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Mediation and Moderated Mediation in Relationships among Environmental Factors, Health-Related Knowledge, Attitudes, Practices, and Gender

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Abstract

This paper addresses the mediation effects of food, built, and social environments, knowledge and attitudes on health, and the influence of the technology environment on health practices, along with gender's moderating effects. Adolescent respondents (n=365) aged 11 to 19 years from 13 private Christian schools in West, Central and East Indonesia were involved. Structural Equation Modeling was utilized to obtain the mediation and moderation effects.

It was found that the food environment, social environment, and health attitude partially mediate the technology environment on health practices. Likewise, the built environment (i) fully mediates the technology environment on food environment, and (ii) partially mediates the social environment and health attitudes. Finally, the food environment, social environment, health attitudes, and knowledge on health fully mediate, respectively, the relationship between the built environment and health practices, while knowledge on health mediates between the social environment and health practices.

Moderated mediation relationships were observed such that for males, (i) technology had a greater influence on the social environment; and (ii) the technology environment had a stronger positive influence on attitudes toward health than for females. On the other hand, the relationship between the built environment and knowledge on health had a stronger negative influence on males than on females.

Keywords: *Mediation, moderated mediation, Structural Equation Modeling, environmental factors*

Introduction

Health is one of the major concerns and needs of the world today, especially among adolescents. Hence, health practices such as eating, physical activity, and sleeping are a great challenge among adolescents. The World Health Organization (WHO) (2014) stated that promoting healthy practices in eating, physical activity, and sleeping during adolescence and taking steps to better protect young people from health risks are critical for the prevention of health problems in adulthood.

According to Hakeem, Thomas, and Badruddin (2001) as well as Aung, Foung, Azman, Zulkifeli, and Hong (2012), efforts are required not only to increase adolescents' knowledge about health, but also to increase awareness and understanding of a healthy body weight to inoculate belief in internal control over one's health. Boyse (2011) as well as Kalra, De Sousa, Sonavane, and Shah (2012) stated that children of mothers who have diabetes are more likely to be overweight. Obese parents contribute to specific food environments through an exposure to high-fat foods. Shopping patterns with high caloric food that are often stocked up at home ensures easy access to these types of food, and weight gain ensues.

Barnett and Casper (2001) defined *social environment* as the immediate physical surroundings, social relationships, and cultural milieus within which defined groups of people function and interact. Social environment can have either a positive or negative influence on health practice. Current thinking is that this is a result of children with a genetic predisposition to obesity living in an *obesogenic* (obesity-promoting) environment (Harding, 2015). In the vast majority of cases, environmental factors, lifestyle preferences, sleep time, and social environment are the significant factors that influence obesity (Del Coso Garrigós, García-Aparicio, Laguna-Nieto, Merino-Merino, & Rodríguez-Cabrero, 2011).

Hence, given the above interrelationships of health-related variables, it is evident that technology, food, social, and built environments have significant roles in health practices. Further, health practices are an integral part of adolescence in the preparation for adulthood. However, these relationships were only assessed from a bivariate perspective. Therefore, it is the purpose of this paper to assess the above-mentioned health-related variables in a multivariate perspective, using mediation and moderated mediation approaches.

Objectives of the Study

Mediation effects can be either partial or full. If both the direct and indirect effects are significant, the effect is considered partial. On the other hand, if the effect of independent variable (direct effect) on the dependent variable is not significant, the effect is considered full.

This study consisted of two parts. The first part traces how i) health attitudes, food, and social environments may directly/indirectly influence the technology environment's effect on health practices; ii) the built environment may influence technology's impact on the food and social environments, along with knowledge/attitudes on health; iii) the food and social environments, along with attitudes and knowledge on health, may affect the built environment's impact on health practices; and iv) knowledge of health may influence the social environment's impact on health practices.

The second part is to find out whether gender moderates the relationships between the following variables: a) technology environment and built, social, and food environments; b) built environment on social and food environments, along with knowledge/attitudes on health; c) social environment on knowledge/attitudes on health; d) knowledge and health practices on each other; e) food environment and health practices.

The following are the hypotheses of the study:

Hypothesis 1.

a. Food environment, social environment, and attitude on health mediate the relationship between the technology environment and health practices.
b. The built environment mediates the relationship between the technology environment and the following variables: knowledge on health, food environment, social environment and attitude on health.
c. Knowledge on health, food environment, social environment and attitude on health mediate the relationship between the built environment and health practices.
d. Knowledge on health mediates the relationship between the social environment and health practices.

Hypothesis 2. Gender moderates the relationship between:

a. The technology environment and the following: built environment, social environment, food environment, attitude on health and health practices.
b. The built environment and the following: social environment, food environment, attitude on health, and knowledge on health.
c. The social environment and the following: knowledge on health and health practices.
d. The knowledge on health and health practices
e. The attitude on health and health practices
f. The food environment and health practices

Theoretical Framework

The theoretical framework of this study is based on Social Ecological Model (SEM) Model. SEM originally developed from Urie Bronfenbrenner's Ecological Systems Theory that describes the broadening layers of influence over individuals' behavior from "micro" to "macro". The ecological

theory of health suggests that health emerges from the day-to-day interactions between people and their environments (Institute National de Santé Quebéc, 2016).

SEM is commonly used in the field of public health; it has four or five different levels that all influence health behavior in some manner. These levels of the interactive system are intrapersonal, interpersonal, institutional/organizational, community, and structure and system as shown in Figure 1.

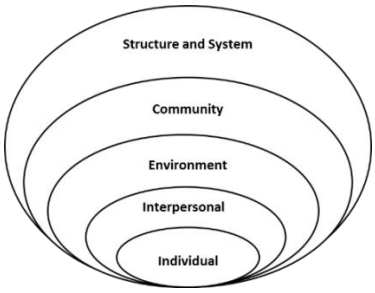

Figure 1. Social-ecological Model

The primary circle represents the intrapersonal or individual, ultimately affected by all other levels of the social-ecological model. Individual-level factors influencing health include behavior, knowledge, attributions, and beliefs. The second tier represents individuals' interactions with one another. The third tier represents the environment that facilitates individuals' interaction. A community that is on the fourth circle can be described as a larger societal construct comprised, in varying combinations, of the three smaller tiers of the SEM.

Communities are composed of individuals as they participate in interpersonal relationships within various groups of institutions and organizations. It may be defined geographically, politically, culturally, or by other common characteristics. Finally, the outermost tier of the model represents the local, state, and federal structures and systems that affect the environment surrounding communities and individuals.

Methodology

Structural Equation Modeling is a multivariate statistical technique or model that is a hybrid of regression analysis, and factor analysis. It is used to analyze inter-relationships among independent and dependent variables. Those that take the role of independent and dependent variables simultaneously are called mediators. Hence, to find out whether mediators play significant roles in the model is called **mediation** analysis.

The research method employed in this study was guided by an interest in understanding gender differences in the effects of environmental factors, and health-related attitudes on health-related knowledge among obese adolescents.

Research Design

This study used the descriptive-correlation design to describe and determine the existing relationships among the variables. Descriptive studies describe the general characteristics of environmental factors (food environment, built environment, socio-cultural environment, and technological environment) as mediated by health-related knowledge and health-related attitude.

Population and Sampling Techniques

This study researched attitudes of 365 adolescents from 13 private Christian schools in West, Central, and East Indonesia. Respondents for the study were selected using purposive sampling. Purposive sampling is a type of non-probability sampling where samples are selected based on the purpose of the researcher (Crossman, 2016). The selected schools, locations, and total number of respondents from each school is presented in Table 1.

Table 1. Schools, Locations, and Total Number of Respondents

Schools	Location	Total Number of Respondents
A	East Indonesia	30
B	East Indonesia	58
C	East Indonesia	15
D	Central Indonesia	30
E	Central Indonesia	54
F	Central Indonesia	27
G	West Indonesia	26
H	West Indonesia	28
I	West Indonesia	19
J	West Indonesia	30
K	West Indonesia	16
L	West Indonesia	16
M	West Indonesia	16
Total		**365**

Criteria for inclusion in the study were as follows: adolescents who were Indonesian, officially and currently enrolled, aged 11 to 19 years old, irrespective of gender, and found to be overweight and obese.

Data Gathering Procedures

The data gathering procedure consisted of three steps. The first step was orientation, where the respondents were gathered in one selected room with the researcher orienting them regarding the purpose of the study, screening procedures, and questionnaires completion procedures.

The second step was screening, where each respondent's weight and height were measured for the BMI. All respondents (both in the pilot and in actual data collection) were measured using calibrated machines to maintain the accuracy of the measurement. A portable digital glass weighing scale (*Beurer GS 201,* deviation +/- 0.5 kg) was used to measure the body weight, and portable *Staturemeter* (*OneMed 26SM SODA*, graduation 1 mm) was used for measuring the height.

In the third step of the data gathering procedure, respondents were requested to fill in a questionnaire to find out if environmental factors, knowledge, and attitude on health would elicit effects on health practices. In order to prevent any missing values, the researcher explained as clearly as possible the mechanism of answering the questions on the questionnaire, and encouraged each one to ask questions if they did not understand a specific item.

Statistical Treatment

To analyze, interpret, and determine the implications of the data, the researcher used Structural Equation Modeling (SEM) as a statistical technique, using Statistical Packages for Social Sciences (SPSS) and Analysis of Moment Structure (AMOS).

After transferring data from SPSS to AMOS, SEM was used to analyze mediation and moderation processes in AMOS to determine if mediator variables have full or partial mediation effects on the independent and dependent variables. SEM was further used to know whether gender moderates the effects among the inter-relationships of variables involved in the study.

Results and Discussion

The results of the study are discussed and classified according to the hypothesis. Hypothesis 1 discusses mediation results while Hypothesis 2 claimed that gender moderates a relationship among health variables.

Hypothesis 1a

The first set of investigations considered the mediation effects of the food environment, social environment, and attitude on health on the relationship between the technology environment and health practices. Hypothesis 1a claimed that the food environment would have a positive effect – that is, the food environment mediates the technology environment effect on health practices. The results in Table 2 agreed with the hypothesis, showing that positive effects exist ($\alpha\beta = 0.097$, $p < 0.001$) and that the food environment partially mediated the technology environment's effect on health practices. The result is in agreement with the study of "The Harvard School of Public Health" (2015), which stated that people have a hard time eating healthfully if healthy foods are not available where they live.

Similarly, social environment and attitude on health partially mediated the respective effects of the technology environment on health practices ($\alpha\beta = 0.036$, $p < 0.005$ and $\alpha\beta = 0.059$, $p < 0.001$). This further confirms the existence of mediation effects in the relationship between the technology environment and health practices. According to Koehly and Loscalzo (2009), the social influences on overweight adolescents vary, but all depend on social interaction. Parents can serve as role models, especially for younger children whose health behaviors are completely influenced by their parents' habits, while older children may look to their friends, teachers, and community leaders as role models for their own health behaviors.

Table 2. Food Environment, Social Environment, and Attitudes on Health as Mediators of Technology Environment on Health Practices

Independent Variable	Mediator	Dependent Var.	Type	Estimate	p-value
Technology Environment	Food Environment	Health Practices	Partial	0.097	0.001
Technology Environment	Social Environment	Health Practices	Partial	0.036	0.003
Technology Environment	Attitude on Health	Health Practices	Partial	0.059	0.000

Hypothesis 1b

Hypothesis 1b argued that the built environment affects the relationship between the technology environment and the following variables: knowledge on health, food environment, social environment, and attitude on health.

The results in Table 3 confirmed that the built environment is a mediator of the technology environment on knowledge and health ($\alpha\beta = -0.358$, $p < 0.005$). In the same manner, the built environment is a mediator in the relationship between the technology environment and the following dependent variables respectively: food environment, social environment, and attitude on health ($\alpha\beta = -0.107$, $p < 0.005$, $\alpha\beta = -0.109$, $p < 0.005$ and $\alpha\beta = -0.097$, $p < 0.05$ respectively).

According to Baron and Kenny (1986), if the effect exists between the independent variable and dependent variable, then the mediation is partial; otherwise, the mediation is full or complete. Therefore, the mediation effect of the built environment in the relationship between the technology environment and knowledge on health is full. However, the effect is negative. This means that the more improved the technology environment is, knowledge on health would decrease. The effect is partial for the dependent variables such as food environment, social environment and attitude on health, with the technology environment being an independent variable. However, for the effect of technology on attitude, the effect is negative. Thus, the technology environment affects negatively on health attitude

Table 3. Built Environment as a Mediator of Technology Environment on Knowledge on Health, Food Environment, Social Environment and Attitude on Health

Independent Variable	Mediator	Dependent Variable	Type	Estimate	p-value
Technology Environment	Built Environment	Knowledge on Health	Full	-0.358	0.001
Technology Environment	Built Environment	Food Environment	Partial	0.107	0.001
Technology Environment	Built Environment	Social Environment	Partial	0.109	0.001
Technology Environment	Built Environment	Attitude on Health	Partial	-0.055	0.026

Hypothesis 1c

Hypothesis 1c posited that the following mediation – knowledge on health, food environment, social environment, and attitude on health – influence the built environment on health practices. Table 4 confirmed the hypothesis affirmatively.

Knowledge on health was fully mediated by the built environment on health practices ($\alpha\beta = 0.020$, $p < 0.01$). The higher utilization of sports facilities the better is their health practices. This result was also similar to food environment, social environment and attitude on health ($\alpha\beta = 0.071$, $p < 0.01$), ($\alpha\beta = 0.027$, $p<.01$) and ($\alpha\beta = -0.033$, $p < 0.05$) respectively.

However, it is interesting to note that when attitude on health mediates, the relationship of the built environment and health practices reverse, that is, the more utilization of sports facilities, the lower was their health practices. According to Tsang, Kohn, Chow, and Singh (2013), attitudes influence physical activity and exercise behaviors. Positive attitudes optimize exercise and physical activity in adolescents, while negative attitudes impair it. Lindelof, Nielsen, and Pedersen (2013) stated that overweight and obese adolescents need a positive attitude so that they will be more active.

Such attitude needs to be learned through everyday life by experiencing joy and its meaning by being physically active. Moreover, Wiley, and Cory (2013) stated that knowledge of sports and a positive attitude on physical activity play an important role in shaping health practices in adolescents.

Table 4. Knowledge on Health, Food Environment, and Social Environment as Mediator Variables of Built Environment on Health Practices

Independent Var.	Mediator	Dependent Var.	Type	Estimate	Upper	p-value
Built Environment	Knowledge on Health	Health Practices	Full	0.020	0.042	0.007
Built Environment	Food Environment	Health Practices	Full	0.071	0.104	0.001
Built Environment	Social Environment	Health Practices	Full	0.029	0.053	0.003
Built Environment	Attitude on Health	Health Practices	Full	-0.033	-0.013	0.014

Hypothesis 1d

Hypothesis 1d claimed that knowledge on health mediates the relationship between the social environment and health practices. Based on the results shown in Table 5, the hypothesis was established. Knowledge on health partially mediates the relationship between the social environment and health practices ($\alpha\beta = 0.016$, $p < 0.01$). Knowledge on health plays a very important role in ones' health endeavors; this is affirmed by Wiley and Cory (2013). Accordingly, health knowledge and attitudes are factors that have been widely demonstrated to play important roles and are widely viewed as essential components of the health-related curriculum.

According to Santrock (2008), it is during the adolescent stage when the cognitive development of formal operation takes place, and adolescents' thoughts become more abstract. Aung, Foung, Azman, Zulkifeli, and Hong (2012) stated that adolescents develop the ability to logically reason, to generate hypotheses, and potentially to act on these thoughts. Knowledge of health can influence health practices. Furthermore, according to Hakeem, Thomas and Badruddin (2001) as well as Phyu, Chan, Azman, Zulkifeli, and Yong (2012), with regards to the prevention of diseases, efforts are required not only to increase adolescents' knowledge about health, but also to increase awareness and understanding of a healthy body weight to inoculate belief in internal control over one's health

Table 5. Knowledge on Health as a Mediator of Social Environment on Health Practices

Independent Var.	Mediator	Dependent Var.	Type	Estimate	p-value
Social Environment	Knowledge on Health	Health Practices	Partial	0.016	0.008

Hypothesis 2a

Hypothesis 2a, has postulated that gender moderates the relationship between the technology environment and the following: built environment, social environment, food environment, attitude on health, and health practices.

To test the moderating effect of gender, mediated moderation was employed. The objective was to assess the effect of gender on the relationship between the technology environment and the built environment. The results are in Table 6, which indicates that gender does not affect the relationship (z-score = 0.926, $p > 0.05$) between the technology environment and the built environment. This implies that regardless of whether male or female serves as a unit of analysis, it does not change the effect of the relationship.

Considering the relationship between the technology environment and the social environment, gender moderates the relationship. The relationship was stronger for males (z-score = -1.691, $p < 0.05$). Although both male and female interactions are significant, yet it is stronger for male respondents ($\beta = 0.211$, $p < 0.001$) than for female respondents ($\beta = 0.211$, $p < 0.01$). This means that males will have a stronger social environment than females whenever they are within the technology environment.

There is no moderating effect for gender in the relationship between the technology environment and the food environment (z-score = 0.189, $p > 0.05$). This only means that whether male or female respondents, they will be affected by technology in the food environment. The effect of gender in the relationship between the technology environment and attitude on health is noteworthy (z-score = 2.377, $p < 0.01$). Table 6 shows that the relationship is stronger in male respondents ($\beta = 0.337$, $p < 0.01$). In fact, when female respondents only are considered, the relationship would not have been significant ($\beta = 0.097$, $p > 0.05$). The inference is that males' attitude on health was enhanced by the technology environment. Therefore, males would have a good attitude about health given that they are in the technology environment.

Table 6. Gender as a Moderator of the Technology Environment on the Built Environment, the Social Environment, the Food Environment and Attitude on Health

Independent Variable	Dependent Variable	Moderator: Gender				z-score
		Male		Female		
		Estimate	p-value	Estimate	p-value	
Technology Environment	Built Environment	0.405	0.000	0.494	0.000	0.926
Technology Environment	Social Environment	0.393	0.000	0.211	0.005	-1.691*
Technology Environment	Food Environment	0.317	0.000	0.331	0.000	0.189
Technology Environment	Attitude on Health	0.337	0.000	0.097	0.160	-2.377**

*Significant at 0.05 level; **Significant at 0.01 level

Hypothesis 2b

Hypothesis 2b asserted that gender moderates the relationship between the built environment and the following: the social environment, food environment, attitude on health, and knowledge on health. Table 7 summarizes the results.

Table 7 shows that gender did not moderate the social environment and the food environment whenever the technology environment is being considered as predictor (z-score = -0.396, $p > 0.05$), (z-score = -0.349, $p > 0.05$), (z-score = 0.273, $p > 0.05$), respectively. This suggests that the effect of the built environment on the social environment, food environment and attitude on health is not due to whether the respondents are male or female.

However, gender influences the relationship between the built environment and knowledge on health (z-score = -2.23, $p < 0.01$). The effect is more intense for female than for male respondents ($\beta = -1.174$, $p < 0.01$), ($\beta = -0.306$, $p < 0.01$), respectively. In fact, when only male respondents are considered, there would be no significant effect on their relationship.

Table 7. Gender as a Moderator of the Built Environment on the Social Environment, Food Environment, Attitude on Health and Knowledge on Health

Independent Variable	Dependent Variable	Moderator: Gender				z-score
		Male		Female		
		Estimate	p-value	Estimate	p-value	
Built Environment	Social Environment	0.271	0.000	0.229	0.002	-0.396
Built Environment	Food Environment	0.255	0.000	0.230	0.000	-0.349
Built Environment	Attitude on Health	-0.132	0.073	-0.105	0.118	0.273
Built Environment	Knowledge on Health	-0.306	0.286	-1.174	0.000	-2.23**

*Significant at 0.05 level, **Significant at 0.01 level

Hypothesis 2c

The results for Hypothesis 2c are presented in Table 8. The hypothesis states that gender moderates the social environment on knowledge on health and health practices. Table 8 denies the hypothesis. Gender does not moderate the relationship between the social environment and knowledge on health (z-score = 1.014, $p > 0.05$). However, considering male respondents, the effect of the social environment on knowledge on health is significant ($\beta = -0.854$, $p < 0.01$), while for females, it is not significant ($\beta = -0.467$, $p > .005$). In spite of this condition, it turned out that the interaction of gender is not significant.

Similarly, gender does not moderate the relationship between the social environment and health practices (z-score = -1.436, $p > 0.05$). Even though the effect of the relationship is significant for male respondents ($\beta = -0.178$, $p < 0.01$) while the effect of the relationship is not significant for female respondents, yet the interaction of gender is not significant.

Table 8. Gender as a Moderator of Social Environment on Knowledge on Health and Health Practices

Independent Variable	Dependent Variable	Moderator: Gender				z-score
		Male		Female		
		Estimate	p-value	Estimate	p-value	
Social Environment	Knowledge on Health	-0.854	0.002	-0.467	0.074	1.014
Social Environment	Health Practices	0.178	0.002	0.075	0.087	-1.436

*Significant at 0.05 level; **Significant at 0.01 level

Hypothesis 2d

Hypothesis 2d posited that gender moderates the relationship between knowledge on health and health practices. The above premise was not confirmed by the results in Table 9, which showed that gender did not interact in the relationship between knowledge on health and health practices (z-score = 0.884, $p > 0.05$). In spite of the fact that the effect for male respondents on the knowledge on health and health practices is significant ($\beta = 0.034$, $p < 0.05$) while the effect for females is not significant ($\beta = -0.018$, $p > 0.05$), yet the result turned out to be not significant.

Table 9. Gender as a Moderator of Knowledge on Health on Health Practices

Independent Variable	Dependent Variable	Moderator: Gender				z-score
		Male		Female		
		Estimate	p-value	Estimate	p-value	
Knowledge on Health	Health Practices	-0.034	0.024	-0.018	0.106	0.884

*Significant at 0.05 level; **Significant at 0.01 level

Hypothesis 2e

Hypothesis 2e speculated that gender moderates the relationship between attitude on health and health practices. The results in Table 10 failed to confirm the above statement, but instead indicated that gender did not moderate the relationship between attitude on health and health practices (z-score = 1.298, $p > 0.05$). However, when both male and female respondents were treated separately, the effect on the attitude on health and health practices is significant ($\beta = 0.223$, $p > 0.01$ and $\beta = -$

.0.322, p < 0.01 respectively). This implies that the influence of their intensity as moderators is both high and significantly the same.

Table 10. Gender as a Moderator of the Effects of Attitude on Health on Health Practices

Independent Variable	Dependent Var.	Moderator: Gender				z-score
		Male		Female		
		Estimate	p-value	Estimate	p-value	
Attitude on Health	Health Practices	0.223	0.000	0.322	0.000	1.298

*Significant at 0.05 level; **Significant at 0.01 level

Hypothesis 2f

Hypothesis 2f posited that gender moderates the relationship between the food environment and health practices. Table 11 gives a result denying the above hypothesis, showing that gender did not moderate in the relationship between the food environment and health practices (z-score = -0.152, p > 0.05). Nonetheless, it was found that both male and female respondents, when treated separately, were affected by the food environment and health practices, so the findings are significant (β = 0.304, p < 0.01 and β = -0.288, p < 0.01 respectively). This means that the effect of their strength as moderators is both high and significantly the same.

Table 11. Gender as a Moderator of the Food Environment on Health Practices

Independent Variable	Dependent Var.	Moderator: Gender				z-score
		Male		Female		
		Estimate	p-value	Estimate	p-value	
Food Environment	Health Practices	0.304	0.000	0.288	0.000	-0.152

***** Significant at 0.05 level; ** Significant at 0.01 level

The Model and its Fitness

The established criteria suggest that a p-value of 0.007, ratio of *Chi-square* to *degrees of freedom* of 2.79, and the *Root Mean Score Error of Approximation* (*RMSEA*) of 0.070 were an acceptable fit. A Standardized *Root Mean Square Residual* (*SRMR*) value of 0.045, *Goodness of Fit Index* (*GFI*) of 0.984, and the *Comparative Fit Index* (*CFI*) of 0.980 were a good fit. The above results are shown in Table 12 below.

Table 12. Model of Fit Values

	Rules of Thumb			
Fit Measure	**Good Fit**	**Acceptable Fit**	**Model Fit**	**VI**
p Value	$0.05 \leq p$ 1.00	$0.01 \leq p \leq 0.05$	0.007	Acceptable Fit
χ^2/df	$0 \leq \chi^2/df \leq 2$	$2 < \chi^2/df \leq 3$	2.79	Acceptable Fit
RMSEA	0 ≤ RMSEA ≤ 0.05	0.05 < RMSEA ≤ 0.08	0.070	Acceptable Fit
SRMR	0 ≤ SRMR ≤ 0.05	0.05 < RMSEA ≤ 0.10	0.045	Good Fit
GFI	0.95 ≤ GFI ≤ 1.00	0.90 ≤ GFI < 0.95	0.984	Good Fit
CFI	0.97 ≤ CFI ≤ 1.00	0.95 ≤ CFI < 0.97	0.980	Good Fit

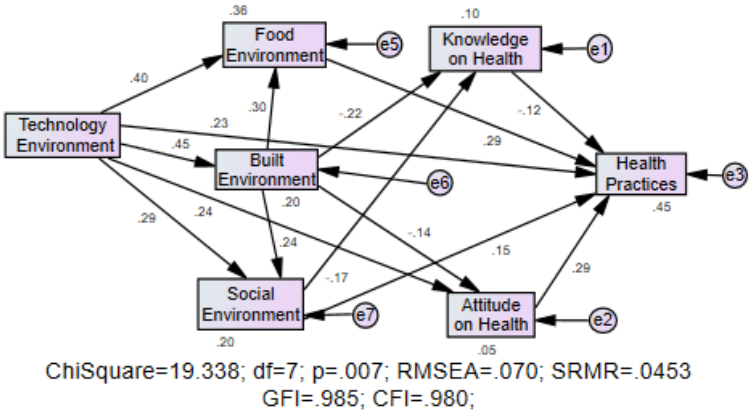

Figure 2.The Emerging Structural Model

Conclusion

The primary goal of this paper was to explore the effects of the technology environment, the food environment, the built environment, the social environment, and knowledge of health and attitudes toward health practices. From among the interrelationships of the health variables, direct and indirect relationships of the indicated variables were assessed using mediation analysis via structural equation modeling. The effects of gender as a moderator among health variable relationships were also assessed.

It was found that the food environment, social environment, and attitude on health are partially influenced by the technology environment and health practices. Meanwhile, the built environment fully mediated the technology environment on knowledge of health, and partially mediated the technology environment on the following dependent variables: the food environment, social environment, and attitude on health.

Knowledge of health, food environment, social environment, and attitude on health were respectively influenced by the built environment on health practices, while knowledge of health partially mediated the social environment on health practices.

The moderating effect of gender in the relationship between the technology environment and the social environment was found to be significant, and the relationship was stronger for male respondents. Similarly, gender was found to interact with the relationship between the technology environment and attitude on health, and that the relationship was more intense for male respondents. Finally, gender moderated the relationship between the built environment and knowledge of health. In this case, the relationship was stronger for female respondents.

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