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Comparing BMI Perceptions of Self- and Others Between Kinesiology and non-Kinesiology University Students

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COMPARING BMI PERCEPTIONS OF SELF- AND OTHERS BETWEEN KINESIOLOGY AND NON-KINESIOLOGY UNIVERSITY STUDENTS

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34 Pages

Misperception of own BMI has been postulated as a factor contributing to the increasing prevalence rates of overweight and obesity. **Objectives**: To examine 1) perceptions university students had toward their own and others' BMI, and 2) if Kinesiology majors could better assess others' BMI classifications than non-Kinesiology majors. **Methods**: Data were collected from 567 (male, n = 144; female, n = 423) university students using a structured questionnaire. Measures consisted of height, weight, perception of own BMI, and visual perception of own and others' BMI. Self-reported BMI was calculated from height and mass then classified per World Health Organization classifications. Percent agreement between self-reported BMI and perceived own BMI, and self-reported BMI and visually perceived own BMI were assessed using cross-tabulations. The difference in average of the total correct BMI classifications assigned to others' BMI between Kinesiology and non-Kinesiology majors was assessed using an independent t-test. **Results**: In general, males were significantly heavier and taller than females ($p < 0.001$). Percent agreement between self-reported BMI and perceived own BMI was 71.5% for males and 74.2% for females. Percent agreement between self-reported BMI and visually perceived BMI was 60.4% and 55.8% for males and females, respectively. The Kinesiology average of 9.89 $\pm$ 2.88 SD was not statistically different from the non-Kinesiology average of 9.21 $\pm$ 3.09 SD ($p = 0.618$). **Conclusions**: Male and female university students were able to perceive their self-reported BMI with a reasonable degree of accuracy. University students accurately visually

perceived lower (underweight, normal weight) and higher BMI classified (obese class I, obese class II, obese class III) pictorial images for both males and females but were less accurate with normal and overweight BMI classifications for both males and females.

KEYWORDS: Body Composition, Pictorial Images, Weight

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D.B.

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CHAPTER I

COMPARING BMI PERCEPTIONS OF SELF- AND OTHERS BETWEEN KINESIOLOGY AND NON-KINESIOLOGY UNIVERSITY STUDENTS

Introduction

Nations around the world are experiencing increases in the prevalence of overweight and obesity.[1,2] This is concerning since increased body mass, and particularly increased adiposity, are associated with negative health consequences. The World Health Organization (WHO) reports a higher body mass index, BMI, increases co-morbidity risks and risks for non-communicable diseases such as: cardiovascular diseases (coronary heart disease, stroke), diabetes, osteoarthritis, and some cancers (breast, ovarian, and prostate) in adults.[3] Furthermore, research studies conducted on the prevention and treatment of overweight and obesity have suggested that misperception of one's BMI is a factor influencing the increasing rates of prevalence of overweight and obesity.[4,5,6]

Misperception of BMI, defined as the discordance between an individual's actual BMI and perceived BMI[7], can be classified as either accurate, an underestimation or overestimation. Underestimation can result in a lack of recognition[8,9,10] and motivation of the need to decrease BMI[7,10] as well as the commencement or continuation of unhealthy lifestyle behaviors.[10,11,12] Overestimation can lead to decreased body satisfaction[7,l3,14] usage of unsafe weight loss techniques[7,14,15], and eating disorders.[7,14,16] Misperception of BMI has been found to occur in several populations including university-aged populations.[8,17-23]

Studies have shown BMI perception varies significantly between male and female university students.[12,21,23] Males underestimate their BMI across all BMI classifications and females of normal BMI overestimate, while those with higher BMI classifications underestimate

their BMI.[10,11,13,16,21,23] While studies have examined self-perception of BMI among university aged populations, there are currently no published research studies that have assessed the visual perception university aged populations have toward others' BMI.

The purpose of the study was to examine 1) how university students perceived their own BMI, 2) how university students perceived others' BMI and 3) if Kinesiology majors could better identify others' BMI classifications than non-Kinesiology majors.

Methods

Participants

A total of 567 university students (male, n = 144; female, n = 423), aged 18 – 25+ years old participated in the study. Of the 567 participants, 87 were Kinesiology majors and 480 were non-Kinesiology majors.

Questionnaire Development

A structured questionnaire was developed for the study. Section I gathered basic, descriptive demographic details (gender, sex, height, weight, education, etc.) about the participants. Section II assessed participants' conceptual and visual self-perception of BMI. Conceptual self-perception evaluated how participants consciously perceived their BMI without any prompts or visual aids. The conceptual self-perception item instructed participants to simply identify what they believed to be their BMI classification from a list of the five WHO BMI classifications (i.e. underweight, normal, overweight, obese class I, obese class II, or obese class III). Meanwhile, visual self-perception evaluated how participants perceived their BMI with the use of pictorial images. The visual self-perception item displayed 10 sex-specific BMI-based body size guides (BSGs) and prompted the participants to choose the one they believed most closely resembled their BMI. BMI-based BSGs are composited, standardized, realistic images of

males and females of each WHO BMI classification that were developed by Harris, Bradlyn, Coffman, Gunel, and Cottrell in 2007[24] to be used when examining BMI perceptions. Lastly, section III examined the visual perception participants had regarding others' BMI classification. For visual perception of others' BMI, participants were shown all 20 (10 male, 10 female) BSGs in random order and asked to identify all the BSGs' BMI classifications. The questionnaire was distributed via e-mail to enrolled university students at a mid-sized university and small college in the Midwest.

Measures

Self-reported BMI. Height (inches) and weight (pounds) were self-reported in section I of the questionnaire. Height was converted to meters and weight was converted to mass in kilograms. BMI was calculated as mass (kg)/height $(m)^2$ and used to represent self-reported BMI. Participants were categorized by WHO classifications into underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), obese class I (30.0-34.9 kg/m^2), obese class II (35.0-39.9 kg/m^2), or obese class III (>40.0 kg/m^2).

Self-perceived BMI: conceptual. Participants reported conceptual perception of their BMI by answering "Which BMI classification do you believe represents your current body weight?". Answers were selected from the WHO BMI classifications: underweight, normal weight, overweight, obese class I, obese class II, or obese class III. After comparing their response to self-reported BMI, participants were categorized into three groups: accurate (self-reported BMI classification selected), underestimated (lower BMI classification was selected), or overestimated (higher BMI classification selected).

Self-perceived BMI: visual. Visual self-perception of participants' BMI was reported by answering "Choose one of the following images which you believe best represents your current body weight." Answers were selected from the 10 BSGs specific to the participant's gender. After comparing their selected pictorial image (BSG) to their self-reported BMI, participants were categorized into three groups: accurate (BSG of appropriate BMI was selected), underestimated (BSG of lower BMI was selected), or overestimated (BSG of higher BMI was selected).

Perceived BMI of others: visual. Visual perception of others' BMI was reported by answering "Please assign a BMI classification to the following image" for 10 female and 10 male BSGs. Responses were categorized into two groups: accurate (correct BMI classification for BSG was selected) or inaccurate (incorrect BMI classification for BSG was selected). Percent accurate was calculated per subject using the equation: (total of correct BMI classifications / total number of BSGs) x 100. The mean of percent accurate was then calculated for Kinesiology and non-Kinesiology majors.

Statistical Analysis

Descriptive statistics for race, age, weight, height, academic status, major and BMI classification were calculated for both males and females. To determine differences between males and females, an independent t-test was used for continuum scale items and a chi-square test was used for ordinal scale items. Agreement between self-reported and perceived BMI, for both conceptual and visual perceptions, was evaluated by creating a six-by-six cross-tabulation. Percent agreement was calculated using: total of accurate cells / total number of cases. Cohen's kappa (κ) represented the agreement/concordance of self-reported and perceived BMI. Kappa was interpreted using the scale proposed by Landis and Koch (1977).[25] Association between

major and accurate response was examined using a chi-square test. If a sample size fell below five responses, a Fisher's exact test was instead applicable. Lastly, an independent t-test assessed the difference between Kinesiology and non-Kinesiology majors' abilities to correctly assign BMI classifications. A p-value of ≤ 0.05 was considered significant. All statistical analyses were performed using the SPSS program (version 24.0, SPSS Inc., 2011, Chicago, IL, USA).

Results

Demographics

Descriptive statistics of participants can be found in Table 1. Age ($\chi^2(7) = 23.9$, $p < 0.001$) and academic status ($\chi^2(6) = 18.1$, $p < 0.001$) were found to be dependent on gender whereas race ($\chi^2(5) = 9.34$, $p = 0.096$), major ($\chi^2(1) = 0.605$, $p = 0.437$) and BMI classification ($\chi^2(5) = 10.8$, $p = 0.055$) were not. There were more females in the 18 - 21 age range and undergraduate academic status than there were males, and there were more males in the 22 – 25+ age range and graduate academic status than females. Additionally, males were significantly heavier ($M = 184.6$, $SD = 35.8$)($t(565) = 7.88$, $p < 0.001$) and taller ($M = 70.8$, $SD = 3.3$)($t(565) = 18.1$, $p < 0.001$) than females. Based on self-reported BMI, 45.1% of males and 57.0% of females were categorized as having normal self-reported BMI. Obesity prevalence (including overweight and obese class I, class II, and class III) was 50.7% and 39.2% for males and females, respectively.

Self-perceived BMI: conceptual

Results of the cross-tabulations for conceptual perception by males and females are presented in Table 2. Seventy-one and a half percent of males accurately self-perceived their BMI while 28.5% misperceived. Within the misperceived population, 85.4% underestimated and 14.6% overestimated their self-reported BMI. There was moderate agreement in accuracy

between the self-reported and perceived BMI for males, $\kappa = 0.569$, $p < 0.001$. As for females, 74.2% accurately self-perceived their BMI leaving 25.8% who misperceived. Of those who misperceived, 70.6% underestimated and 29.4% overestimated. Cohen's kappa indicated moderate agreement in accuracy between self-reported and perceived BMI for females, $\kappa = 0.565$, $p < 0.001$.

Self-perceived BMI: visual

Results of the cross-tabulations for visual self-perception by males and females are presented in Table 3. For males, 60.4% accurately self- perceived their BMI but 39.6% were inaccurate. Of the misperceived population, 66.7% underestimated their BMI with 33.3% overestimating. A moderate agreement of accuracy between self-reported and perceived BMI was determined by Cohen's kappa, $k = 0.403$, $p < 0.001$. On the other hand, only 55.8% of females accurately perceived their BMI. Of the 44.2% who misperceived, 74.9% underestimated and 25.1% overestimated. Fair agreement between self-reported and perceived BMI was found, $k = 0.312$, $p < 0.001$.

Perceived BMI of others: visual

Percentages of underestimation, accurate, and overestimation by Kinesiology and non-Kinesiology majors for male and female BSGs are presented in Figure 1 and Figure 2, respectively. For male BSGs, Kinesiology majors had the highest percentage of accuracy (95.4%) at the underweight BSG and the lowest percentage (27.0%) at the obese I BSGs. Non-Kinesiology majors also had their highest percentage of accuracy of 98.8% at the underweight BSG and the lowest percentage of 23.9% at obese I BSGs. A chi-square test indicated there was significant association between major and accuracy of BMI classification for the overweight BSG ($\chi^2(1) = 5.32$, $p = 0.021$), obese II BSGs ($\chi^2(1) = 6.96$, $p = 0.008$), and obese III BSGs ($\chi^2(1)$

= 9.09, p = 0.003). Kinesiology majors could more accurately assign BMI classifications than non-Kinesiology majors for the male overweight BSG, obese II BSGs, and obese III BSGs.

For female BSGs, 80.5% accuracy at the normal BSGs was the highest percentage whereas 32.0% accuracy at the obese I BSGs was the lowest percentage among Kinesiology majors. Non-Kinesiology majors had similar percentages with highest 83.1% accuracy at the normal BSGs and lowest 32.5% accuracy at the obese I BSGs. A chi-square test showed there was significant association between major and accuracy of BMI classification for only obese III BSGs ($\chi^2(1) = 6.63$, p = 0.010). Kinesiology majors could more accurately assign BMI classifications than non-Kinesiology majors for the female obese III BSGs.

An independent t-test was performed to determine if Kinesiology majors could more correctly assign BMI classifications to the 20 BSGs than non-Kinesiology majors. Results indicated Kinesiology majors (M = 9.89, SD = 2.88) had a higher accuracy percentage than the non-Kinesiology majors (M = 9.21, SD = 3.09) by 3.3%. However, the difference was not statically significant (t(565) = 1.89, p = 0.618) so Kinesiology majors could not assign BMI classifications more accurately than non-Kinesiology majors.

Discussion

This study examined the conceptual and visual perceptions university students had toward their and others' BMI. Based on previous research[24], it was anticipated prior to conducting the study that participants would be able to equally and accurately self-perceive their conceptual and visual BMI. However, the first main finding suggests males and females more accurately perceived their BMI conceptually than visually. The yielded conceptual accuracy percentages of 71.5% and 74.2% for males and females, respectively, were higher than the visual accuracy percentages of 60.4% and 55.8% for males and females, respectively. Conceptual

accuracy percentages found by this study agree with results reported by other studies examining self-perception of BMI among university students.[7,10,12]

The second main finding suggests underestimation and overestimation differs between conceptual and visual self-perception for males and females. The data suggest males conceptually underestimated their BMI across all BMI classifications. Underweight and normal BMI females conceptually overestimated, whereas females of overweight and obese (class I, class II, and class III) BMI classifications underestimated their BMI. Conceptual perception results from the present study provide further support to the universal claims that males, regardless of BMI classification, and females, of higher BMI classifications, conceptually underestimate their BMI, while females of normal BMI classification overestimate their BMI.[10,11,13,16,21,23]

Visual self-perception produced different results for both males and females when compared to conceptual perception. The data suggest underweight and normal BMI males visually overestimated their BMI with overweight and obese (class I, class II, and class III) males underestimating their BMI. Underweight females visually overestimated their BMI while all other females underestimated their BMI. Unlike the consistent trends of conceptual misperceptions of BMI that are recognized universally, trends of visual misperceptions of BMI tend to vary among countries due to different cultural influences on body image and shape. For example, a study conducted in Italy, where cultural views on body image and shape resemble the cultural views within the United States, reported visual misperception results in agreement with those of this present study.[14] However, a study conducted in Brazil, where culture promotes more curvy, robust body shapes more appealing for females, with university students found most

normal weight and overweight females visually overestimated their body size while obese females and all men underestimated their body size.[13]

The third main finding suggests the visual perceptions Kinesiology and non-Kinesiology majors have for others' BMI status more closely resemble the tendencies of conceptual self-perception through pictorial images than other visual perception studies. The data suggest Kinesiology and non-Kinesiology majors visually underestimated the BMI of males across all BMI classifications. However, Kinesiology and non-Kinesiology majors had difficulty with accuracy at the extremes; they visually overestimated the lower BMI BSGs for females (selected higher BMI classifications than actual BMI classification) but underestimated the higher BMI BSGs (selected lower BMI classification than actual BMI classification) for females. These misperception trends match those previously reported in this study for conceptual self-perception of BMI as well as other studies that examined self-perception of BMI.[10,11,13,16,21,23] Of the few other studies which have examined visual perception of others' BMI, different methodology was used, including absence of pictorial images. These studies had opposite results to the present study and it is unknown if this is a function of the methodology. Christensen[17] found that participants, when positioned in a face-to-face situation, reported males and females in higher BMI categories regardless of actual BMI; thus, indicating overestimation for both females and males. However, Cardinal, Kaciroti, and Lumeng[26] found high correlations between in-person ratings and accurate BMI classification being selected. An important distinction between the present study and the two visual perception studies is use of 2D pictorial images models versus the 3D models.

The fourth main finding suggests Kinesiology majors cannot better assign BMI classifications to the BSGs than non-Kinesiology majors. Although the Kinesiology majors'

average was 3.3% higher than the non-Kinesiology majors' average, it was not statistically significant. It was anticipated prior to conducting the study that Kinesiology majors would have a higher total accuracy average than non-Kinesiology majors due to their exposure to BMI education in Kinesiology courses. Nonetheless, when participants were asked to identify the amount of knowledge they had on BMI, a majority of Kinesiology and non-Kinesiology majors reported having 'average knowledge' or 'much knowledge' on BMI. This might indicate that the assumption of greater knowledge on the part of Kinesiology majors was unfounded because non-Kinesiology majors had a higher level of understanding about BMI than anticipated. Either way, the low accuracy percentages for visual perception of others' BMI by both Kinesiology and non-Kinesiology majors shows participants have knowledge about BMI but are unable to apply it in assessment situations. Therefore, it might be beneficial to include visual-perception of BMI through pictorial images in BMI education.

One strength of the present study is that visual self-perception was examined using the BSGs rather than the contour drawing scale or a silhouette drawing scale. Since the results of visual self-perception from this study were comparable and consistent to results from another study examining visual self-perception, it increases the validity of BSGs as adequate replacements for the older contour drawing scales or silhouette line drawings, and the reliability of this study's findings. Another strength is that this study was the first to directly examine perceptions university students had toward others' BMI using pictorial images. This study can be used as the base for result comparisons by future studies examining visual perception among university students using pictorial images.

Meanwhile, a limitation for this study was the large difference between the number of Kinesiology and non-Kinesiology students that partook in the study. The low sample size of 87

Kinesiology students lessens the ability to generalize the results to all Kinesiology students. Lastly, some participants conveyed their dissatisfaction with the BSGs lacking representation of muscular bodies corresponding with BMI classifications. Perhaps more fit participants could not identify, or relate to, any of the BSGs so their selected BSG may not be a true representation of their self-perception. Thus, future research should include developing BSGs of muscular body composition to supplement the current BSGs.

Conclusion

Male and female university students were able to conceptually perceive their self-reported BMI with a reasonable degree of accuracy. Furthermore, university students accurately visually perceived lower (underweight, normal weight) and higher BMI classifications (obese class I, obese class II, obese class III) pictorial images for both males and females but are less accurate with normal and overweight BMI classifications for both males and females. Finally, kinesiology majors cannot better visually perceive others' BMI classifications than non-Kinesiology majors.

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Table 1 Demographic, descriptive statistics by sex.

		Males		Females			
		N = 144		*N = 423*		*N = 567*	
		n	%	*n*	%	Total	P-Value
Race	White	121	84	368	87	489	0.096
	African American	6	4.2	18	4.3	24	
	American Indian	0	0	1	0.2	1	
	Asian	8	5.6	11	2.6	19	
	Pacific Islander	2	1.4	0	0	2	
	Other	7	4.9	25	5.9	32	
Age (years)	18 - 19	35	24.3	118	27.9	153	0.001**
	20 - 21	48	33.3	191	45.1	239	
	22 - 23	31	21.5	60	14.3	91	
	24 – 25+	30	20.8	54	12.8	84	
Body Weight	Kilograms (SD)	83.7 (16.2)		69.9 (18.7)			0.001**
Height	Meters (SD)	1.80 (0.08)		1.66 (0.08)			0.001**
Academic	Undergraduate	113		371		484	0.006**
Status	Graduate	31		52		83	
Major	Kinesiology	25	17.4	62	14.7		0.437
	Non-Kinesiology	119	82.6	361	85.3		
BMI	Underweight	6	4.2	16	3.8	22	0.055
Classification	Normal	65	45.1	241	57.0	306	
	Overweight	48	33.3	100	23.6	148	
	Obese I	16	11.1	29	6.9	45	
	Obese II	7	4.9	22	5.2	29	
	Obese III	2	1.4	15	3.5	17	

Notes: BMI = Body Mass Index

** = P-value significant at $p \leq 0.001$

Table 2 Cross-tabulation of self-reported BMI and conceptually perceived BMI by males and females.

Visually Perceived BMI by Males								
	BMI Classifications							Classification
Self-Reported BMI	Underweight	Normal	Overweight	Obese I	Obese II	Obese III	Total (%)	% Agreement
Underweight	6						6 (4.1)	
Normal	6	56	3				65 (45.1)	71.5#
Overweight		11	34	3			48 (33.3)	
Obese I		2	8	6			16 (11.1)	
Obese II			2	5			7 (4.9)	
Obese III					1	1	2 (1.4)	
Total	12	69	47	14	1	1	144 (100)	
(%)	(8.3)	(47.9)	(32.6)	(9.7)	(0.1)	(0.1)		

Visually Perceived BMI by Females								
	BMI Classifications							Classification
Self-Reported BMI	Underweight	Normal	Overweight	Obese I	Obese II	Obese III	Total (%)	% Agreement
Underweight	9	7					16 (3.8)	
Normal	6	216	19				241 (57.0)	
Overweight		25	73	2			100 (23.6)	74.2#
Obese I			15	10	4		29 (68.6)	
Obese II			11	7	4		22 (5.2)	
Obese III			1	6	6	2	15 (3.6)	
Total	15	248	119	25	14	2	423 (100)	
(%)	(3.6)	(58.6)	(28.1)	(59.1)	(3.31)	(0.5)		

Notes: BMI = Body Mass Index; # = Kappa ($\varkappa$) value of 0.57

Table 3 Cross-tabulation of self-reported BMI and visually perceived BMI by males and females.

Visually Perceived BMI by Males								
	BMI Classifications							Classification
Self-Reported BMI	Underweight	Normal	Overweight	Obese I	Obese II	Obese III	Total (%)	% Agreement
Underweight	5	1					6 (4.1)	
Normal	4	55	5	1			65 (45.1)	60.4*
Overweight		18	19	11			48 (33.3)	
Obese I		4	5	6	1		16 (11.1)	
Obese II			2	4	1		7 (4.9)	
Obese III				1		1	2 (1.4)	
Total	9	78	31	23	2	1	144 (100)	
(%)	(6.3)	(54.2)	(21.5)	(16.0)	(1.4)	(0.7)		

Visually Perceived BMI by Females								
	BMI Classifications							Classification
Self-Reported BMI	Underweight	Normal	Overweight	Obese I	Obese II	Obese III	Total (%)	% Agreement
Underweight	11	5					16 (3.8)	
Normal	56	178	2	4	1		241 (57.0)	
Overweight	1	55	14	28	2		100 (23.6)	55.8**
Obese I		4	5	17	3		29 (68.6)	
Obese II			2	12	7	1	22 (5.2)	
Obese III			1		5	9	15 (3.6)	
Total	68	242	24	61	18	10	423 (100)	
(%)	(16.1)	(57.2)	(5.7)	(14.4)	(4.26)	(2.4)		

Notes: BMI = Body Mass Index; * = Kappa ($\varkappa$) value of 0.40; ** = Kappa ($\varkappa$) value of 0.31

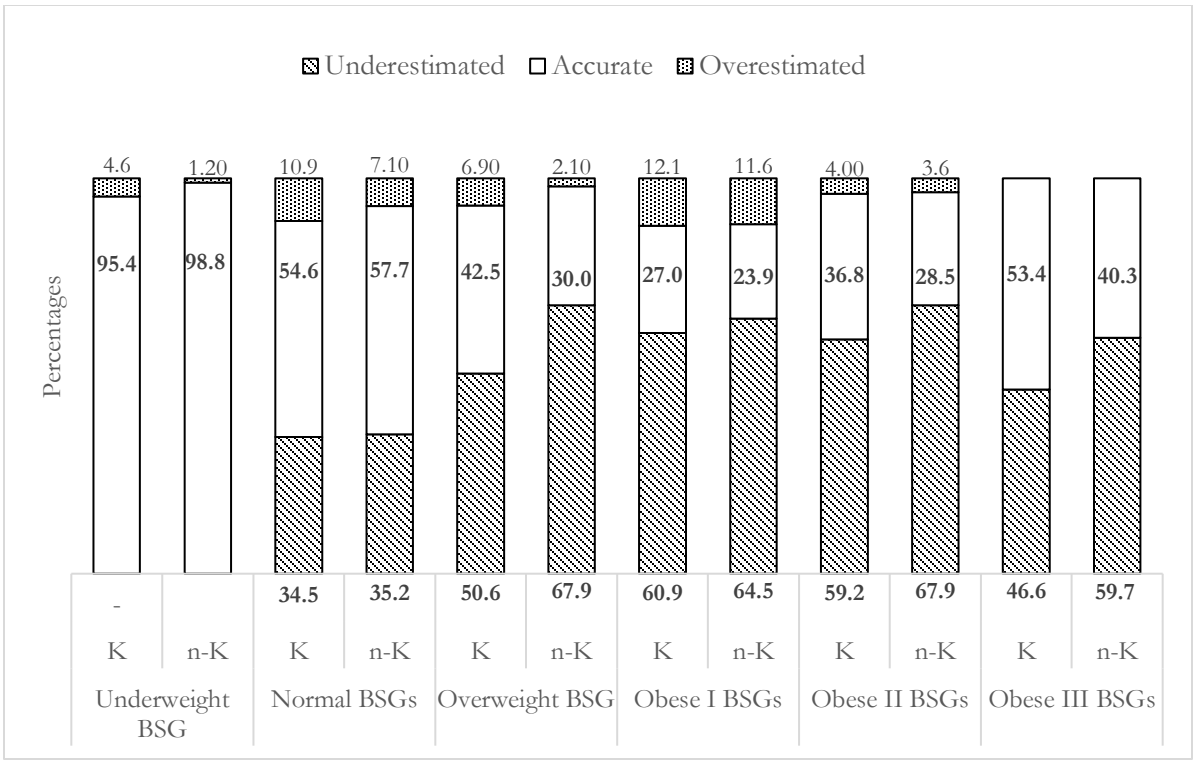

Figure 1 Underestimation, accurate, and overestimation percentages for male BSGs by Kinesiology (K) and non-Kinesiology (n-K) majors.

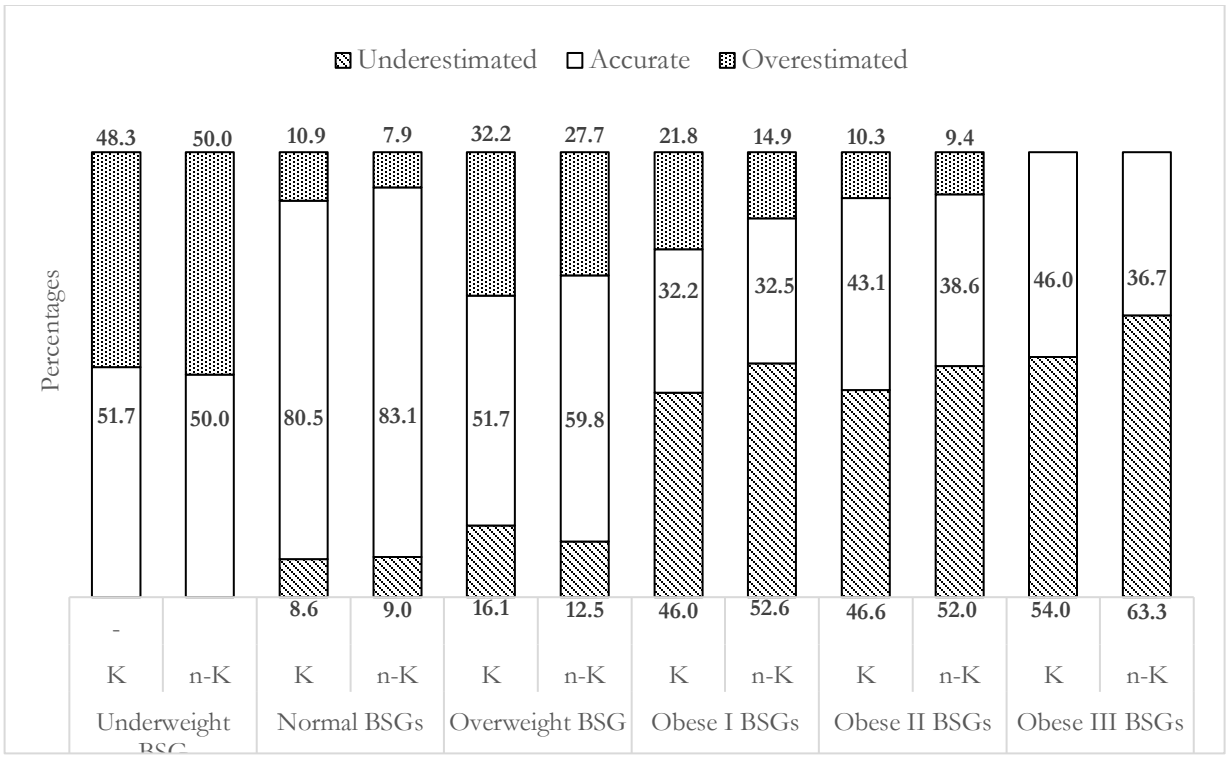

Figure 2 Underestimation, accurate, and overestimation percentages for female BSGs by Kinesiology (K) and non-Kinesiology (n-K) majors.

CHAPTER II

EXTENDED REVIEW OF THE LITERATURE

Specific Research

Misperception of one's BMI has been postulated as a factor influencing the increase in the prevalence of overweight and obesity. Research has indicated that misperception of one's BMI occurs in several populations across the world; however, the trends of misperception between populations could vary depending where the population was geographically located. Thus, the following literature review examined the trends of misperception among different university-aged populations from different geographical locations.

Hastuti et al.[1] set out to investigate BMI perception among university students living in the Yogykarta Province. At the time of their study, there was no previous study that had examined BMI perception in populations of younger Indonesian individuals. Their main goal was to specifically examine the association between BMI and BMI perception in university aged students. Therefore, Hastuti et al.[1] administered a structured questionnaire at two universities, Universitas Gadjah (UGM) and Universitas Teknologi Yogyakarta (UTY), located in Yogyakarta Province to collect data.

Hastuti et al.[1] developed a structured questionnaire covering topics such as background information (birth date and place, ethnicity, school grade, etc.), education level of parents, socioeconomic status, engagement in physical activity, dieting practices, and weight perception. The weight perception topic contained questions requiring participants to classify their peers, family members and their own weight status into one of four BMI classifications (i.e. underweight, normal, overweight or obese). The subjects were specifically asked '*How do you classify your body at this moment?*' when asked about their own weight. In addition to the

questionnaire, Hastuti et al.[1] acquired body weight and stature of each subject using the standard protocol of the International Society for the Advancement of Kinanthropometry (ISAK). BMI of subjects was then calculated using kg/m^2 and each subject was categorized into underweight ($<18.5\ kg/m^2$), normal ($18.5\text{-}24.9\ kg/m^2$), overweight (25.0-26.9 kg/m2) and obese ($\geq 27.0\ kg/m^2$). To analyze the collected data, SPSS was used to run a t-student test for continuum scale and chi-square test for ordinal scale for characteristic differences between males and females. An ordered regression analysis was performed to evaluate factors contributing to weight status misperception among males and females. A p-value of <0.05 was considered significant.

In total, the study had 209 males and 269 females aged 17 – 25 years old who were currently in Grades 1st to 4th at UGM or UTY. The male averages for age, weight, stature, and BMI were 20.8 years old, 62.61 kg, 167.35 cm, and 22.27 kg/m^2, respectively; while female averages were 20.7 years old, 50.92 kg, 155.25 cm, and 21.10 kg/m^2, respectively. Differences at all categories, except age, were statistically significant at the $p<0.001$. In terms of self-perception, 43.5% of males and 37.5% of females misclassified their weight status relative to the medical standards. More specifically, 32.5% of males classified themselves as having a lower weight than their actual while 27.1% of females overjudged their weight status as higher than their actual weight. Those who were determined obese according to actual BMI, perceived themselves as overweight or even normal weight in both males (75.9%) and females (78.6%).

Overall, Hastuti et al.[1] found there was misperception of weight status at all categories and for both sexes. For example, males in normal weight range according to their actual BMI show a greater prevalence of underestimation while females in the same group are more likely to overestimate their weight status. As for the obese populations, only about one forth in males and

one fifth in females correctly identified their weight status whereas the rest underestimated their weight status.

Another article that examined BMI perception in university students was the study conducted by Wardle, Haase, & Steptoe[2]. The first goal of their study was to shed light on weight perception on a global scale; while the second goal was to assess the loss, or gain, of weight that accompanied the perceptions. Like Hastuti et al.[1], the data was collected by using a self-report questionnaire.

The International Health and Behaviour Survey (IHBS) is an established survey consisting of self-report questions on a wide range of health behaviors and health beliefs. In 23 different countries, the IHBS was administered by established collaborators between 1999 and 2001 to undergraduate university students in non-health related courses. Since Wardle et al.[2] were only interested in aspects of weight perception and weight control, only questions related to weight perception and control, weight, height, BMI, gender, and age were pertinent. The weight perception question asked participants if they considered themselves to be '*very overweight*', '*slightly overweight*', '*about right*', '*slightly underweight*', or '*very underweight*'. The weight control question was a straight forward '*Are you trying to lose weight?*' with either a 'yes/no' answer. BMI was derived by 1) the self-reported weight and height measurements and 2) the kg/m^2 equation. Once data was collected, SPSS was used to run statistical analysis.

For statistical analyses, multiple factors were evaluated. First, the authors compared BMI values of their study to previous studies to determine if under-reporting of weight occurred. Second, the answers for the weight perception question were categorized into 'perceived overweight', 'perceived normal weight', and 'perceived underweight' groups. This allowed a

comparison of BMI, perceived overweight, and frequency of trying to lose weight in both males and females. Comparisons were investigated using ANOVA and x^2 analyses.

The study had a total of 18,512 university students (male, n= 8,115; female, n= 10,397) aged 17 – 30 years whom completed all necessary questions. Across all 22 countries, males had weight averages fall in the range of 60.4 – 78.2 kg, height averages in the range of 171.5 – 185.1 cm., and finally, BMI ranges of 20.5 – 24.3 kg/m^2. On the other hand, females had weight ranges of 50.1 – 64.3 kg, height ranges of 159.6 – 169.0 cm, and BMI ranges of 19.3 – 22.6 kg/m^2. According to the weight and heights reported, 4.8% of males and 18.1% females were in the underweight range (BMI <18.5 kg/m^2), 15.0% of males and 5.1% of women in the overweight range (> 25 kg/m^2) while 2% of males and 1% of females in the obese range (≥ 30 kg/m2). When compared to previous research on certain countries, there was under-reporting of BMI. Wardle et al.[2] could not obtain comparable data for other countries but they had no reason to think self-reports would be any more valid from those participants. Thus, Wardle et al.[2] proceeded under the notion that all countries under-reported BMI. As for weight loss, females in lower BMI classifications were trying to lose weight while not all women in the higher classifications were. Males saw the same trend but less than 60% of men in higher BMI classifications were trying to lose weight. Indeed, these results mimic those of Hastuti et al.[1].

Wardle et al.[2] were able to not only produce similar results to Hastuti et al.[1] but also expand those further. Hastuti et al.[1] found Indonesian university female students overestimated their weight status while university males underestimated. The Wardle et al.[2] indicates the same tendencies were and could be applied on a global scale. Across the 22 countries, women tended to overestimate their weight status while men underestimated theirs showing a striking international consistency. Moreover, Wardle et al.[2] could show females were more likely to

report weight loss attempts than men who appeared to be more comfortable with their weight status and less likely to attempt weight loss.

Mikolajczyk, Maxwell, El Ansari, Stock, Petkeviciene, and Guillen-Grima F[3] aimed to further expand on the study conducted by Wardle et al.[2]. Mikolajczyk et al.[3] were concerned the IHBS was only administered in four European countries but generalizations were being made about the rest of Europe. Additionally, they believed the sample size of each European country in the IHBS was too small to perform certain statistical analyses. So, the aim of their study was to compare the relationship between perceived body weight and BMI based on self-reported height and weight in student populations of larger sample sizes.

Mikolajczyk et al.[3] did not collect data themselves but rather used the database from the Cross National Student Health Survey (CNSHS), consisting of 5,900 records of university students from seven different European countries. The CNSHS was administered at universities in Germany (DE), Denmark (DE), Poland (PL), Bulgaria (BG), Turkey (TR), Lithuania (LT), and lastly, Spain (ES) during a span of 1998 to 2003. Although the survey contains a multitude of questions regarding health topics, only those focused-on weight, height, gender, age, and weight perception were relevant. The weight perception question asked was: '*Do you consider yourself much too thin, a little too thin, just right, a little too fat or much too fat*?' Again, BMI was calculated by the standard kg/m^2 equation using the self-reported height and weight.

To assess how perceived body weight was related to the BMI reported by students, three separate dichotomous responses were employed. They were as follows: 1) '*just right*' vs. remaining, 2) '*much too thin*' vs. remaining, and 3) '*much too fat*' and '*little too fat*' vs. remaining. Then, the probability of a given response across the BMI spectrum was modelled

using non-parametric egression with locally weighted polynomial fit implemented in R library gam. Statistical difference across the strata was tested using an interaction term in a joint model.

Of the 5,900 participants, 558 did not report height or weight leaving 5,342 for analysis. Males ranged in age from 20 – 23+ years with an average weight range of 71 – 73 kg, an average height range of 177 – 182 cm and BMI range of 22.1 – 23.8 kg/m^2. Females had ranges of 20 – 23+ years, 55 – 66 kg, 165 – 171 cm, and 19.9 – 22.4 kg/m^2, respectively. Results showed 65% to 85% of normal weight among the participants but only 32% to 68% of participants considered their weight '*just right*'. Between 22% and 51% of females considered themselves '*a little too fat*'. Results for males showed 11% to 38% considered themselves '*a little too fat'* with substantial amounts in all countries who considered themselves '*a little too thin*'. When compared jointly, less than 70% of participants considered their weight '*just right*' for any given BMI.

Overall, this study found females across all countries were more likely to describe themselves as '*a little too fat or much too fat'* while male students were opposite describing themselves as '*a little too thin'*. This should come as no surprise for it aligns well with the previous two articles discussed. Again, these results support the suggestion that females tend to overestimate their weight status while males tend to underestimate. One of the main concerns for Mikolajczyk et al.[3] was that Wardle et al.[2] did not have a large enough sample size from Europe to assume the trend they found in other countries could be generalized. However, in the discussion of their study, Mikolajczyk et al.[3] confirms that the trends do indeed apply to countries in Europe as well.

While Mikolajczyk et al.[3] examined university aged populations across multiple countries in Europe, Wronka, Suliga, and Pawlinska-Chmara[4] specifically examined university aged

populations in Poland. The study examined if accuracy of weight perception among young women in Poland depended on their BMI-based weight status. Just as the previous studies, Wronka et al.[4] used a questionnaire to collect data.

The questionnaire contained questions of self-assessment of body weight and desired body weight. More specifically, the questionnaire asked participants: '*Do you think your weight is: too low, correct, too high, or correct?*' as well as '*I have too much fatty tissue on my abdomen, hips or thighs: agree or disagree?*' Lastly participants were asked '*I would like to weigh less, more, have slimmer waist, slimmer hips or thighs, or wouldn't want to change anything: select which apply to you.*' In addition to the questionnaire, height and weight were directly measured and used to calculate BMI for each participant. Measures were analyzed using chi-squared tests for categorial variables and logistical regression for relation of self-assessment and measured BMI. Separate models were constructed for underestimation and overestimation.

In total, 1,129 female students from three separate universities across Poland participated in the study. Approximately 11.1% of the females were classified as underweight, 6.5% of females were classified as having a BMI ranging from 25-3- kg/m^2 and only 0.5% were classified as having a BMI of more than 30 kg/m^2. Overall, 71.9% of the surveyed females correctly estimated, 24.2% overestimated and 3.9% underestimated their body weight. Underweight women tended to incorrectly assess their body weight more often than normal weight women or overweight women (43.2% vs. 75.4% vs. 77.2%).

These results are in agreement with those found by Mikolajczyk et al.[3]. Both studies found that females from Poland had higher percentages of overestimation rather than underestimation when looking at BMI or weight status perception. Furthermore, Hastuti et al.[1], Wardle et al.[2], Mikolajczyk et al.[3], and Wronka et al.[4] have all produced results which further

support the notion of overestimation tendencies by females while males underestimate across BMI classifications.

Binkley, Fry and Brown[5] also examined BMI and weight status perception among university students. More specifically, Binkley et al.[5] investigated the accuracy of self-reported, perceived BMI and actual, measured BMI among university students in the United States. For their study, 192 university students (66 males and 126 females) were recruited from the recreation center located on the campus of a large Mid-Southern university. First, participants were asked to complete the questionnaire before any anthropometric measurements were recorded. The survey used the Quetelet BMI guide to assess participants' perceptions of their body weight status. Once completed, height and weight were measured and used to calculate actual BMI while self-reported BMI was calculated from height and weight reported in the questionnaire.

Binkley et al.[5] found that males had no statistical difference between self-reported BMI and actual BMI; however, females had significantly higher actual BMI than self-reported BMI. In terms of perceived BMI, females with higher actual BMI scores tended to report a lower perceived weight classification, while females with lower actual BMI scores were more likely to report a higher perceived weight classification. On the other hands, males were more accurate across all BMI classifications, but if there was misperception occurring, males tended to underestimate their BMI classification.

Once again, the results reported by Binkley et al.[5] concur with those of Hastuti et al.[1], Wardle et al.[2], Mikolajczyk et al.[3], and Wronka et al.[4]. All the studies have found that females overestimated while males underestimated. However, Binkley et al.[5] was the first study in this review to suggest that females of higher BMI classification underestimated while those at lower

BMI classifications overestimated their BMI. As for males, these results indicate men across all BMI underestimated their BMI, which again matches those reported earlier.

In Malaysia, Shagar, Shakiba, and Rahmah[6] conducted a study to the determine factors that influence misperception of own weight status among university students. However, for this literature review, the only the necessary information on misperception data was used. Like the studies previously reviewed, Shagar et al.[6] also used a questionnaire to gather data. The questionnaire consisted of close-ended questions examining perception of weight along with other variables not pertinent to this review. The misperception questions were referenced from previous studies. Using SPSS, Shagar et al.[6] performed a chi square test for the bivariate analysis to determine the association between variables and misperception of own weight status. Additionally, a level of significance was p value < 0.05.

A total of 313 (182 females and 131 males) participated in the study. Results showed younger university students, aged 18-19, had a higher percentage of misperception of own weight status compared to older university students, 20-21 years old. Also, females had higher percentages of misperception (34.6%) than males (26.7%). Obese individuals had higher misperception percentages (66.7%) compared to non-obese individuals (28.4%). Overall, 31.3% misperceived their own weight status while 68.7% perceived their weight status correctly.

The accuracy percentages Shagar et. al[6] found were similar to those reported by Hastuti et al.[1] and Wronka et al.[4]. All three studies had accuracy percentages in the seventies and all three studies found that higher BMI individuals had higher percentages of misperception when compared to lower BMI individuals. Unfortunately, Shagar et al.[6] did not examine misperception trends between BMI classifications so no comparisons can be drawn. However, another study conducted in Pakistan did look at misperception trends by BMI classifications.

Sirang, Bashir, Jalil, Kahn, Hussain, Baig et al.[7] examined body weight and BMI perception among female university students in Karachi, Pakistan. Their main objective was to examine the relationship between body weight perception, actual weight status, and weight control behavior among university students. Like Wronka et al.[4], Sirang et al.[7] used only female university students as their sample population.

During September to October 2009, female university students in the city of Karachi, Pakistan, were recruited from eight well-recognized universities; however, four universities declined to participate. Therefore, the questionnaire was only distributed to the four universities who agreed. The questionnaire sections included demographics, self-reported measures, body shape concern and weight satisfaction. Pertinent measures to this review included actual weight status, which was measured by the researchers, and weight perception where participants were asked to describe their body weight using BMI classifications. Like many of the previous articles, a chi square test was performed, due to the categorical nature of the questions, to determine the difference between actual and perceived BMI.

A total of 338 female participants aged 20.64 $\pm$ 1.49 years (53.81 kg $\pm$ 9.78; 1.61 m $\pm$ 0.06) completed the questionnaire and were measured. Overall, 66.3% of the females accurately perceived their BMI with 33.7% misperceiving. Of the normal BMI females, 23.6% overestimated their BMI while only 9.8% underestimated. Of the overweight BMI females, 80.3% correctly perceived themselves with only 18.3% underestimated their BMI.

The accuracy percentages in this study were slightly lower than those reported by Hastuti et al.[1], Wronka et al.[4], and Shagar et al.[6] who had accuracy percentages in the seventies. However, the claim of overestimation at lower BMI classifications and underestimation at higher

BMI classifications has been well established in this literature review, which is further strengthened by Sirang et al.[7] findings.

Up to this point, all the studies which have been reviewed have used questionnaires as the main form of data collection when observing or examining BMI perception. The next set of studies had more variety in their methodology. For example, in addition to using questionnaires, Kakeshita & de Sousa Almeida[8] depended on using three different psychometric methods, weight and height measures and self-administration of a questionnaire to collect their data. Students from one private and one public university in Brazil were recruited to participate in the study. In the first segment ("choice", CM), participants were asked to choose one of nine body contour drawings (drawings represented a BMI range of 17.5 to 37.5 kg/m^2 in ascending order) to represent their current body contour. Next, the participant was asked to choose one of the nine contour drawings to represent their desired body contour. In the second segment ("absolute", AT), the body contour drawings were presented in a random order. Again, the participant was asked to choose the contour drawing representing their current body contour and then their desired body contour. The third segment involved a visual analogue scale (VAS). The participant was shown the lowest limit body contour and the highest limit body contour on a line. They were then asked to make a vertical mark on the line where the participant thought their current body contour fell. Fourth segment was a direct measure of both weight and height. The fifth, and final segment, had participants fill out the Body Shape Questionnaire (BSQ). It was in this segment where self-perception questions were addressed.

An ANOVA statistical analysis (BMI classes) for each method was conducted and a two factorial ANOVA (BMI class and gender) for BSQ data and differences between current and actual BMI was run. A Newman-Keuls post-*hoc* test was used if necessary.

The ANOVA results indicated the selection of a drawing corresponding to their current control were statistically significant for BMI class for CM [$F(2.54) = 38.76$; $p < 0.001$], VAS [$F(2.54) = 10.63$; $p < 0.001$] and AT [$F(2.54) = 24.99$; $p < 0.001$] for females and CM [$F(2.46)= 38.76$; $p < 0.001$], VAS [$F(2.46) = 45.07$; $p < 0.001$] and AT [$F(2.54) = 36.69$; $p < 0.001$] for males. Post-*hoc* analysis showed class one means < class two means < class thee means ($p< 0.05$) for females. Male post-*hoc* analysis showed significant effect in class three compared to class one and two. The deviation between current and actual BMI in women showed statistically significant effects of BMI class in CM [$F(2.54) = 15.16$; $p < 0.001$], VAS [$F(2.54) = 10.63$; $p < 0.001$] and AT [$F(2.54) = 17.84$; $p < 0.001$] for females and only in AT [$F(2.46) = 7.29$; $p < 0.001$] for males. The post-*hoc* results indicated class one and class two overestimated their body size, while class three underestimated in females. As for males, post-*hoc* results indicated significant effect in class 3 compared to class one and class two. The two factorial ANOVA showed significant effect of class [$F(2.100) = 98.27$; $p<0.001$] and gender [$F(2.100) = 25.34$; $p <0.001$] for current perception of body image in CM. Post-*hoc* analysis showed class one and class two females chose contour drawings with BMI significantly higher than males ($p<0.05$). Lastly, the ANOVA showed significant effect of class [$F(2.100) = 7.75$; $p<0.001$] and gender [$F(1.100) = 23.79$; $p < 0.001$] in regard to BSQ. Post-*hoc* showed females had higher scores compared to men ($p<0.05$).

Overall, Kakeshita and de Sousa Almeida[8] found that females overestimated their weight status while males underestimated theirs. Females of lower BMI classifications chose contour drawings higher than their BMI classification while males chose contour drawings lower than their BMI classification. Other studies that have used contour drawing scales have had similar results. Specifically, Hadipour, Wan Abdul, and Leng[9] found that females at lower BMI

classifications chose higher BMI contours and females at higher BMI classifications chose lower BMI contours. However, a study conducted in Italy using contour drawings to assess BMI perceptions found that females at all BMI classifications underestimated weight status by choosing contour drawings lower than their BMI classification.[10] The differences in results are not believed to have been influenced by the methodology of using a questionnaire versus contour drawings, but rather influenced by the cultural influences on body shape and image.

Summary

This literature reviewed aimed to identify the misperception trends that were occurring among university aged populations from different geographically locations. It has become evident through the review of the literature that females at lower BMI classifications overestimate their BMI or weight status while females at higher BMI classifications underestimate their BMI or weight status. The literature also suggests males underestimate their BMI or weight status, regardless of the BMI classification. These trends were seen regardless of methodology used by the study. However, there were a few exceptions where the trend did not apply to a certain geographical location. The difference shows that the cultural pressures from within that geographical location are different than those of the other geographical locations.

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