Social Support Mediated by Cognitive and Behavioral Determinants as Predictors of Body Mass Index among Korean Adolescents: A Structural Equation Model

Kim, Dong-Hee[1] · Kim, Young-Ae[2] · Kang, In-Soon[2]

1) Flinders University, Australia, 2) Department of Nursing, Pusan National University

= Abstract =

Purpose: This investigation examined a model to predict body mass index in order to prevent later development of obesity among adolescents. The hypothesized model was developed based on the principle of Social Cognitive Theory that social influences predict perceptions of cognition as well as behavior. **Method:** The 5,770 adolescents, aged 14-18 who participated in this study came from 11 separate school districts in Busan and Kyungnam province of South Korea. The adolescent surveys were administered in a group setting at the participating school. Of the 5770 surveys, adolescents with more than 10 percent missing data in the entire survey were excluded. The final sample contained 4,527 cases. The adolescents were included 2,250 (49.7%) males and 2,277 (50.3%) females. Data was analyzed Pearson correlation coefficients using SPSS 12 program and structural equation model (SEM) using Maximum Likelihood estimation was employed using Amos 5.0. **Results:** Social support directly affects cognitive determinants. Cognitive determinants directly affect behavior determinants which directly affect BMI. Cognitive and behavioral factors mediated the relationship between social support and BMI (GFI= 0.984, CFI= 0.974, RMSEA=0.031). **Conclusion:** Social levels should be supportive to help adolescents have healthier behaviors. This support can be accomplished by providing frequent support to establish positive cognitive factors as the foundation of the solution to prevent overweight and obesity.

Key words : Social support, Body mass index, Adolescent, Structural equation model

INTRODUCTION

Adolescence is a time marked by biological, cognitive and cultural changes (Perry, 2000), and adolescents establish dietary habits and activity patterns during this important developmental phase (Berkey, Rockett, Gillman & Colditz, 2003). These behaviors may affect adolescents' health problems such as obesity.

It is necessary to monitor weight status in adolescence, in particular, to address the problems associated with adult obesity as well as obese youth. The number of overweight and obese adolescents has been increasing alarmingly in the world (World Health Organization, 2004) and substantial consequences of obesity in youth are associated with physical, emotional and social health that occurs short-term and long-term (Must & Strauss, 1999). In addition, the probability of obesity at age 35

교신저자 : 강인순(E-mail: nursing@pusan.ac.kr)
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• Address reprint requests to : Kang, In-Soon(Corresponding Author)
　　　　　　　　　　　Department of Nursing, Pusan National University
　　　　　　　　　　　1-10, Ami-dong, Seo-gu, Pusan, Korea, 602-739
　　　　　　　　　　　Tel: 82-51-240-7748 C.P.: 82-19-521-1954 Fax: 82-51-248-2669 E-mail: nursing@pusan.ac.kr

was calculated as 2 times the odd ratio for 9 year olds and 4 times for adolescents aged 17 when the probability of obesity at age 35 is predicted from BMI at the 95th percentile in children and adolescents (Guo & Chumlea, 1999).

To limit the impact of obesity, preventive strategies are more effective than treatment because of the poor success in weight reduction. Moreover, because lasting weight reduction becomes more difficult over time (Rees, 1990), the management of being overweight and obese in teenagers is important.

Genetic and non-genetic factors interact across a person's lifespan to have an effect on the development, expression and maintenance of obesity (Pender & Stein, 2002). However, obesity is likely to appear as a complex multifactorial condition. 24% of genetic components and 70% of environmental factors contribute to weight gain through involving energy metabolism (Bouchard, Perusse, Rice, & Rao, 1997). Hill and Peters (1998) supported this view by indicating that the genetic composition of the population does not change rapidly, so the enormous increase in obesity must reflect changes in non-genetic characteristics. Genes are a susceptible characteristic, not an inevitable one, and the increasing prevalence of obesity can not be attributed to genetic characteristics alone (Hill & Peters, 1998).

The environment has often received the least attention in the classic epidemiological triad of host, agent and environment. In particular, how the social environment impinges on the distribution of body mass in adolescents is not clear (Flegal, 1999). Link & Phelan (1995) argued that social factors such as social support were recognized to be fundamental causes of disease that affect multiple mechanisms associated with behavior, belief and biology. However, few researchers have investigated the relationship between body mass in adolescents and social factors such as family, friends, peoples in community networks.

Although some research has shown that individual factors are influenced by developmental social support, the mechanism to explain how these general patterns of interactions within a family and peer group lead to changes in behaviors remains unclear. In addition, there is a lack of literature exploring the relationship between social environmental factors and body mass index in adolescents using cognitive and behavior characteristics such as self-efficacy, self-concept, physical activity and dietary habits as mediators. For these reasons, this

study has been undertaken.

This investigation examined a model to predict body mass index for the prevention of later development of obesity among adolescents. Hypothesized model was developed based principally on Social Cognitive Theory that social influences predict perceptions of cognition as well as behavior (Bandura, 1986). Characteristics such as social support, self-efficacy, self-concept, physical activity and eating habits were included based on Bandura's social cognitive theory's predictions and findings (Motl et al., 2002; Wilson et al., 2002).

Successful preventive interventions for conditions depend on identification of critical processes that inform key health outcomes (Levers-Landis et al., 2003). To our knowledge, this is the first epidemiological study with regard to cognitive factors (self-concept and self-efficacy), behavioral factors (physical activity and eating habits) and body mass index in Korean adolescents. This will afford a more comprehensive and meaningful explanation of adolescents' BMI (Body Mass Index) than has previously been available. Moreover, this will guide for interventions implemented to encourage health life style patterns, which also contribute to the prevention of obesity over children and adolescents through adults.

METHODS

Hypothesized model

Hypothesized model was developed based on Social Cognitive Theory and literatures. We expected that social support, cognitive and behavioral factors were associated with BMI. Significant associations will be further tested in a structural equation model.
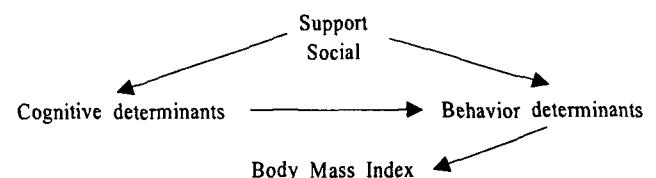
<Figure 1> Hypothesized model: How social-cognitive-behavioral determinants affect adolescents' BMI

Design

This study is mass survey, which identifies an influence of

social support mediated by cognitive and behavioral determinants as predictors of BMI among Korean Adolescents

Participants

The 5,770 aged 14-18 adolescents that participated in this study came from 11 separate school districts in Busan and Kyungnam province of South Korea from June to August 2004. The eleven districts were selected to ensure a more diverse sample. The selected schools have students that were considered to be representative of adolescents living in urban and suburban areas in South Korea. The participants came from different socioeconomic backgrounds and gender balance also was achieved as the schools were co-educational. Of the 5770 surveys, adolescents with more than 10 percent missing data in the entire survey were excluded. The final sample contained 4,527 cases. The adolescents were comprised of 2,250 (49.7%) males and 2,277 (50.3%) females.

Procedure

Prior to contacting potential adolescents, approval was obtained through the Flinders University Social and Behavioral Research Ethics Committee. Approvals from Principals of the Korean schools were also obtained.

The original English versions of the instruments used in this study were initially translated to Korean by two bilingual professors in nursing and the researcher. The Korean versions were then compared and the vocabulary modified to improve the understanding by Korean adolescents. Another bilingual person who had never seen the English version of the instruments then translated the Korean items back into English and this translation was compared with the Korean version.

Four pilot studies were conducted in Korea to ensure of appropriateness of the Korean version of the questionnaire translated from English and to assess validity and reliability of all measures and determine of the time required for procedures. The results of the tests indicated that all instruments reflected and measured the underlying concepts of the present study<Table 1>.

All teachers and school nurses were advised that their involvement was voluntary and whether they chose to assist or not would have no effect on their employment. The researcher obtained consent from the Principal of each school, teachers, school nurses, parents and students who wanted to participate in this study.

The adolescent surveys were administered in a group setting at the participating school. Students who agreed to participate in this study were given the questionnaire, consent form and information sheet in an envelope. Surveys were completed in class, sealed in an envelope by the student and returned to the teacher or researcher. Participants did not place their names on the questionnaires and were assured of the confidentiality of their responses.

Measures

<Table 1> Social cognitive behavioral factors

Factors	Scale		Cronbach	Test–retest	Sample items
Social support	Supports from parents, teachers, classmates, close friends, others	Malecki & Demaray (2002)	0.984	0.910	My parents help me practice my activities.
Cognitive factors	Self-concept	Song & Hattie (1984)	0.932	0.924	I have respect for myself
	Physical activity self-efficacy	Motl, et al. (2000)	0.876	0.870	I can be physically active during my free time on most days.
	Dietary self-efficacy	Clark, Abrams, & Niaura (1991)	0.932	0.882	I can resist eating when I am anxious
Behavioral factors	Physical activity	Godin & Shephard (1985)	0.854	0.907	Are you usually physically active (out of school) three times a week for at least 20minutes at a time?
	Eating habits	Harris (1983)	0.864	0.867	Do you find that the more you eat, the more you want to eat?
BMI	Body Mass Index	-	-	-	

● Social support

Social support is an individual's perception of general support or specific supportive behaviors (available or enacted on) from people in their social network (Malecki & Demaray, 2002). In this study, Social support was assessed with the Child and Adolescent Social Support Scale (CASSS) (Malecki & Demaray, 2002). The CASSS contains 60 items and measures perceived social support from parents, teachers, classmates, close friends and other people. It consists of a six-point scale 1 (Never) to 6 (Always). In this study, Cronbach alpha of social support was 0.984 and test-retest correlation coefficient was 0.910. Overall, the social support score was obtained by summing the score on the five subscales. Higher subscale and overall score indicate a more positive social support.

● Physical Activity Self-efficacy

Self-efficacy is the self-perception of one's skills and abilities to perform courses of action required to deal with prospective situation (Bandura, 1986).

The physical activity self-efficacy questionnaire (Motl et al., 2000) contains 8 items that pertain to confidence in one's ability to be physically active. These items are rated on a five-point scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). For the sample of adolescents in this study, Cronbach alpha was 0.876 and test-retest correlation coefficient was 0.870.

● Dietary self-efficacy

Dietary self-efficacy was assessed with the Weight Efficacy Life-Style Questionnaire (WEL; Clark, Abrams & Niaura, 1991) which contains 20 items using a 10-point scale rating from 0 (Not confident) to 9 (Very confident). Cronbach alpha was 0.932 and test-retest correlation coefficient was 0.882 for the sample of adolescents in this investigation.

● Self- concept

Self-concept is a set of belief that dominates processes of behavior as well as a process itself that involves a set of beliefs which guides, mediates and regulates action (Lewis & Brooks-Gunn, 1979). Self-concept was assessed with the Song and Hattie Test (1984). It contains 35 items using a five-point scale ranging from 1 (Never) to 5 (Always). For the sample of adolescents in this investigation, Cronbach alpha was 0.932

and test-retest correlation coefficient was 0.924.

● Physical activity

Physical activity was assessed using a physical activity questionnaire from Godin and Shephard's Leisure-Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985). There were four questions. Three questions assessed how many hours were spent in strenuous intensity physical activity, moderate-intensity physical activity, and low intensity physical activity during a week. Another question was added to assess how often adolescents were physically active out of school for at least 20 minutes in a typical week. The questionnaire rated on an 8-point scale ranging from 1 (Never) to 8 (7days) for each type of activity. The Cronbach alpha (0.854) and test-retest correlation coefficient (0.907) remained acceptable for the four-item scale with adolescents in South Korea.

● Eating habits

A measure of eating behavior was obtained with 10 items based on those used by Harris (1983) designed to assess eating habits. It consists of 10 items using a five-point scale rating 1 (Never) to 5 (Always). Cronbach alpha was 0.864 and test-retest correlation coefficient was 0.867 for the sample of adolescents in this study.

● Weight status

In this study, approval was not given to place an identifying code on the questionnaire that enabled cross correlation with measured height and weight. Height and weight were measured and accurate height and weight were provided to adolescents prior to collection of the data. BMI was calculated from the formula, weight (kg) divided by the square of the height (meters), based on the self-reported weight and height.

Data Analyses

Structural equation modeling (SEM) using Maximum Likelihood estimation was employed using Amos 5.0 (Arbuckle, 2003). SEM is an extension of the general linear model that enables a researcher to test a set of regression equations simultaneously (The University of Texas, 2005). Maximum likelihood estimation has resulted in minimally biased fit indices and parameter estimates under mild to severe violations of normality (Olsson, Foss, Troye, & Howell, 2000).

Jaccard and Wan (1996) suggested using several different indices when evaluating the overall fit of a model. The model fit was evaluated using several indices Higher value of Goodness of Fit Index (GFI > 0.90), Comparative Fit Index (CFI > 0.90), Non Normed Fit Index (NNFI > 0.90) and lower Root Mean Square Error of Approximation (RMSEA < 0.05) were indicative of good fit (Hu & Bentler, 1999).
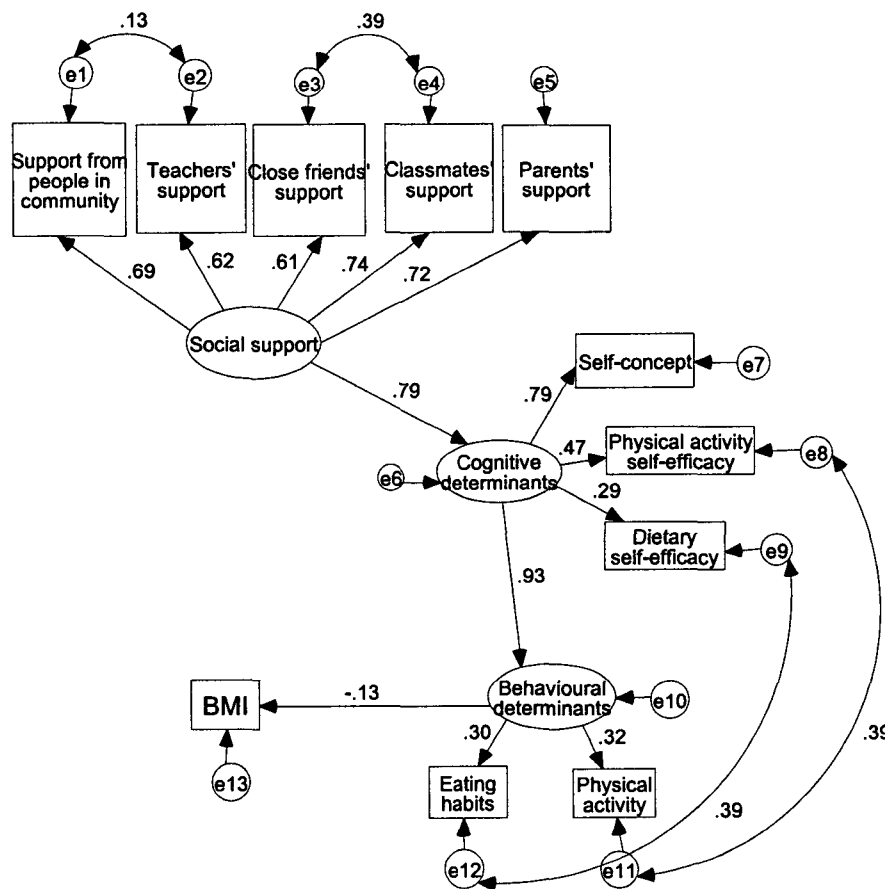
RESULTS

The correlations in Table 3 indicated that it was feasible to test a theoretically based structural model to describe interrelationships. As expected, social supports, cognitive and behavioral factors predicted adolescents' BMI, and BMI was negatively correlated to other variables (p< 0.05).

We tested the initial model in Figure1 (GFI= 0.980, CFI= 0.961, NNFI= 0.968, RMSEA= 0.049). Model modifications were conducted using an iterative process that involved

removing a single path with a nonsignificant t value and then reestimating the model (Joreskog, 1993). Paths with nonsignificant t values were removed because no substantively meaningful interpretation can be provided for the parameter estimates (Joreskog, 1993). We dropped the path between social support and behavior factors. Final structural model presented in <Figure 2> shows a good fit to the data, GFI= 0.984, CFI= 0.974, NNFI= 0.974, RMSEA=0.031. Also, the structural parameters and p values for this model are shown in <Table 2>.

Based on these results, social support directly affects cognitive determinants. Cognitive determinants directly affect behavior determinants which directly affect BMI. Cognitive factors mediated the relationship between social support and behavioral determinants. Behavioral factors mediated the relationship between cognitive factors and BMI.

DISCUSSION

<Figure 2> Significant relationships among social support, cognitive determinants, behavioral determinants and BMI

<Table 2> Correlation matrix for the study constructs

	1	2	3	4	5	6	7	8	9	10	11
1.PAS	1.00										
2.CMS	.51**	1.00									
3.CFS	.55**	.63**	1.00								
4.TS	.48**	.51**	.34**	1.00							
5.PS	.50**	.48**	.47**	.51**	1.00						
6.SC	.48**	.48**	.39**	.38**	.40**	1.00					
7.PASE	.27**	.26**	.29**	.22**	.24**	.35**	1.00				
8.DSE	.16**	.13**	.14**	.17**	.13**	.22**	.31**	1.00			
9.PA	.11**	.14**	.23**	.16**	.12**	.24**	.49**	.22**	1.00		
10.DH	.14**	.10**	.13**	.13**	.09**	.23**	.16**	.44**	.14**	1.00	
11.BMI	-.08**	-.12**	-.11**	-.04**	-.08**	-.09**	-.10*	-.09*	-.28**	-.16**	1.00

PAS: Parent' support, CMS: Classmate's support, CFS: Close friend's support, TS: Teacher's support,
PS: Support from other people in community, SC: Self-concept, PASE: Physical activity self-efficacy,
DSE: Dietary self-efficacy, PA: Physical activity, DH: Dietary habits, BMI: Body Mass Index.
$^*p< .05$, $^{**}p< .01$

This investigation examined a model to predict body mass index for the prevention of later development of obesity among adolescents. Our findings from a structural equation model were in accord with Bandura's predictions of the relationships of social support and cognitive factors to behaviors. The findings of this investigation clearly support the hypothesis that social support, cognitive and behavior factors had an indirect/ direct effect or both effects on adolescents' BMI. As expected, social support has a direct effect on cognitive factors, cognitive factors directly affect behavioral factors and behavioral factors affect BMI. The results of this study also support Bandura's theory that cognitive determinants operate as mediators linking social determinants to health-related behaviors. This study showed that the strongest path was that of cognitive determinants to behavioral determinants, which is consistent with previous findings (Bandura, 1986; Wilson et al., 2002). From these results, social levels should be supportive of adolescents' making healthier behaviors by providing frequent support to establish positive cognitive factors such as self-concept and self-efficacy.

Positive support is likely to reinforce adolescent's cognitive processes, which encourage behavioral changes. Positive reinforcement by family, friends, teachers and other people in communities in changing behaviors is more effective than no or negative reinforcement (Sothern et al., 1999). For example, a family encourages and supports adolescent to perform the recommended behaviors through learning and practicing the behaviors together or giving some incentives, such as increasing pocket money, when adolescent perform the

recommended behaviors. Schools can encourage and support through providing an opportunity to discuss recommended behaviors at a class time that may allow students to encourage each others. Schools can also provide more information about the behaviors such as the benefits of physical activity and healthy eating, and provide an opportunity to practice the behaviors with classmates during lunchtime or class time. A class teacher organizes students into small groups and gives a checklist to each group to mark the numbers of students who perform the behaviors in a group. A month later, the teacher provides a reward to a group that has the highest number. This may be a way that a student supports and encourages other student in the same group to perform the behaviors. Communities can promote good eating behaviors and show the performance of these behaviors by famous people. Adolescents may then learn how to perform the recommended behavior.

It is essential for adolescents, parents, schools and communities to work together in addressing the prevention of weight gain and maintenance of weight. The strategies linking individual, families, schools and communities, therefore, must be addressed as the foundation of the solution to prevent overweight and obesity. These multifaceted approaches may decrease the burden associated with overweight and obesity as well as improve public health through establishment of adequate resources for education and treatment, and policies in adolescence.

Limitations

There are some limitations in this study. One weakness was the inability to corroborate actual height and weight with perceived height and weight. However previous research indicated that self-reported weight and height are highly correlated with measured weight and height (Davis & Gergen, 1994).

To provide the accuracy of self-reported height and weight, we compared the self-reported values with measured values. The results of the t-tests indicated that self-reported height and weight in the present study did not significantly differ from the measured values for the School Health Record (p values were ranged from 0.771 to 0.884).

This study collected data on physical activity by recall that may have been limited by recall bias and the validity of measure based on self-report. However, there is some evidence for the reliability and validity of physical activity recalls and self-report eating recalls used with adolescents (Sawaya et al., 1996). In addition, because a convenience sample consisted mainly of adolescents in Busan and Kyungnam province, the results can not be generalized to all adolescents in Korea. However, participants were selected from eleven separate schools districts to ensure a more diverse sample, and the selected schools have students that were considered to be a representative sample of adolescents of urban centers in South Korea as they come from different ethnic and socioeconomic backgrounds.

Conclusions

This study has important findings for current practice and implications for future research. The results of this study afford a more comprehensive and meaningful explanation of adolescents' weight status than has previously been available by confirming the paths of influence between social supports, and cognitive and behavioral determinants. This study provides an empirically based analysis for extending models with a conceptualized multi-level context by assembling adolescent and social environmental determinants into a single model. This model provides a more complete picture of mechanisms, including direct and indirect effects, among adolescent level (adolescents' cognitive, behavioral determinants) and social level (social supports) in relation to weight status. Recognition of the contextual complexity and dynamics in the developmental obesity has been achieved in this study. The results of this

study will provide a guide for interventions that may be implemented to encourage healthy life style patterns by adolescents, which will also contribute to the prevention of obesity throughout adolescence and adulthood.

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