale, Healthy Lifestyle Behavior Scale, Perceived Difficulty Scale, Nutrition and Activity Knowledge Scales. We conducted path analysis to test our theoretical model by using Mplus5.21.
Results: Fit indices included $\chi 2$ (23, 453) =33.75, *P*= .05, *CFI*=.98, and *RMSEA*=.03, indicating that the model fit the model well. Healthy lifestyle beliefs had a significant positive effect on healthy lifestyle behaviors (β= .41, *P*= .01). Moreover, there was a significant negative relationship between perceived difficulty and healthy lifestyle behaviors (β= -.54, *P*= .01).
Conclusion: Our findings suggest that promoting positive beliefs about healthy lifestyle among adolescents may facilitate healthy lifestyle changes and help them perceive less difficulty in maintaining a healthy lifestyle. School nurses and health professionals in Taiwan need to coordinate essential resources and implement theoretical-based educational program that address issues on increasing adolescents' healthy lifestyle beliefs.

Keywords: Healthy Lifestyle Beliefs; Taiwanese adolescents; Cognitive-behavioral Therapy; Obesity.

1. INTRODUCTION

The high prevalence of overweight and obese adolescents in Taiwan has become a public health concern in recent years. A survey from 2018 revealed that 30.5 % of boys and 22.2 % of girls aged 12 to 15 years of age were overweight or obese [1]. Moreover, a recent report found that 24.3% of Taiwanese adolescents (n=436) aged 13 to 15 years were overweight or obese [1].

Adolescence is a crucial period of physical development and development of healthy lifestyle habits. Unhealthy lifestyle behavior, including a lack of physical activity and excessive sugary drink consumption, are risk factors for becoming overweight and obese [2]. Most adolescents understand that living a healthy lifestyle includes eating fruit and vegetables and doing exercise [3]. However, the prevalence of adolescents with unhealthy lifestyles has increased (i.e., they eat less fruit and become more sedentary) as they get older [4,5]. According to a survey from the National Health and Nutrition Examination in Taiwan, 51% of Taiwanese adolescents aged 13-15 years drank at least one high-calorie drink per day [1]. Furthermore, the most recent national data collected in 2018 (n=5,703) revealed that 74.6% of Taiwanese adolescents have sedentary home lifestyles (i.e., they play games or watch television more than two hours

per day) and 54.4% of adolescents also use computers for recreation during the school day [1]. An interesting but unsurprising finding is that sedentary lifestyles (e.g., heavy TV watching) may encourage adolescents to eat unhealthy foods (i.e., high fat food or "junk food") and increase their BMI [6,7].

A reviewed article found that obesity in adolescents has become common in recent years, and obesity had been identified as a risk factor for type 2 Diabetes Mellius (DM) and Cardiovascular Disease (CVD) [8]. Conversely, the study indicated that health conscious adolescents with healthy lifestyles (i.e., a healthier diet, higher levels of physical activity) and better nutritional knowledge have a lower risk of being obese [9]. The relationship between leading a healthy lifestyle (i.e., belief), cognitive (i.e., knowledge) and mental health variables (i.e., depression) has been well explored in correlational and intervention studies among western adolescents, but these variables have not been properly investigated in Taiwanese adolescents [10,12]. Thus, this study aimed to examine the interplay between cognitive and mental health variables (e.g., healthy lifestyle beliefs), healthy lifestyle behavior and their influence on Taiwanese adolescents' BMI.

2. METHODOLOGY

2.1 Design

This is a theoretically-based, cross-sectional research study that assessed factors of healthy lifestyle beliefs/behaviors, physical activity, perceived difficulty, gender, and mental health factors including depression, anxiety, and self-concept on Body Mass Index (BMI) in Taiwanese adolescents.

2.1.1 Theoretical framework

This study is based on the principles of cognitive behavioral theory (CBT). Cognitive behavioral theory postulates that peoples' feelings, emotions, and behaviors are influenced by conscious thought [12,13]. According to Wright et al. (2006), Cognitive Theory (CT), focuses on three levels of cognitive phenomena: (a) automatic thoughts; (b) cognitive distortions, and (c) schema. Automatic thoughts are specifically private or unspoken and are generated spontaneously as an individual evaluates the significance of events in their daily lives [14]. We also experience cognitive distortions, which are systematic errors in reasoning [14]. Schema are based on individual experiences stemming from interactions with others and with the environment [15]. The theory predicts that adolescents who lack confidence in their ability to live a healthy lifestyle and who perceive maintaining a healthy lifestyle to be difficult should have increased BMI; concordantly, their levels of depression, anxiety, and poor self-esteem should be elevated as well. Automatic thoughts, cognitive distortions and schema were explored as moderators of the relationship between healthy lifestyle behavior and BMI in Taiwanese adolescents.

2.1.2 Procedures

The study was approved by the Human Subjects Institutional Review Board of Arizona State University (ASU) (IRB Protocol No. 1109006862) and Taiwan schools. Written parental consent and student assent were collected from all parents and participants prior to data collection. Oral and written information including the purpose of the study, the possibility to withdraw at any point without affecting any school rights, contact information such as phone number and e-mail, and participants' name would be presented only on consent forms and remain anonymous.

2.1.3 Participants

Inclusion criteria for this study were: (1) was between 13 to 15 years of age, (2) read and wrote Chinese, and (3) returned both the adolescent assent and the parental consent forms. Students who did not meet all of the inclusion criteria were excluded. Data were conducted from Sep 2011 to November 2011.

2.2 Measures

2.2.1 Demographics

Demographic information was collected on a questionnaire which was developed for this study and included age, gender, date of birth, physical activity, and Body Mass Index (BMI) which was calculated as body weight (kg) divided by the square of height (meter). Weights and heights were obtained from the school nurse's records.

Physical activity was a self-reported question and assessed time spent in physical activity. This measure was tested in adolescents (N=148) by Prochaska et al. (2001) and had an intraclass correlation of .77 [16].

2.2.2 Beck Youth Inventory II (Depression, Anxiety, Self-concept)

The self-concept, depression, and anxiety questionnaires were self-report scales that have been validated for youth aged from 7 to 18 years. Self-concept scale consisted of 17 questions and both depression and anxiety scales consisted of 20 questions each. Original scores were converted to T scores regarding age and gender based on population norms [17]. The Cronbach'α for the self-concept, depression, and anxiety scales with this sample were .93, .95, and .94, respectively.

2.2.3 Healthy Lifestyle Beliefs Scale

The healthy lifestyle beliefs scale evaluates adolescents' belief/confidence about their ability to live a healthy lifestyle (e.g., "I believe that I can be more active.") on a 5-point Likert scale that ranged from 1(*strongly disagree*) to 5 (*strongly agree*) [18]. This scale has 16 items and total scores ranged from 16 to 80 with higher scores indicating stronger beliefs/confidence about ability to engage in health lifestyle behaviors. The Cronbach's α with this sample was .94.

2.2.4 Perceived Difficulty Scale

The perceived difficulty scale measures one's perceived difficulty in living a healthy lifestyle (e.g., eat healthy, exercise regularly) and adolescent answer to 11 questions on a 5-point Likert scale that ranges from 1 (*very hard to do*) to 5 (*very easy to do*) [19]. Items are reverse scored for analysis and the total scores ranged from 11 to 55. Higher scores indicate that an adolescent perceives it is difficult living in a healthy lifestyle. The Cronbach's α with this sample was .91.

2.2.5 Healthy Lifestyle Behaviors Scale

The healthy lifestyle behaviors scale measures an individual's current healthy lifestyle behavioral activities and adolescent answers to 16 questions (e.g., "I exercise on a regular basis") on a 5-point Likert scale that ranged from 1(*strongly disagree*) to 5 (*strongly agree*) [20]. The Cronbach's α with this sample was .90.

2.2.6 Nutrition and Activity Knowledge Scales

Adolescents' knowledge about healthy eating (e.g., "It is a good idea to have fruit juice at every meal") and physical activity (e.g., "Exercise helps reduce stress") was evaluated via 12- and 8-question scales [21, 22]. The 12-question scale asked about knowledge regarding foods nutritional information, eating habits, and health and the 8-question scale measures knowledge regarding physical activity. Adolescents answer questions with "yes," "no," or "don't know"; choosing incorrect answers or "don't know" answers are obtained 0-point and correct answers obtain 1-point. The Cronbach'α for the nutrition and activity knowledge scales with this sample was .86 and .70, respectively.

2.2.7 Data Analysis

The theoretical path model was tested using path analysis, with M*plus* 5.21 [23]. Model fit was assessed using chi-square、root mean square error of approximation (*RMSEA*), and comparative fit index (*CF*I).A non-significant in the chi-square indicates that a model perfectly fits the data [24].The RMSEA value was .05 or lower indicates close fit of the model to the data, .05 and .08 indicate fair fit, .08 and .10 indicate mediocre fit, and values greater than .10 suggests poor fit [25-28]. The CFI value was greater than .95, indicating acceptable fit (Hu & Benler,1999).Full information maximum likelihood (FIML) was used for dealing with missing data [29].

3. RESULTS

3.1 Demographics

The sample was comprised of 453 participants (52.5% females) with a mean age of 13.42 years who met the inclusion criteria and mean of BMI was 20.78 (*SD*= 4.30). Sample demographic and BMI were listed in Table 1. The significant correlations ranged between .12 and .84 and the correlation matrix between variables was displayed in Table 2.

Table 1. Descriptive Statistics for Sample Demographics (N=453)

Age Group	***N (%)***	***Range***	***Min***	***Max***	***M(SD)***
	453	13-15	13	15	13.42 (.64)
13 (%)	299 (66.0)				
14 (%)	116 (25.6)				
15 (%)	38 (8.4)				
BMI	453		12.8	40.4	20.78 (4.30)
Gender	***n***			**%**	
Female	238			52.5	
Male	215			47.5	

**BMI=body mass index; M=mean; SD=standard deviation.*

Table 2. ***Correlation Matrix between Variables in the Conceptual Path Model***

	Variables	1	2	3	4	5	6	7	8	9	10	11
1	Gender	1										
2	BMI	**-.23****	1									
3	Depression	.02	.08	1								
4	Physical Activity	**-.14****	.01	-.01	1							
5	Self-Concept	-.07	.01	**-.40****	**.17****	1						
6	Healthy Lifestyle Beliefs	.02	.02	**-.52****	**.17****	**.68****	1					
7	Healthy Lifestyle Behaviors	**.17****	.05	**-.44****	**.24****	**.56****	**.81****	1				
8	Perceived Difficulty	**-.12***	.08	**.39****	**-.32****	**-.48****	**-.73****	**-.84****	1			
9	Nutrition Knowledge	**.19****	.05	.02	.02	**.16****	**.19****	**.12***	-.09	1		
10	Activity Knowledge	-.07	.03	**-.13****	**.14****	**.27****	**.37****	**.29****	**-.25****	**.39****	1	
11	Anxiety	.04	.07	**.84****	.00	**-.29****	**-.37****	**-.36****	**.30****	.07	-.08	1

**Male is the reference group; ** P= .01.* P= .05.*

3.2 Test of the theoretical path model

The path model was created based on the CBT model (Fig. 1). Fit indices included χ^2 (23, 453) =33.75, *P* > .05, *CFI*=.98, and *RMSEA*=.03, indicating that the model fit the model well. Study showed that healthy lifestyle beliefs had a significant positive effect on healthy lifestyle behaviors (β= .41, *P* = .01) and had a significant negative effect on physical activity (β= -.15, *P* = .05), indicating that adolescents who had a higher level of healthy lifestyle beliefs engaged in more healthy lifestyle behaviors, but had less physical activity. Furthermore, there was a significant negative relationship between perceived difficulty and healthy lifestyle behaviors (β= -.54, *P* = .01) and between perceived difficulty and physical activity (β= -.41, *P* = .01), which indicated that adolescents who perceived more difficulty in leading a healthy lifestyle reported less healthy behaviors and less physical activity. Two non-significant paths were found between activity knowledge and healthy lifestyle behaviors and between activity knowledge and physical activity. In addition, the path between nutrition knowledge and healthy lifestyle behaviors was not significant. The relationship between healthy lifestyle behaviors and BMI and between physical activity and BMI were not significant.

Results of this study indicated that both healthy lifestyle behaviors and physical activity did not mediate the relationship predictors (i.e., activity knowledge, nutrition knowledge, healthy lifestyle beliefs, and perceived difficulty) and BMI. Depression moderated the relationship between physical activity and BMI (β= -.22, *P* = .05). However, anxiety and self-concept did not moderate the relationship between physical activity and BMI. Furthermore, depression, anxiety, and self-concept did not moderate the relationship between healthy lifestyle behaviors and BMI.

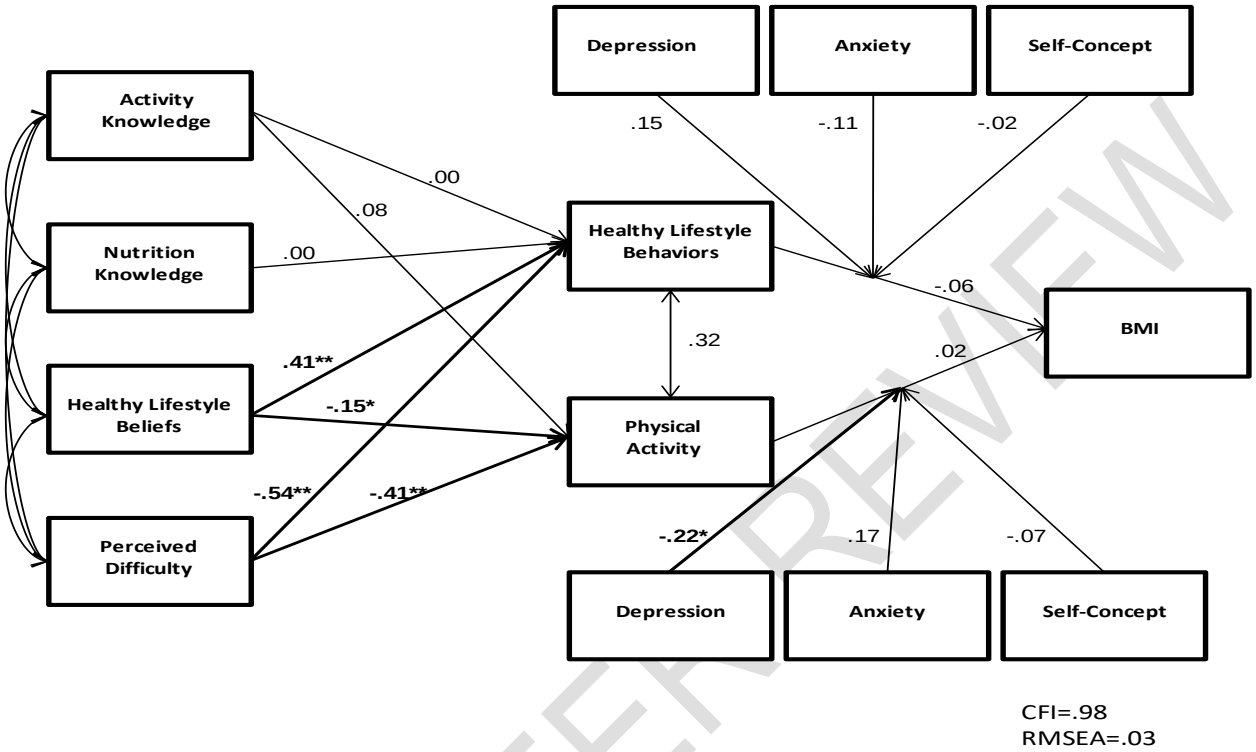

Fig. 1. Standardized parameters estimate of alternative path model demonstrates relations among activity/nutrition knowledge, healthy lifestyle beliefs/behaviors, physical activity, depression, anxiety, self-concept, and BMI. (-) Signifies an inverse relation between the variables. ** *P*= .01.* *P*= .05.

4. DISCUSSION

Cognitive-behavioral therapy builds skills such as problem solving, behavior change and cognitive re-structuring. With the guidance of a psychology professional in a clinical setting, therapeutic goals are achieved by reflecting upon the relationship between one's thoughts, feelings, and behavior [30]. Findings from this study indicated that Taiwanese adolescents who had more positive lifestyle beliefs were more engaged in healthy lifestyle behavior. This is consistent with findings from studies of adolescent subjects in the U.S. [10-11, 31]. McGovern et al. (2018) [38] which indicated that more positive-thinking adolescents tended to have healthier lifestyle habits. Furthermore, this finding concurs with another finding from an intervention study conducted by Jacobson and Melnyk (2012) which revealed that an increase in adolescents' healthy lifestyle beliefs is associated with greater incidences of healthy lifestyle behavior.

Our study found that Taiwanese adolescents who had a higher level of healthy lifestyle beliefs reported less physical activity, which was inconsistent with the findings from Melnyk and her colleagues (2013) [32]. Another recent intervention study was based on cognitive-behavioral skills training. One portion of the training course covers a concept called the healthy lifestyles thinking, feeling and behavior triangle. Western adolescents who attended the Creating Opportunities for Personal Empowerment (COPE) program significantly increased their frequency of physical activity, which was inconsistent with our study finding [32]. Although our subjects had positive impressions about physical exercise, they were discouraged from being more physically active due to physical discomfort, fatigue, and somatic pain after exercise. [33-34]. Moreover, other obstacles such as laziness, lack of time and fitness skills further encouraged them to remain sedentary [35-36]. Given these findings, suggesting a low but adequate level of physical activity (30 minutes or less) and designing an interesting aerobic program might encourage adolescents to be more active.

In addition, Chen and Ho (2012) revealed that parental involvement mediated Taiwanese adolescents' beliefs, and consequently influenced their child's academic performance as defined by GPA [37]. Parents in Asia typically set high academic standards for their children; this focus on higher grades and preparation for entrance examinations often comes at the cost of adequate physical activity [33, 39-40]. Culturally-Chinese adolescents spend extra time in "intensive class" to enhance academic performance, therefore they are more sedentary [41]. A study showed an association between blood pressure and academic performance, indicating that higher blood pressure is related to better academic performance in adolescents [42]. Elevated blood pressure in adolescents might be due to learning stress. A study reported a positive relationship between physical activity and academic performance, so teachers should encourage adolescents to be more active [43].

Consistent with previous studies on Western adolescents, our findings indicated that adolescents who perceive more difficulty in leading a healthy lifestyle report less healthy behavior and less physical activity [10,31,44]. Our present study found there is not a direct relationship between perceived significance of activity and actual physical activity, indicating increased awareness did not result in increased levels of physical activity. However, this increased awareness decreased sedentary behavior (i.e., time spent watching television) and improved adolescents' attitudes toward regular exercise, resulting in better academic performance [45]. Peer pressure was another contributing factor; group exercise and having an exercise partner helped increase individual levels of physical activity [46]. Adolescents who perceived more difficulty in leading healthy lifestyles reported less healthy behavior and less physical activity, which is consistent with previous studies [31,44]. Glazier et al. (2014) reporting that individuals living in less walkable spaces tend to be overweight and/or obese. Most of Taiwan is heavily urbanized, which limits the available space to safely walk, jog, or cycle[47]. The population density of Taiwan is approximately 647 persons/km2 [48]. Furthermore, there are local civil and environmental factors which discourage exercise, including heavy traffic, cluttered streets, poor air quality, and a hot, humid, semi-tropical climate.

In contrast to a previous study conducted by Jacobson and Melnyk (2012) and Gupta et al. (2013), increased knowledge about activity and nutrition did not increase healthy lifestyle behavior in Taiwanese adolescents [40.,49]. Hyun et al. (2017) found that Korean adolescents had higher scores in nutritional knowledge, but most of them did not use this knowledge in their daily lives. Instead, they preferred to adopt severe personal weight control measures [50]. An intervention study indicated that adolescents who participated in educational programs had more positive attitudes regarding healthy eating and were more likely to read nutritional information on food labels when shopping for food [45]. Based on the findings above, public information campaigns to sway general public attitudes toward healthy eating seem to be better than trying to teach nutrition to adolescent students. In addition, an interesting study finding showed that adolescents tended to choose food based on individual preference rather than general nutritional knowledge [51]. Findings from this study indicate that it was Taiwanese adolescents suffering from depression who increased their physical activity and decreased their BMIs the most. However, a study revealed that increased symptoms of depression negatively affected female adolescents' physical activity, so depression as a moderator between physical activity and BMI in Taiwanese adolescents is an area needing further study [52]. According to the DSM-IV, depression can be associated with either increased or decreased physical activity, and increased or decreased appetite [53]. Findings from a study conducted by Wit et al. (2009), note a positive U-shaped trend in the relationship between depression and BMI. This provides indirect support for future research on quadratic trends within BMI categories [54]. Thus, increased a level of healthy lifestyle beliefs in adolescents would increase their healthy lifestyle behaviors in their daily life. Furthermore, decreased a level of difficulty in engaging in healthy lifestyle in adolescents would increase their healthy lifestyle behaviors in their daily life.

4. LIMITATIONS

Several limitations include the following: first, our sample is limited to Taiwanese adolescents, so it is difficult to generalize findings to the wider population. Second, height and weight were obtained from school records, which might decrease their reliability. Third, this sample was a convenience sample, which limits external validity.

5. CONCLUSION

To increase engagement in healthy lifestyle beliefs and decrease perceived difficulty in engaging in healthy lifestyle behaviors, our results suggest that promoting positive beliefs about healthy lifestyle among adolescents may facilitate healthy lifestyle changes and help them perceive less difficulty in maintaining a healthy lifestyle. School nurses in Taiwan can conducted educational programs that focus on increasing adolescents' healthy lifestyle beliefs and help them perceived less difficulty in engaging in healthy lifestyle behaviors.

CONSENT

Written parental consent and student assent were collected from all parents and participants.

ETHICAL APPROVAL

The study was approved by the Human Subjects Institutional Review Board of Arizona State University (ASU) (IRB Protocol No. 1109006862) and Taiwan schools. All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki."

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