Working Draft
A Data Mining Approach for Developing Intervention Programs to Lessen Body Dissatisfaction and Promote Healthy Weight Management

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ABSTRACT

Due to the fact that body dissatisfaction is pervasive and is associated with many negative effects, it is important to recognize and begin to treat at an early developmental stage in order to prevent for the problem from becoming a more chronic condition. Many scholars and/or health professionals attempt to find effective interventions to alleviate this problem. This study applies a data mining approach to predict and explain the key determinants of body dissatisfaction from the data set of Thai adolescences. The main goal is to turn data into insights and identify factors that contribute to body dissatisfaction. The key findings indicate the key determinants of body dissatisfaction in more detailed and in different aspects from available literature, which can be used to support the development of intervention programs to lessen body dissatisfaction and promote healthy weight management.

INTRODUCTION

Body image is how ones perceive, think, and feel about their physical self (Grogan, 2016). Body image is formed through messages ones received from their societies about their bodies and also what type of body is desirable (or undesirable) in their particular contexts. Ideal body of individual is influenced by their society (Aronson, Wilson, & Sommers, 2015). When there is a discrepancy between their current body and ideal body, the body dissatisfaction (BD) occurs. BD is a cognitive process that individual compared themselves with his or her ideal body type (such as figures, weight, muscle and fat mass, and waist and hip circumferences), which results in a negative thoughts or feelings about their own body (Grogan, 2016). It is important to note that body image distortions or body misperception is different from BD. Body misperception is a condition where individual perceives their body to be larger or smaller that it is (Association, 2013).

A large body of literature observed a high prevalence of BD in both males and females across countries and age groups (Chongwatpol & Gates, 2016; Lawler & Nixon, 2011; Nouri, Hill, & Orrell-Valente, 2011; Pallan, Hiam, Duda, & Adab, 2011). BD appears to occur in early childhood (Adams et al., 2000; Schur, Sanders, & Steiner, 2000) and increase throughout the transition to young adulthood (Bucchianeri, Arikian, Hannan, Eisenberg, & Neumark-Sztainer, 2013). BD has been shown to be an important predictor of eating disordered, health outcomes (Neumark-Sztainer, Paxton, Hannan, Haines, & Story, 2006), and psychopathology (Mond, van den Berg, Boutelle, Hannan, & Neumark-Sztainer, 2011). Given the negative health-related outcomes, many scholars attempted to find risk factors or predictors of BD with the aims of detecting the BD at the early developmental stage and be able to treat or prevent at the early onset of BD from becoming a more chronic condition.

Many factors have been identified as predictors of BD such as gender (Chongwatpol & Gates, 2016), age (Bucchianeri et al., 2013), BMI (Chongwatpol & Gates, 2016; Cromley et al., 2012; Lawler & Nixon, 2011; Quick, Eisenberg, Bucchianeri, & Neumark-Sztainer, 2013; Xanthopoulos et al., 2011), socioeconomic status (Chongwatpol & Gates, 2016; Patricia A. van den Berg, Jonathan Mond, Marla Eisenberg, Diann Ackard, & Dianne Neumark-Sztainer, 2010), and the influence of parents, peers, and media (Ata, Ludden, & Lally, 2007; Chen, Gao, & Jackson, 2007; Mellor et al., 2009). However, the predictors differ across samples and cultures. There are only a few studies about BD available in the Thai population (Chongwatpol & Gates, 2016; Sharps, Price-Sharps, & Hanson, 2001; Wardle, Haase, & Steptoe, 2006) and no previous research examined the influence of sociocultural factors on body attitudes and related behaviors. Therefore, it is crucial to identify predictors and patterns of BD specifically in the Thai population.

Many measurement tools widely used in the field of nutrition research are questionnaire, which consists of different questions with different aspects in order to capture a single interested variable. For example, in order to assess physical activity, several questions were asked regarding their activity on weekdays, weekends, evening, etc. Then, the total scores will be calculated from all questions and used (Chongwatpol & Gates, 2016; Janz, Lutuchy, Wenthe, & Levy, 2008). However, individual with similar scores might have different activity patterns, such as ones might have more activity on weekdays and another have more activity on weekends. Another example is the questionnaire uses

to assess perceive pressure from their parents on their body. This questionnaire consists of questions regarding the comments adolescents received from their parents to lose weight, gain weight, or become more muscular (McCabe & Ricciardelli, 2001; Xu et al., 2010). The total scores were calculated, and adolescents with the same scores will be interpreted that they have similar level of perceived pressure from their parents. However, one might receive comments about losing weight but one might be encouraged to gain weight. These aspects cannot be captured when reporting total scores alone. These aspects are very important when the target variable is BD because BD is multi-direction, which can be either wanted to have a smaller or larger body size.

As mentioned above, many research in the area of nutrition use a total score that derive from a questionnaire to report the interested variables, which can partially explain the interested variables but does not capture the differences in patterns that individuals might have. Very few, if any, research in nutrition have incorporate a data mining approach, which can further explore the data and capture patterns in the data set that cannot be done through the traditional statistical analysis. Therefore, rather than analyzing the data in traditional ways through descriptive statistics or conventional Excel-based regression analysis, employing the data mining technique will give valuable insights and recognize more detailed characteristics that contribute to body dissatisfaction among Thai adolescents.

RESEARCH METHODOLOGY

We follow the CRISP-DM (Cross Industry Standard Process for Data Mining) methodology as a guideline in structuring the data mining project for diagnosing defects in the energy industry. CRISPDM breaks down this data mining project into six phases: business understanding, data understanding, data preparation, modeling, evaluation, and deployment. A case study of the evaluation of body dissatisfaction in Thailand was conducted to explore the benefit of applying analytical methods in the nutrition industry. The questionnaire was distributed to nine schools in Bangkok Metropolitan Region Thailand in June - July, 2014. The participants were 10th -12th grade students (15-18 years old). A total of 1,820 questionnaires were included in this study analysis. The detailed of participants and data collection has been described in detail elsewhere (Chongwatpol & Gates, 2016).

The measures about demographic information, height, weight, body weight perception, body dissatisfaction, food choice behaviors, physical activity levels, and weight management practices used has been described in detail elsewhere (Chongwatpol & Gates, 2016). Briefly, self-report height and weight (including current and ideal) were used to calculate current and ideal body mass index (BMI). The WHO growth reference for school-aged children and adolescents were used as cut-offs (Onis et al., 2007). To assess body perception, the participants were asked, "How do you describe your weight? (Responses: underweight, about the right weight, slightly overweight, or very overweight). Their answers were compared to their current BMI categories (underweight, healthy weight, overweight, or obese). The participants were then classified whether they underestimated, overestimated, or correctly estimated their body size.

Body dissatisfaction (BD) was assessed using Stunkard's figure rating scale (FRS) (Stunkard, Sorensen, & Schulsinger, 1983). The scale consists of 9 drawing figures ranging from very thin to very fat (see Figure 1). The participants were asked to choose the figure that looks most like their current body and the figure that looks most like their ideal body. The participants had BD if there is a discrepancy score between selected current and ideal figures. Negative discrepancy scores indicate the desire to have a bigger figure than the current figure and positive discrepancy scores indicate the desire to have a smaller figure than the current figure.

A modified version of questions from the Youth Risk Behavior Surveillance Survey (YRBSS) was used to determine food choice behaviors of the participants. The total score from 9 items were calculated, and the higher scores indicated healthier food choice behaviors (Centers for Disease Control and Prevention, 2013). Physical activity level was assessed using the Physical Activity Questionnaire for Adolescents (PAQ-A). The higher scores represent higher physical activity levels (Janz et al., 2008).

The influence of sociocultural factors on body dissatisfaction was determined using a modified version of the Sociocultural Influences Questionnaire (McCabe & Ricciardelli, 2001). The original questionnaire had separate sections for father, mother, best male friends, and best female friends. Due to the length of the questionnaire, several modifications were made. First, this study combined father and mother to one section as a primary caregiver, which the participants were asked to indicate whom they identified as their primary caregiver. Second, the best male friends and best female friends were combined into one section for best friends. Questions asked about frequency of the feedback that the participants received from a primary caregiver and best friends, and the perception from media to lose weight, gain weight, or increase muscle. Example questions included "Does your primary caregiver/best friend encourage you to lose weight?" and "Do the media (i.e. T.V, movies, magazines and newspaper) give the idea that you should be slimmer?" Items were rated on a 5-point Likert scale from "never" to "always", scoring from 1 to 5. Final scores of each category (primary caregiver, best friends, and media) were calculated. The final scores ranged from 9-45 for the primary caregiver and best friends, and 10-50 for media. Higher scores indicated higher perceived pressure from those factors. Table 1 presents the list of variables used in this analysis.
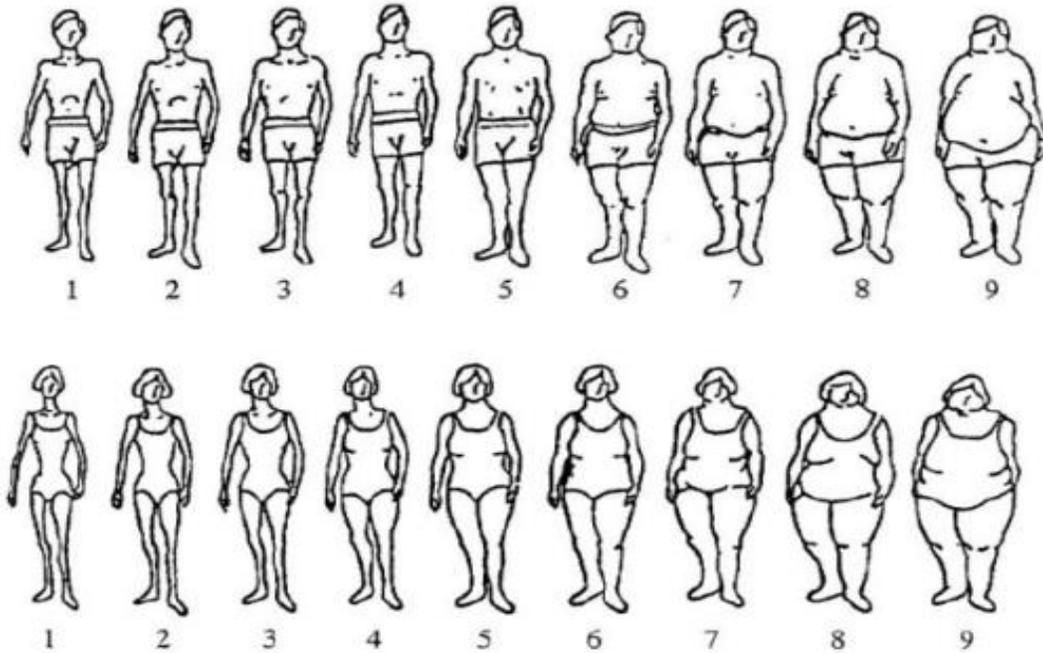
Figure 1: Figure Rating Scale (FRS)

Table 1: The Description of Variables Included in the Study

	Variables	Type	Measurement level	Variable descriptions
Y	Dissatisfaction_Body	Target	Interval	Degree of body dissatisfaction (negative value: wanted to a have bigger body size, positive value: wanted to have a smaller body size)
X_1	Body perception	Input	Nominal	Compare the perception of their body with their BMI categories: corrected, underestimated, or overestimated.
X_2	Age	Input	Nominal	15, 16, 17, 18 years
X_3	Gender	Input	Nominal	Male or female
X_4	School Program	Input	Nominal	Math-science, Arts-math, Arts, others
X_5	Father's Education	Input	Nominal	Grade 6th or lower, Grade 12th, College/diploma, Bachelor, Master and higher
X_6	School types	Input	Nominal	Single or mixed gender school
X_7	Mother's Education	Input	Nominal	Grade 6th or lower, Grade 12th, College/diploma, Bachelor, Master and higher
X_8	Household income	Input	Nominal	more than 10,000 baht, 10,001-30,000 baht, 30,001-50,000 baht, > 50,001 baht
X_9	Actual_BMI	Input	Interval	Participants' BMI calculated from self-reported height and weight
X_{10}	BMI_Zscore	Input	Nominal	Participants' BMI were categorized into underweight, health weight, overweight, or obese.

X_{11}	PC Influence	Input	Interval	Calculated scores from X_{12}-X_{23}. Higher scores indicate higher influence from their primary caregivers on their body
X_{12}	PC FB on Size/Shape	Input	Nominal	Type of feedback participants got from their primary caregiver about the size or shape of your body. (Responses: Extremely negative, Negative, In between, Positive, Extremely positive)
X_{13}	PC FB on Eating Pattern	Input	Nominal	Type of feedback participants got from their primary caregiver about their eating pattern to change their body size or shape. (Responses: Extremely negative, Negative, In between, Positive, Extremely positive)
X_{14}	PC FB on Exercise	Input	Nominal	Type of feedback participants got from their primary caregiver about their level of exercise to change their body size or shape. (Responses: Extremely negative, Negative, In between, Positive, Extremely positive)
X_{15}	PC Encourage_Lose Weight	Input	Nominal	Primary caregiver encouraged them to lose weight. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{16}	PC Encourage_Gain Weight	Input	Nominal	Primary caregiver encouraged them to gain weight. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{17}	PC Encourage_Muscular	Input	Nominal	Primary caregiver encouraged them to become more muscular. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{18}	PC Lose Weight	Input	Nominal	Their primary caregiver diet to lose weight. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{19}	PC Gain Weight	Input	Nominal	Their primary caregiver tried to put on weight. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{20}	PC More Muscular	Input	Nominal	Their primary caregiver tried to become more muscular. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{21}	PC Teasing_Too Thin	Input	Nominal	Their primary caregiver teased them because they are too thin. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{22}	PC Teasing_Eat Less	Input	Nominal	Their primary caregiver teased them because they should eat less. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{23}	PC Teasing_Not Muscular	Input	Nominal	Their primary caregiver teased them because they are not muscular enough. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{24}	Important of PC FB	Input	Nominal	Important of their primary caregivers' thoughts about the shape of their body. (Responses: Extremely unimportant, Fairy unimportant, In between, Fairly important, and Extremely important)
X_{25}	BF Influence	Input	Interval	Calculated scores from X_{26}-X_{37}. Higher scores indicate higher influence from their best friends on their body
X_{26}	BF FB on Size/Shape	Input	Nominal	Type of feedback participants got from their best friends about the size or shape of your body.

				(Responses: Extremely negative, Negative, In between, Positive, Extremely positive)
X_{27}	BF FB on Eating Pattern	Input	Nominal	Type of feedback participants got from their best friends about their eating pattern to change their body size or shape. (Responses: Extremely negative, Negative, In between, Positive, Extremely positive)
X_{28}	BF FB on Exercise	Input	Nominal	Type of feedback participants got from their best friends about their level of exercise to change their body size or shape. (Responses: Extremely negative, Negative, In between, Positive, Extremely positive)
X_{29}	BF Encourage_Lose Weight	Input	Nominal	Best friends encouraged them to lose weight. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{30}	BF Encourage_Gain Weight	Input	Nominal	Best friends encouraged them to gain weight. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{31}	BF Encourage_Muscular	Input	Nominal	Best friends encouraged them to become more muscular. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{32}	BF Lose Weight	Input	Nominal	Their best friends diet to lose weight. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{33}	BF Gain Weight	Input	Nominal	Their best friends tried to put on weight. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{34}	BF More Muscular	Input	Nominal	Their best friends tried to become more muscular. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{35}	BF Teasing_Too Thin	Input	Nominal	Their best friends teased them because they are too thin. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{36}	BF Teasing_Eat Less	Input	Nominal	Their best friends teased them because they should eat less. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{37}	BF Teasing_Muscular	Input	Nominal	Their best friends teased them because they are not muscular enough. (Responses: Never, Sometimes, Frequently, Almost always, Always)
X_{38}	Important of BF FB	Input	Nominal	Important of their best friends' thoughts about the shape of their body. (Responses: Extremely unimportant, Fairy unimportant, In between, Fairly important, and Extremely important)
X_{39}	Media Influence	Input	Interval	Calculated scores from X_{40}-X_{49}. Higher scores indicate higher influence from media on their body
X_{40}	Media_LW	Input	Nominal	Media gave the idea that they should be slimmer. (Responses: Strongly disagree, Disagree, Unsure, Agree, Strongly agree)
X_{41}	Media Eat Less_LW	Input	Nominal	Media gave the idea that they should eat less to lose weight. (Responses: Strongly disagree, Disagree, Unsure, Agree, Strongly agree)

X_{42}	Media Exercise_LW	Input	Nominal	Media gave the idea that they should exercise more to lose weight. (Responses: Strongly disagree, Disagree, Unsure, Agree, Strongly agree)
X_{43}	Media_GW	Input	Nominal	Media gave the idea that they should gain weight. (Responses: Strongly disagree, Disagree, Unsure, Agree, Strongly agree)
X_{44}	Media Exercise_GW	Input	Nominal	Media gave the idea that they should exercise more to gain weight. (Responses: Strongly disagree, Disagree, Unsure, Agree, Strongly agree)
X_{45}	Media Eat More_GW	Input	Nominal	Media gave the idea that they should eat more to gain weight. (Responses: Strongly disagree, Disagree, Unsure, Agree, Strongly agree)
X_{46}	Media_MM	Input	Nominal	Media gave the idea that they should be more muscular. (Responses: Strongly disagree, Disagree, Unsure, Agree, Strongly agree)
X_{47}	Media Exercise_MM	Input	Nominal	Media gave the idea that they should exercise more to be more muscular. (Responses: Strongly disagree, Disagree, Unsure, Agree, Strongly agree)
X_{48}	Media Eat Less_MM	Input	Nominal	Media gave the idea that they should eat less to be more muscular. (Responses: Strongly disagree, Disagree, Unsure, Agree, Strongly agree)
X_{49}	Media Eat More_MM	Input	Nominal	Media gave the idea that they should eat more to be more muscular. (Responses: Strongly disagree, Disagree, Unsure, Agree, Strongly agree)
X_{50}	Fruit Juices	Input	Nominal	Fruit juice consumption in the past 7 days (Responses: Did not consume, 1-3 times, 4-6 times, 1 time/day, 2 times/day, 3 times/day, 4 times/day)
X_{51}	Fruits	Input	Nominal	Fruit consumption in the past 7 days (Responses: Did not consume, 1-3 times, 4-6 times, 1 time/day, 2 times/day, 3 times/day, 4 times/day)
X_{52}	Vegetables	Input	Nominal	Vegetable consumption in the past 7 days (Responses: Did not consume, 1-3 times, 4-6 times, 1 time/day, 2 times/day, 3 times/day, 4 times/day)
X_{53}	Soda/pop	Input	Nominal	Soda/pop consumption in the past 7 days (Responses: Did not consume, 1-3 times, 4-6 times, 1 time/day, 2 times/day, 3 times/day, 4 times/day)
X_{54}	Sweet Drinks	Input	Nominal	Sweet drink consumption in the past 7 days (Responses: Did not consume, 1-3 times, 4-6 times, 1 time/day, 2 times/day, 3 times/day, 4 times/day)
X_{55}	Milk	Input	Nominal	Milk consumption in the past 7 days (Responses: Did not drink milk, 1-3 glasses, 4-6 glasses, 1 glass/day, 2 glasses /day, 3 glasses /day, 4 glasses /day)
X_{56}	Breakfast (day)	Input	Interval	Number of days they ate breakfast in the past 7 days.
X_{57}	Meal (times/day)	Input	Nominal	Average number of main meals they ate in one day (recall from the past 7 days) (Responses: 1 time, 2 times, 3 times, 4 times or more)
X_{58}	Snacks	Input	Nominal	How often they take snacks apart from regular meal in the past 7 days. (Responses: Rarely, 1-2 times/week, 3-4 times/week, 4 times or more/week)

X_{59}	PE Class (active)	Input	Nominal	During your physical education (PE) classes, how often they were very active. (Responses: Don't do PE, Hardly ever, Sometimes, Quite often, Always)
X_{60}	Activities at Lunch	Input	Nominal	What did they normally do at lunch. (Responses: Sat down, Stood/walked around, Ran or played a bit, Ran around and play quite a bit, Ran and played hard most of the time)
X_{61}	After School Activity	Input	Nominal	On how many days right after school they were very active. (Responses: None, 1 time, 2-3 times, 4 times, 5 times)
X_{62}	Evening Activity	Input	Nominal	On how many evenings they were very active. (Responses: None, 1 time, 2-3 times, 4-5 times, 6-7 times)
X_{63}	Weekend Activity	Input	Nominal	On the last weekend, how many times they were very active. (Responses: None, 1 time, 2-3 times, 4-5 times, 6 or more times)
X_{64}	7-day Activity	Input	Nominal	Which one of the following describes they best for the last 7 days. (Responses: All or most of my free time was spent doing things that involve little physical effort; I sometimes (1 — 2 times last week) did physical things in my free time; I often (3 — 4 times last week) did physical things in my free time; I quite often (5 — 6 times last week) did physical things in my free time; I very often (7 or more times last week) did physical things in my free time)

After getting a sense of the dataset for any errors, inconsistencies, or outliers (extreme values) in the data. Frequency distribution, descriptive statistics, and cross-tab analysis are used in this section. The data exploration and model development are performed using SAS® Enterprise Miner™. Figure 2 presents the histogram of media influence score across the different groups of participants who dissatisfy with their body. Figure 3 presents how body perception is varied by genders. A closer look on the 3D scatter plot in Figure 4 indicates that BMI, food choices, and influences from their best friends may have a great impact on the degree of body dissatisfaction.

RESULTS

Stepwise regression analysis shows a significant effect of the combined predictor variables on body dissatisfaction (BD), $F_{(41, 1778)} = 96.97$, $p < 0.001$, $R^2 = 0.691$. the final model contained the following 15 variables, which are significant contributors to BD: 1) X_{10}: BMI_Zscore, 2) X_{29}: BF_Encourage_Lose_Weight, 3) X_{31}: BF_Encourage_Muscular, 4) X_{28}: BF_FB_on_Exercise, 5) X_{35}: BF_Teasing_Too_Thin, 6) X_1: Body_Perception, 6) X_3: Gender, 7) X_{38}: Important_of_BF_FB, 8) X_{16}: PC_Encourage_Gain_Weight, 9) X_{41}: Media_Eat_Less_LW, 10) X_{49}: Media_Eat_More_MM, 11) X_{43}: Media_GW, and 12) X_6: School_Types.

From the stepwise regression analysis, body mass index (BMI) has been shown to be a strongest contributor for BD. The use of BMI is to capture participants' nutritional status from their height and weight according to their age. Then, in the decision tree, the participants were categorized as underweight, healthy weight, or overweight and obese according to WHO growth reference for school-aged children and adolescents. Figure 5 presents an example of the 2-way decision model form SAS® Enterprise Miner™ 14.2.

Obese participants

The degree of BD was highest among male adolescents who were obese and receive extremely positive feedback from their best friends about their eating pattern to change their body size or shape (BD = 3.7143). On the other hand, among female adolescents who were obese, participants who underestimated their body size have smaller degree of body dissatisfaction (BD = 1.333) compare to the participants with corrected perception of their body size (BD = 2.3143) (Figure 6).
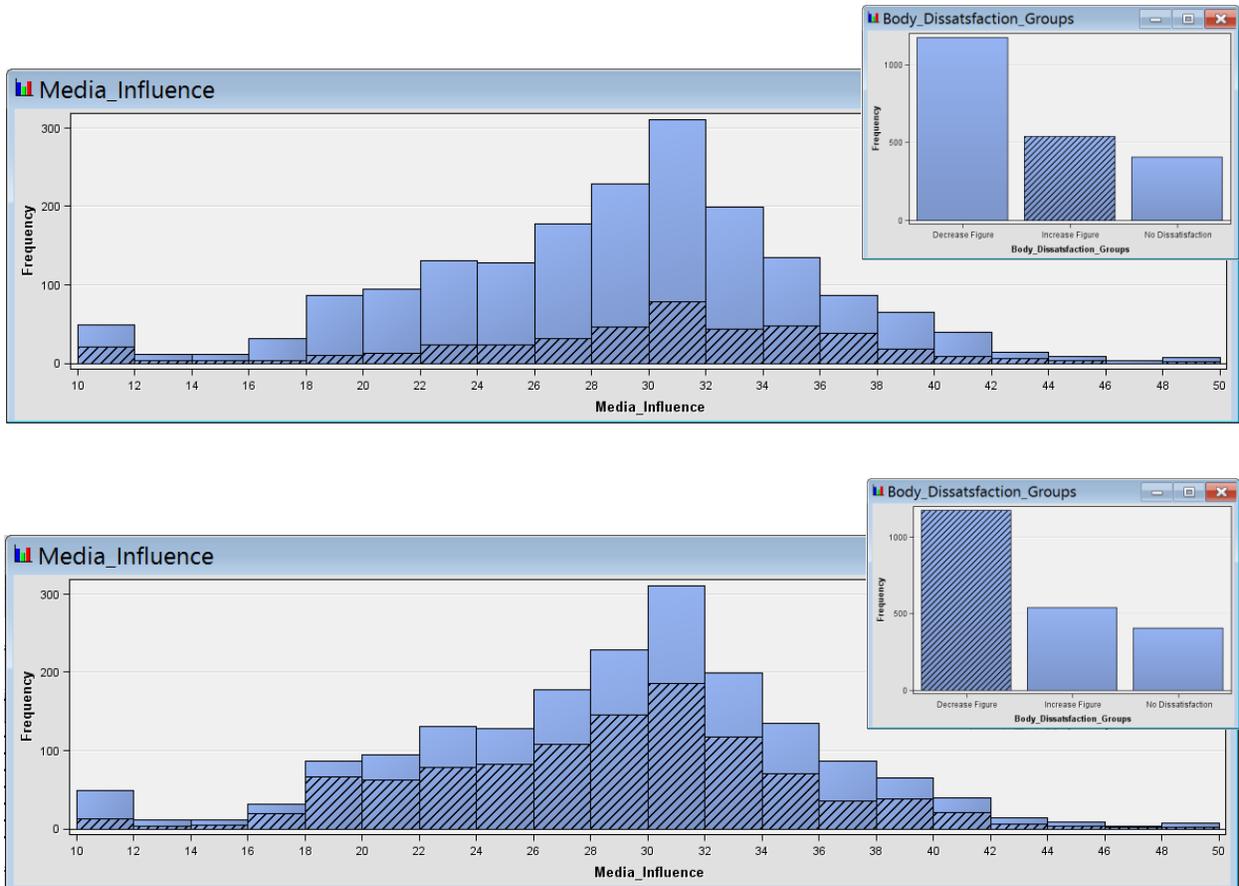
Figure 2: The Histogram of Media Influence Score

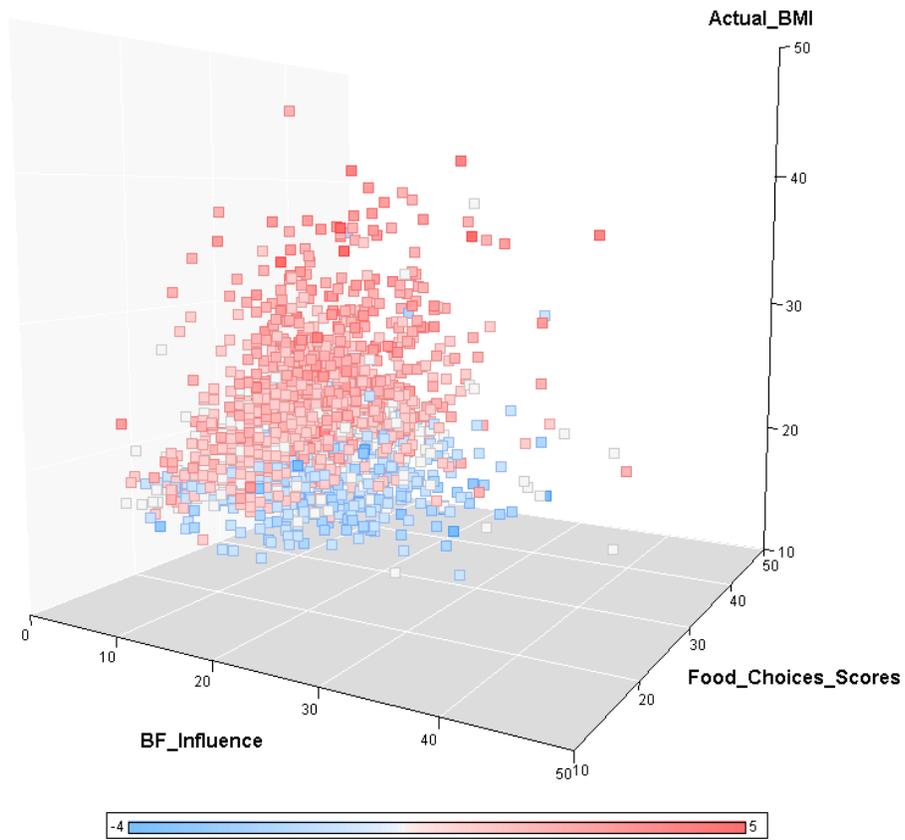
Figure 3: Body Perception by Gender

Figure 4: The 3D Scatter Plots on BF_Influence, Food_Choices_Score, and BMI
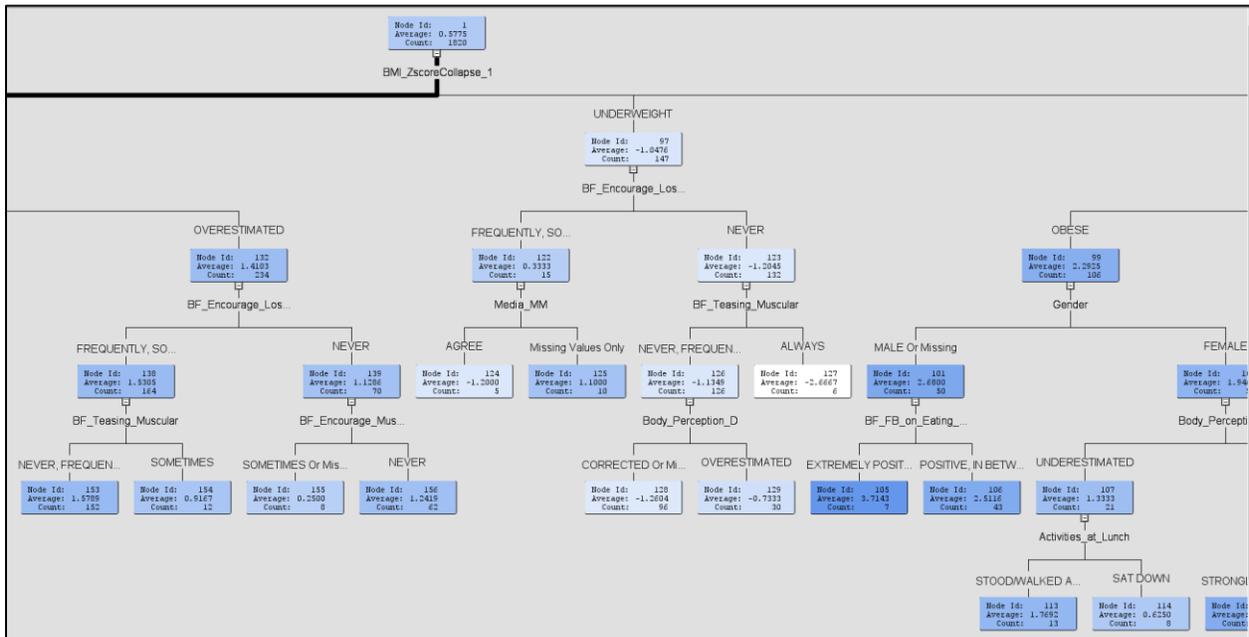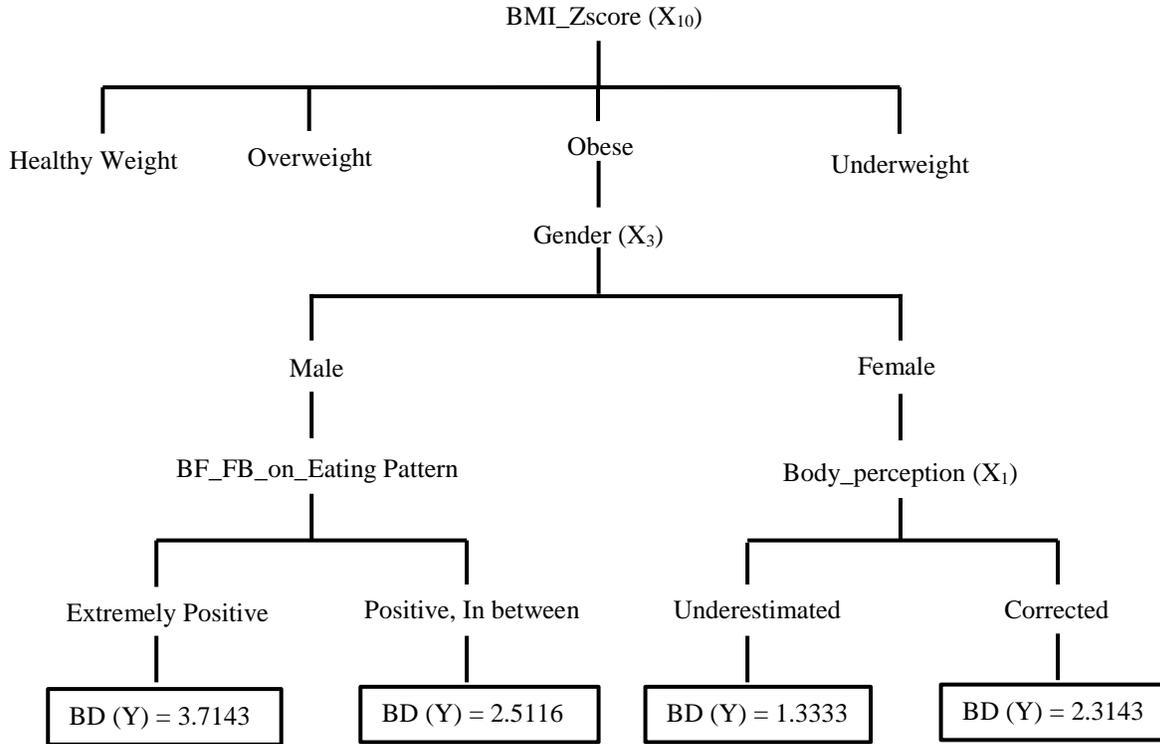

Figure 5: Decision Tree Model

Figure 6: Decision Tree for Obese Participants

Overweight participants

Participants who were overweight, overestimated their body size, frequently or almost always got teased by their primary caregivers that they should eat less, but have positive feedback from their primary caregivers about their body size reported the highest BD among overweight adolescents (BD = 2.7692). Surprisingly, participants with similar characteristics but received in between feedback from their primary caregivers about their body size have less BD (BD = 2.0) (Figure 2).

Overweight participants who underestimated their body size reported smaller degree of BD (BD = 1.5685) compared to obese participants who overestimated their body size (BD = 2.0577). Overweight male participants who underestimated their body size and consumed fruits 1-3 times/week or 1 time/day were more dissatisfied with their body (BD = 1.6216) than female participants with similar characteristics (BD = 1.1463) (Figure 7).
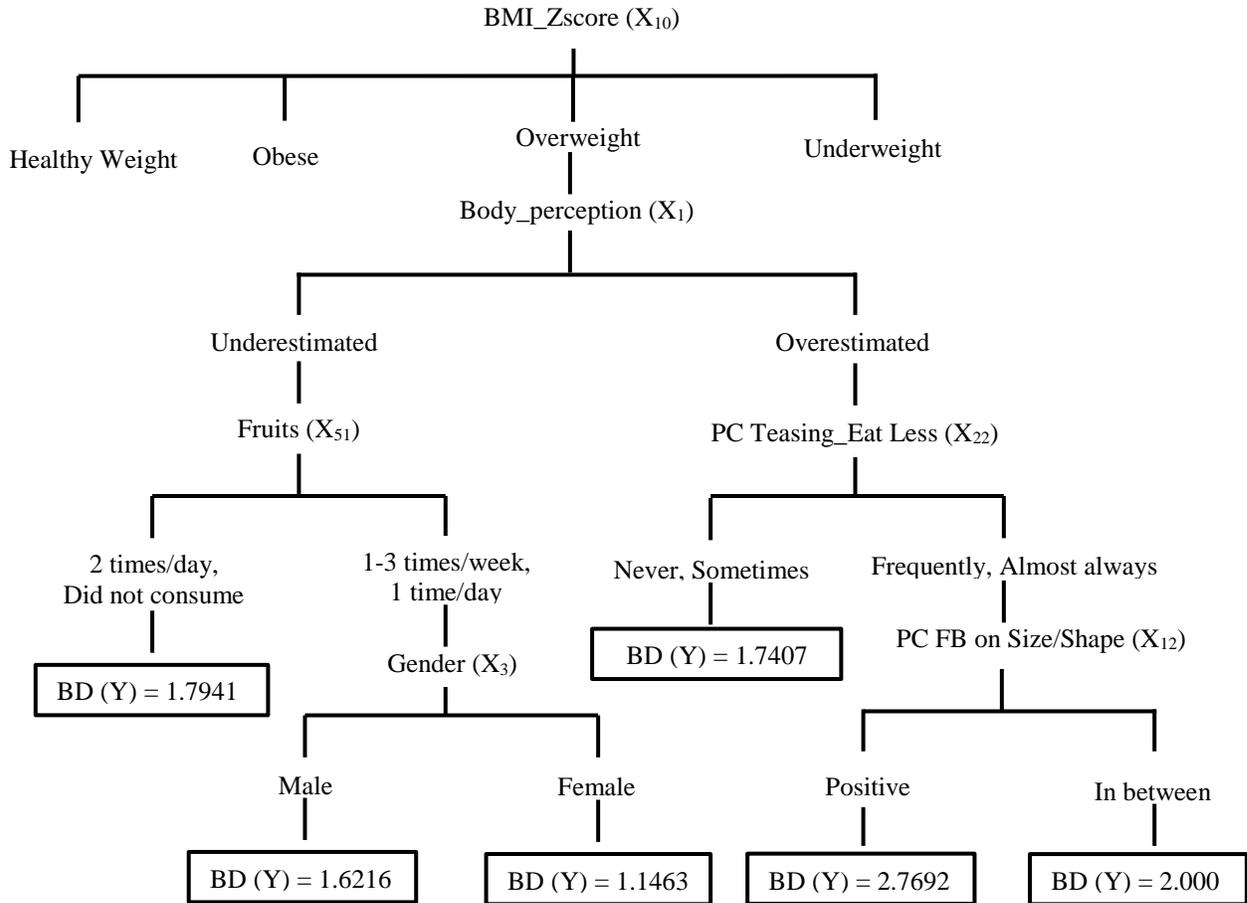
Figure 7: Decision Tree for Overweight Participants

Underweight Participants

An average of underweight participants reported wanted to have a bigger figure (BD = -1.0476); however, if their best friends encouraged them to lose weight, their desire changed to wanted to have a smaller figure (BD = 0.3333). On the other hand, underweight participants who never been encouraged by their best friends to lose weight still showed a desire of having a bigger body size (BD = -1.2045). But the desire to have a bigger figure increased if their best friends always teased them because they were not muscular enough (BD = -2.6667). In contrast, the desire to have a bigger figure is smaller when their best friends never or frequently teased them because they were not muscular enough (BD = -1.1349) and the desire is even getting smaller if the participants overestimated their body size (BD = -0.7333) (Figure 8).
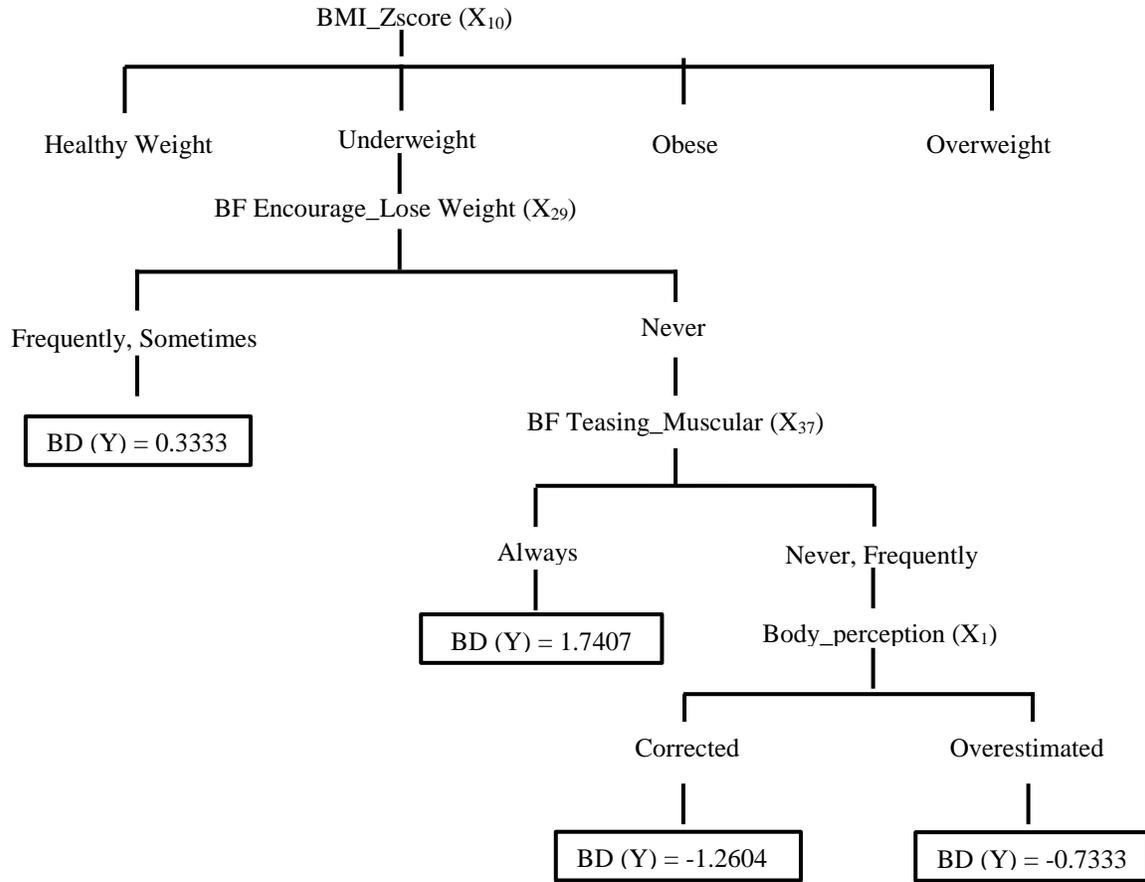
Figure 8: Decision Tree for Underweight Participants

Healthy weight participants

Healthy weight participants who overestimated their body size showed a desire to have a smaller figure (BD = 1.4103). However, if their best friends frequently or sometimes encouraged them to lose weight, the degree of BD is higher (BD = 1.5305) than the participants whose friend never encouraged them to lose weight (BD = 1.1286).

Among healthy weight participants who underestimated their body size intended to increase their figure (BD = -0.8659). But if their best friends encouraged them to lose weight, their intentions changed to a desire for a smaller figure (BD = 0.2). On the other hand, the intention can be reversed to a desire of wanted a bigger figure if their best friends frequently encourage them to gain weight (BD = -0.5833), but if their best friends never encouraged them to gain weight, the degree of wanted a smaller figure increase (BD = 0.9231). In contrast, the healthy participants who underestimated their body and never received encouragement from best friends to lose weight remained a desire of having a bigger figure (BD = -1.0390), and the primary caregiver encouragement to become more muscular effects the degree of wanted a bigger figure. The more frequent encouragement they got from their primary caregiver, the higher degree of body dissatisfaction (Figure 9).
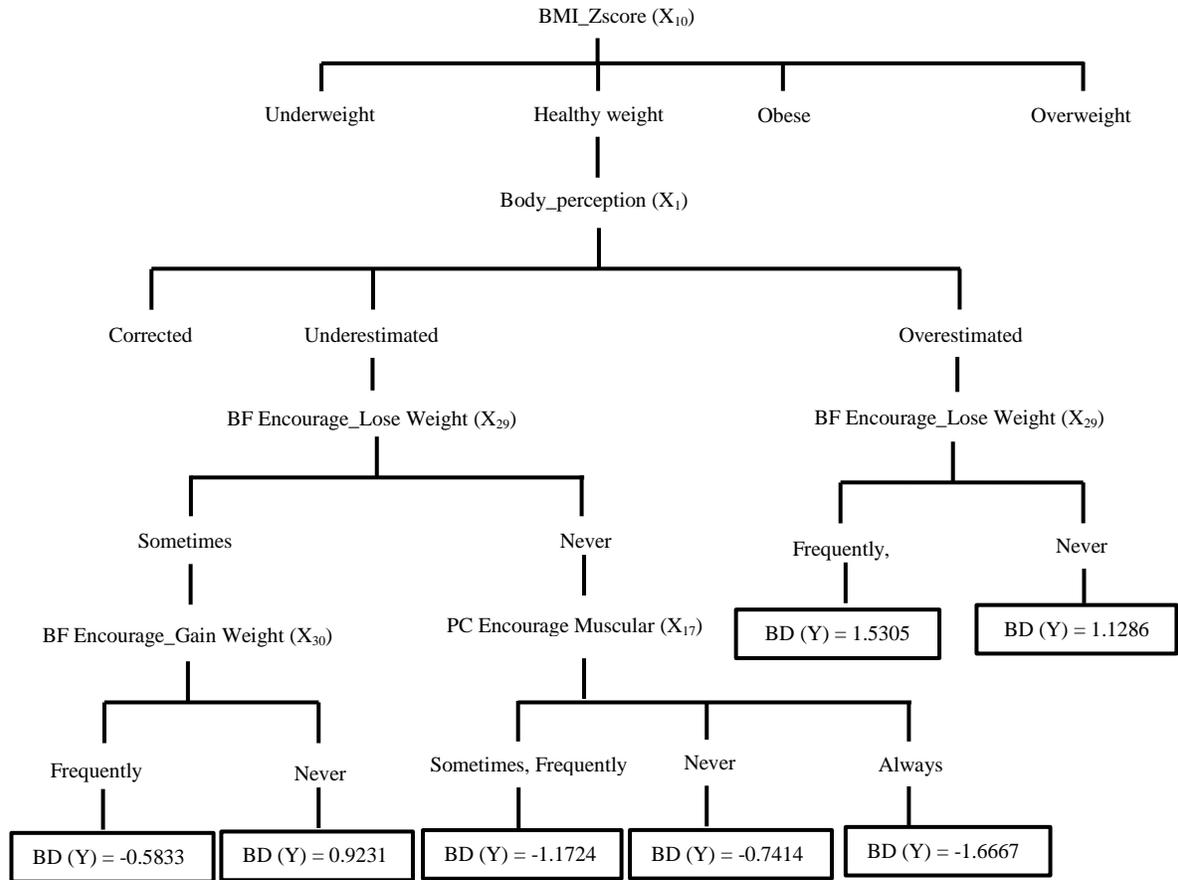
Figure 9: Decision Tree for Healthy Weight Participants Who Either Underestimated or Overestimated their Body Size

Healthy weight participants who had corrected body perception were least dissatisfied with their body (BD = 0.4718) compared to participants who were over- or underestimated their body size. Among this group, if they disagreed that media give an idea to eat less in order to lose weight, they tended to desire for a bigger figure (BD = -0.1708). Moreover, if they strongly agreed that they should gain weight because of the media, the degree of a desire for bigger figure is even higher (BD = -0.7143). In contrast, if they disagreed or strongly disagreed with the media that they should gain weight, they showed a sign of wanted a smaller figure (BD = 0.1544), and the degree of dissatisfaction increase if sometimes their best friends encouraged them to lose weight (BD = 0.8). Interestingly, if the healthy weight participants had corrected body perception, strongly disagreed with the media that they should eat less to lose weight, disagreed or strongly disagreed with the media that they should gain weight, and never got encouraged by their best friends to lose weight; the participants with these characteristics showed almost no dissatisfaction with their body (BD = 0.0242).

Healthy weight participant who correctly identified their body size, if they agreed or strongly agreed with the media that they should eat less, the degree of wanted to have a smaller figure was higher (BD = 0.9181) than other groups. Moreover, the degree of wanted to have a smaller figure increased (BD = 1.2872) if their friends frequently or almost always encouraged them to lose weight. And this is even higher, if their friend sometimes or frequently teased them because they should eat less (BD = 1.4769) (Figure 10).
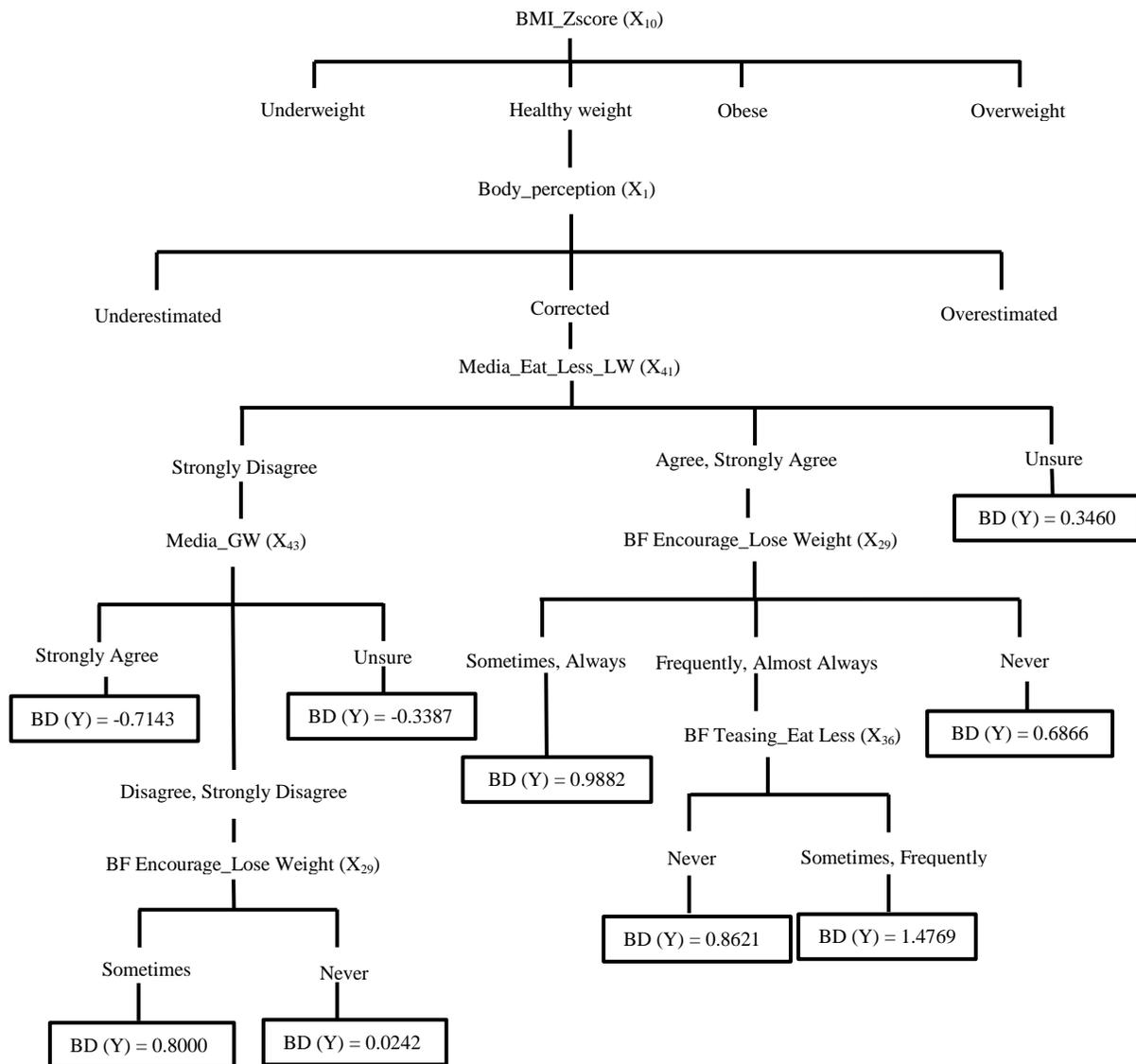
Figure 10: Decision Tree for Healthy Weight Participants Who Correctly Perceived Their Body Size

DISCUSSION AND CONCLUSION

The decision tree provides the participants' characteristic with different aspects of body dissatisfaction. In sum, the degree of wanted to have a smaller figure was highest if the participants were obese, being male, and have extremely positive feedback from the best friends on their eating patter. The participants who have healthy weight but underestimated their body size, their best friends never encouraged them to lose weight, and always got encouragement from primary caregiver to become more muscular, tended to have highest degree of a desire to have a bigger figure. The characteristics of participants who almost has no body dissatisfaction are the participants who had corrected body perception, strongly disagreed with the media that they should eat less to lose weight, disagreed or strongly disagreed with the media that they should gain weight, and never got encouraged by their best friends to lose weight.

Available literature that mentioned the relationship between body misperception (individual perceives their body to be larger or smaller that it is) and BD, mostly simply stated that body misperception was associated with an increase of body dissatisfaction. The findings from the current study agreed with the available literature but found additional information about impacts of body misperception on the specific groups of participants especially participants who were malnutrition. The information from the decision tree suggests that not all aspects of body misconception lead to an increase of body dissatisfaction. Body size overestimation might be a problem among healthy weight and overweight participants, because it led to a higher degree of BD. However, among obese and underweight participants who were underestimated their body size actually have less BD than the participants who correctly identified their body size. If we were to focus only on the degree of BD, which a large body of literature found an association with many consequences, body size underestimation might be beneficial in reducing a degree of body dissatisfaction. However, this does not imply that body misconception is a good thing, having a correct body perception is still an ideal. Future research might explore what factors contribute to under- or overestimation of body size. One of the possible factors might be self-esteem, in which participants with higher self-esteem may be more likely to underestimate their body size rather than overestimated because higher self-esteem has been shown to associate with lower BD (Patricia A van den Berg, Jonathan Mond, Marla Eisenberg, Diann Ackard, & Dianne Neumark-Sztainer, 2010).

Many available literature conclude that females were more dissatisfied with their body than males, and some found that there was no difference in body dissatisfaction between male and female (Patricia A van den Berg et al., 2010). However, in the present study, gender was shown to be an important characteristic among obese participants (Figure 1), and overweight participants who underestimated their body size, which male had higher degree of BD than female with similar characteristics. One explanation might be because male participants might have higher BMI than female participants, but they fell in the same BMI categories, which higher BMI has been shown to associate with higher BD (Chongwatpol & Gates, 2016).

In terms of the influence of sociocultural factors on BD, overall, participants who reported higher perceived pressure from best friends, parents, or media showed a higher degree of BD in this current study. However, types of comments also impact participant differently. Important examples arise on the decision tree are the followings. Healthy weight participants who underestimated their body size showed a desire of wanting a bigger figure (BD = -0.8659). Interestingly, the direction changed when their best friends encouraged them to lose weight. They changed to wanting a smaller figure, even though the degree is decrease (BD = 0.2000). Their desire also changed back to a bigger figure when their best friends encouraged them to gain weight (BD = -0.5833). Similar observation was found on underweight participants, in which the desire of wanting a bigger figure changed to a desire for a smaller figure when their friend encouraged them to lose weight, although the degree of BD decreased. Other surprising findings are that we believe that the negative comments of feedback about size and shape have a negative impact on BD, which is true but might not be applicable in all circumstances. Here in the decision tree, positive feedback on size and shape from primary caregivers and on eating pattern from best friends actually increase the degree of body dissatisfaction among overweight and obese participants. These might be because among participants who were overweight and obese, the positive comments might make them feel that their unhealthy behaviors and the current unhealthy weight status are still fine, which foster the ongoing of unhealthy behaviors and weight status, then results in a more dissatisfied with their body.

The findings from this analytical tool can be utilized as components that should be included in the healthy weight management intervention. Since participants with BD will try to do something with their body and/or weight, it is important that they engage healthy practices to reach their ideal body and/or weight. Apart from the fundamental components include in almost every nutrition intervention, which are healthy eating and physical activity, the findings from this study observed importance of body perception and sociocultural factors among Thai adolescents. It is important to make participants know what is healthy weight and body, and they should correctly identify their own body, which they will know when they need to change and when they are fine. In terms of sociocultural factors, parents and friends need to be educated about healthy weight and body and also the influence of their comments on ones' thoughts about their body. For example, they should not encourage underweight participants to lose weight. More importantly, parents and friends should be careful about their comments give to obese and overweight participants. Using harsh comments about their body size or eating pattern should be forbid, but positive comments should be avoided as well. Because they have unhealthy weight status, then it would be assumed that their eating pattern and/or physical activity are not healthy either. By giving positive comments, they will think that what they have been done is still okay, and will continue to do so without motivation to change. Parents and friends should alarm them in a lenient way that they need to change. Since we cannot control what the media will deliver to us, health knowledge and correct body perception should help to reduce the negative influence that individuals perceived from the media about their body. In sum, healthy weight management for Thai adolescents should include not only the individuals themselves, but should include their friends and families as well. The program should incorporated education about healthy weight management (healthy eating and physical activity); makes them know about their body; what weight/body is healthy; when they need to change/improve; the influence of comments about ones' feeling on their body; and also when they should make a comment and what types of comments they should use.

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