A PILOT STUDY: ACTUAL VERSUS PERCEIVED HEALTH STATUS OF COLLEGE STUDENTS

by

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ABSTRACT

Background: A relationship exists between perception of one's health based on weight, and how they manage their health. Normal-weight college students who physically appear healthy may unknowingly develop a chronic disease because they view good physical appearance as verification of good health.

Objective: The purpose of this study was twofold: 1) compare the perceived health status of TCU students to their actual health status; and 2) assess the health status of TCU students of normal BMI.

Design: This study was a cross-sectional, descriptive design.

Methods: Twenty-five normal-weight college students between ages 18-24 of any sex and race were recruited to complete a health perception assessment survey 24 hours prior to their lab visit. Participant's anthropometric measurements (height, weight, body fat percentage, waist/hip circumference, and waist-hip ratio), blood pressure, fasting blood glucose (via finger prick) and a 10 mL blood sample were collected. Blood was analyzed for hemoglobin A1c and a lipid panel. Self-reported survey results were compared with results obtained during the study visit to identify any discrepancies between actual and perceived health status and evaluate the overall health status of participants.

Results: Average BMI and waist-hip ratio of participants were 22.39±1.94 kg/m^2 and 0.76±0.04, respectively. The most commonly elevated measured values were fasting blood glucose (29% prevalence), and body fat percentage, blood pressure, and LDL cholesterol (21% prevalence each). Fifty-two percent of participants presented with at least one measured value outside normal limits and 29% presented with two or more values outside normal limits. However, 92% described themselves as *very healthy, healthy*, or *somewhat healthy.*

Conclusion: Despite the appearance and perception of health, a significant proportion of TCU students ages 18-24 may risk developing a chronic disease. Our results suggest that regardless of self-perceived health status, TCU students should receive regular check-ups to identify and manage physiological markers of health.

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CHAPTER I

INTRODUCTION

It is widely accepted that a primary battle in health care in the United States (US) is lifestyle diseases such as obesity, diabetes, and cardiovascular disease. During the last few decades, there has been a significant increase in rates of adult obesity from 30.5 to 39.6 percent.[1] As of 2015, 30.3 million Americans (9.4%) were living with diabetes while 84.1 million adults (33.9%), had prediabetes.[2] In the same year, 70.6% of American adults were overweight or obese, and 30.2% were living with hypertension.[3] Although improving, 12.4% of US adults had high cholesterol during 2015-2016, and in that same time period, 18.4% of US adults had low high-density lipoprotein (HDL) cholesterol.[4]

Unfortunately, similar adverse health outcomes are demonstrated among American college students. For example, one study of 1,701 students at the University of New Hampshire exhibited overweight/obese status of 33%, 53% elevated LDL cholesterol, and 86% elevated systolic or diastolic blood pressure.[5] The World Health Organization classifies the above mentioned conditions, overweight and obesity, elevated blood glucose, and elevated blood lipids, as risk factors for cardiovascular disease.[6] Heart disease is responsible for one in every four deaths and is the number one cause of death for both men and women.[7]

These chronic diseases are directly related to lifestyle habits such as diet, physical activity, and avoidance of smoking and alcohol use.[7] When the average American considers how healthy they are, they often only consider how much they weigh, how they feel physically, and how many medications they are currently taking. Many Americans may consider themselves to be healthy according to these criteria, but is there a more accurate method to determine health

status by engaging individuals in their health? If individuals had a more developed and thorough understanding of their health status, perhaps the incidence of chronic, lifestyle diseases would be halted or reversed. Research has shown that individuals with higher health literacy and education are likely to have a better health status. After gathering results from the short form of the Test of Functional Health Literacy in Adults from 2,923 participants across the US, Wolf et. al concluded that individuals with inadequate health literacy had worse physical function ($p<0.001$) and mental health ($p<0.001$) than those with satisfactory health literacy.[8]

Yet, despite the prevalence of chronic disease, 66% of Americans surveyed classified their personal and families' current health as *very good* or *excellent*, despite the fact that six in ten Americans lives with a chronic disease, and four in ten live with two or more.[9,10] Inconsistencies between actual and perceived health status on a national level bring up the question of whether or not substantial differences occur on an individual basis. And if so, whether a knowledge gap regarding current status of health exists in college-aged students.

The purpose of this cross-sectional, descriptive study was two-fold: 1) to compare the perceived health status of Texas Christian University (TCU) students to their actual health status; and 2) to assess the health status of TCU students of normal body mass index (BMI). We hypothesized that the majority of participants would present with altered health status (i.e. dyslipidemia - high levels of low-density lipoprotein (LDL), elevated triglycerides, and low levels of HDL - elevated blood pressure, elevated body fat percentage, etc.), as evidenced by measured values outside normal limits. We further hypothesized that TCU students would have the impression that they are generally healthy (without dyslipidemia, elevated blood pressure, etc.), as measured by the health perception assessment survey.

CHAPTER II

LITERATURE REVIEW

Metabolic Syndrome

In the US, there are very few comprehensive studies on the general health state of college aged students. In 2011, Fernandes et. al at the University of Rhode Island found evidence of metabolic syndrome criteria in 28% of their student sample (n=189), with the most prevalent criteria being results of a lipid panel (low HDL cholesterol and elevated triglycerides).[11] Similarly, at Central Michigan University in 2017, Yahia et. al found that 11.6% of students aged 18-25 (n=462) had obesity.[12] One third of students surveyed also presented with at least one metabolic abnormality such as low HDL cholesterol, high waist circumference or elevated triglycerides.[12] These studies suggest that metabolic syndrome components are currently prevalent in college-aged student populations.

Body Fat Percentage

Research has shown that body fat percentage (BF%) can be used to assess underlying health risks even in lean populations, as characterized by BMI 18.5-24.9 kg/m^2. Gómez-Ambrosio et al. (2011) sought to analyze the impact of body adiposity on prediabetes and type II diabetes (n=4,828). Researchers measured BMI, BF%, waist circumference, and glucose tolerance after a 75g oral glucose test. In lean women, according to BMI, BF% measured higher in participants with prediabetes and type II diabetes, when compared to lean normal glycemic participants ($p<0.001$).[13] The same study found similar results in men ($p=0.020$). In addition, of the lean normal glycemic participants, 56% measured as overweight or obese based on their BF% (>20 or 25% for men and >30 or 35% for women).[13] This research suggests that

BF% can be used to assess risk for prediabetes and type II diabetes in lean populations, as it appears that body adiposity contributes to insulin resistance.

A similar study analyzed the relationship between elevated BF% and cardiometabolic abnormalities in normal BMI individuals (n=977). Cardiometabolic abnormalities assessed include decreased HDL cholesterol, elevated triglycerides, glucose and high-sensitivity C-reactive protein levels, insulin resistance, and hypertension. Researchers classified medium and high BF% as 15.3+% for men and 29.8+% for women. These two groups, medium and high BF%, had a combined 31.5% prevalence of cardiometabolic abnormalities, compared to a 7.4% prevalence in the low BF% group.[14] These findings indicate an association between elevated BF% and cardiometabolic disease risk factors, despite participants being of normal BMI.

Hemoglobin A1c

Hemoglobin A1c (HbA1c) measures glycated hemoglobin, and helps medical professionals assess average blood sugar levels over the previous two to three months. This test provides insight into glucose control abnormalities, including prediabetes and diabetes. An analysis of the NHANES III and NHANES focused on prediabetes in normal weight (BMI) individuals between 1988-1994 and 1999-2012. Prediabetes was defined by HbA1c between 5.7% and 6.4%, as defined by the American Diabetes Association. Results showed an increase in prediabetes for adults twenty and older from 10.2% in 1988-1994 to 18.5% in 2012.[15] Prediabetes defined by elevated HbA1c is also prevalent in adolescent populations. NHANES data from 1999-2014 revealed that the prevalence of prediabetes in adolescents aged 12-19 increased from 1.87% in 1999 to 4.99% in 2014 ($n=2,606$, $p<0.0001$).[16]

Elevated HbA1c, as a sign of prediabetes, relates to type II diabetes risk. Bonora et al. (2011) found that one in four subjects with HbA1c 6.0-6.49% developed type II diabetes over a fifteen year longitudinal prospective study period (n=70).[17] Of those with HbA1c 5.50-5.99%, 9.8% developed type II diabetes over the same fifteen year timeframe.[17] This data indicates not only that the prevalence of elevated HbA1c is on the rise, but also that the resulting prediabetes is an indicator for type II diabetes, a common chronic disease in the United States.

Fasting Blood Glucose

Medical professionals often use fasting blood glucose similarly to HbA1c, to assess glucose control and potential prediabetes and diabetes. However, research has recently linked elevated glucose to cardiac and mortality risks. Lee et al. (2018) tracked fasting blood glucose in Korean individuals without diabetes over an eight-year period (n=260,487). At baseline and for subsequent measurements, individuals were classified as having normal, impaired or diabetic fasting glucose (NFG, IFG, DFG). Results revealed an increased risk of stroke (HR [95% CI]: 1.19 [1.02–1.38]) in participants who shifted from NFG at baseline to DFG, compared to those who maintained NFG.[18] Additionally, an increase in all-cause mortality existed for those who shifted from NFG to IFG or DFG, compared to those who maintained NFG (HR [95% CI]: 1.08 [1.02–1.14] for NFG to IFG and 1.56 [1.39–1.75] for NFG to DFG).[18] This study concludes that changes in fasting blood glucose to impaired or diabetic levels has adverse health effects beyond prediabetes and diabetes.

Actual Versus Perceived Health Status

Extensive research regarding discrepancies between actual and perceived health status, particularly in younger adults, is lacking. In 2014, researchers at the Mayo Clinic compared self

perceived height, weight, and BMI category of adult internal medicine patients to actual measured values (n=508).[19] Results showed that self-reported height was significantly taller than actual height, and that self-reported weight was significantly lower than actual weight ($p<0.001$).[19] Thus, self-reported BMI, calculated using self-reported height and weight, was significantly lower than actual BMI ($p<0.001$).[19] In addition, 32% of patients presented with obesity, yet only 6% perceived themselves as obese.[19] Inaccurate perceptions of BMI have been documented in adolescent populations as well. Researchers in Norway surveyed students 18-23 years of age (n=629) and found that men and women misperceive themselves as both 'false fat' and 'false thin'.[20] Percentages of BMI misperception for men and women were 27.9% and 20.2%, respectively.[20]

Very little research describing differences between actual and perceived general health status exists in college student populations. One recent study performed an assessment of type II diabetes risk in 660 American college students. Researchers found more than 30.4% of participants at high risk for developing type II diabetes.[21] Most importantly, 30% of participants perceived their personal risk to be ten points below their actual risk, as determined by the CDC's risk screening tool.[21] Perception of health status influences both lifestyle and medical decisions, hence why evidence of significant differences in actual versus perceived health status in multiple populations is concerning. Based on this literature search, more research is needed comparing actual and perceived health status, beyond measurements of BMI and diabetes risk, in college student populations.

CHAPTER III

METHODS

Study Design

This study was a cross-sectional, descriptive design. Participants completed a health perception assessment survey followed by one visit to the Obesity Prevention Laboratory (OPL) at TCU. The survey consisted of 34 questions and asked students to report on and/or estimate their various health measurements and dietary habits. During the laboratory visit, student researchers took the following measurements: height, weight, body fat percentage, waist and hip circumference, blood pressure (BP), fasting blood glucose (FBG, via finger prick), and blood analyses including a lipid panel (total cholesterol, triglycerides, HDL cholesterol, LDL cholesterol, and risk ratio (LDL/HDL)) and HbA1c. The TCU Institutional Review Board approved this study protocol and all participants provided written informed consent.

Participants

Twenty-five male and female TCU students (n=11 men, n=14 women) of any race participated in this study. Participants were 18-24 years old and of normal weight, defined as a BMI between 18.5 and 24.9 kg/m^2. The student researchers recruited participants via flyers, TCU Announce, and word of mouth.

Protocol

Potential participants who were interested in volunteering for this research study were screened over the phone. If they met inclusion criteria, research personnel discussed the study, answered any questions, and scheduled the participant for their in-person lab visit. Exclusion criteria for this study include: diagnosis of cancer, following a medically prescribed diet or

medically prescribed exercise program, donated blood or plasma within the last 30 days, surgery within the last 30 days, and currently pregnant, lactating, or planning on becoming pregnant prior to the conclusion of this study. Participants were also asked to disclose any chronic disease, eating disorder, etc. but these did not disqualify them from participating. The research personnel also sent the participant a Qualtrics® link through which they signed the consent document electronically and completed the health perception assessment survey twenty-four hours prior to their lab visit. After completion, research personnel gave participants instructions regarding preparation for their lab visit. The instructions included 1) abstain from both food and drink for twelve hours (overnight fast) prior to your lab visit, 2) abstain from alcohol and caffeine for twenty-four hours leading up to your visit, and 3) avoid vigorous exercise for twenty-four hours prior to your visit.

On the day of their scheduled testing, participants arrived at the OPL at TCU for their ~30-minute lab visit. Research personnel verified that participants had signed the consent form and completed the health perception assessment survey. Next, height and weight were measured, followed by body composition analysis with the BODPOD (COSMED, Rome, Italy). Participants received instructions to wear the tightest fitting clothes possible; a one-piece swimsuit or sports bra and compression shorts for women, and compression shorts for men. This testing took approximately five minutes. Then, research personnel measured waist and hip circumference. Participants were then seated for five minutes, followed by two BP readings with a two-minute break between readings. Next, FBG was measured by finger prick. Lastly, a trained phlebotomist collected a 10 mL blood sample from the antecubital vein. The blood was drawn into BD Vacutainer blood collection tubes and analyzed for a lipid panel and HbA1c.

Statistical Analysis

Excel statistical analyses were utilized for survey and laboratory data. Descriptive statistics including mean, range, and standard deviation were calculated for all variables. All values were expressed as mean±standard error of the mean (SEM) unless otherwise indicated. Using reference values, percent of participants out of normal range was calculated for all measured values. Statistical significance was set at $p<0.05$.

CHAPTER IV

RESULTS

Participant Characteristics

Participants consisted of eleven males and fourteen females, with an average age of 19.8±1.29 years. The race/ethnicity breakdown was eleven White, five Asian, four Hispanic, three Black, and two *other*. Twenty-two different majors were represented. The participant population is a representative sample of the TCU student population except for the majors represented and diet preferences. The diet preferences of the TCU student population are not reported by the TCU Fact Book.[22] Comparison of participants to the overall TCU population can be found in **Table 1**.

Table 1: Participant Population Characteristics

	Participant Population ***(N=25)*** ***N (%)***	**TCU Student Population** ***(N=9,474)*** ***N (%)***
AVERAGE AGE (yr)	19.8±1.29	20.3
GENDER		
Male	11 (44)	3,945 (41)
Female	14 (56)	5,529 (58)
RACE/ETHNICITY		
White	11 (44)	6,461 (68)
Asian	5 (20)	275 (2)
Hispanic	4 (16)	1,385 (14)
Black	3 (12)	493 (5)
Other	2 (8)	
MAJORS REPRESENTED	22 (18.8)	117 (100)
DIET		
No restrictions	18	Not reported by TCU Fact Book
Vegetarian	3	
Pescatarian	2	
Paleo	1	

Measured and Predicted Values

Average participant measured values can be found in **Table 2**. Mean blood pressure was the only measured value out of normal reference range (120/80 mmHg). This could be due to the participants fasting state during their lab visit. Percent prevalence for each measured value outside normal limits can be found in **Table 3.** Most common were elevated FBG (29%), BP, BF%, and LDL cholesterol (all 21%). The percent of participants who presented with zero, one, or two-plus measured values outside normal limits were 21%, 50%, and 29%, respectively. (**Figure 1**) Notably, the majority (50%) of participants had at least one measured value outside normal limits.

Four percent of participants predicted, via survey, abnormal cholesterol levels, and eight percent predicted abnormal BP. For all other measured values, all participants predicted themselves to have normal values. The percentage of participants who had measured abnormal cholesterol levels and abnormal BP was 25% and 13%, respectively. Comparison of predicted and measured abnormal values can be found in **Figure 2**.

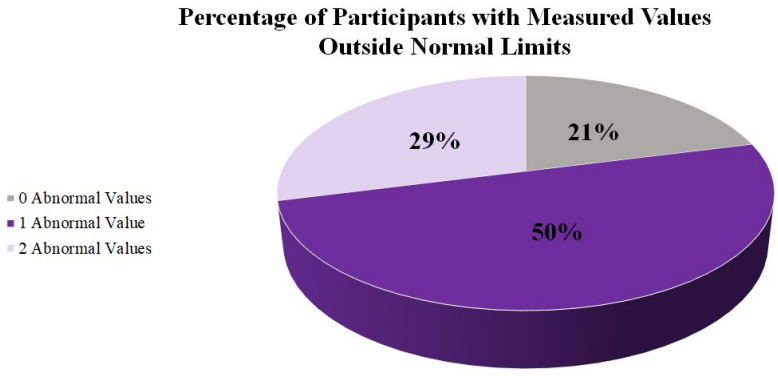


Figure 1. Figure represents the percentage of study participants that had zero, one, or two measured values from lab visit outside of normal limits. Fifty percent of participants had at least 1 measured value outside normal limits, 29% had 2 or more measured values normal limits, and 21% of participants had 0 measured values outside normal limits.

Table 2: Average Participant Measured Value Characteristics	
Age (yr)	19.8 ± 1.29
Height (m)	1.7 ± 0.069
Weight (kg)	65.3 ± 7.7
BMI	22.4 ± 1.9
Body Fat %	21.4 ± 7.6
Waist Circumference (cm)	73.3 ± 6.0
Hip Circumference (cm)	96.0 ± 5.2
Waist-Hip Ratio	0.76 ± 0.05
Blood Pressure (mmHg)	109 ± 14.4/70 ± 7.2
Fasting Blood Glucose (mg/dL)	94.4 ± 10.1

Table 3: Prevalence of Measured Values Outside Normal Limits			
Body Fat Percentage	21%	**Total Cholesterol**	4%
Waist-Hip Ratio	4%	**LDL**	21%
Blood Pressure	21%	**HDL**	4%
Fasting Blood Glucose	29%	**Risk Ratio LDL/HDL**	4%
HbA1c	0%	**Triglycerides**	0%

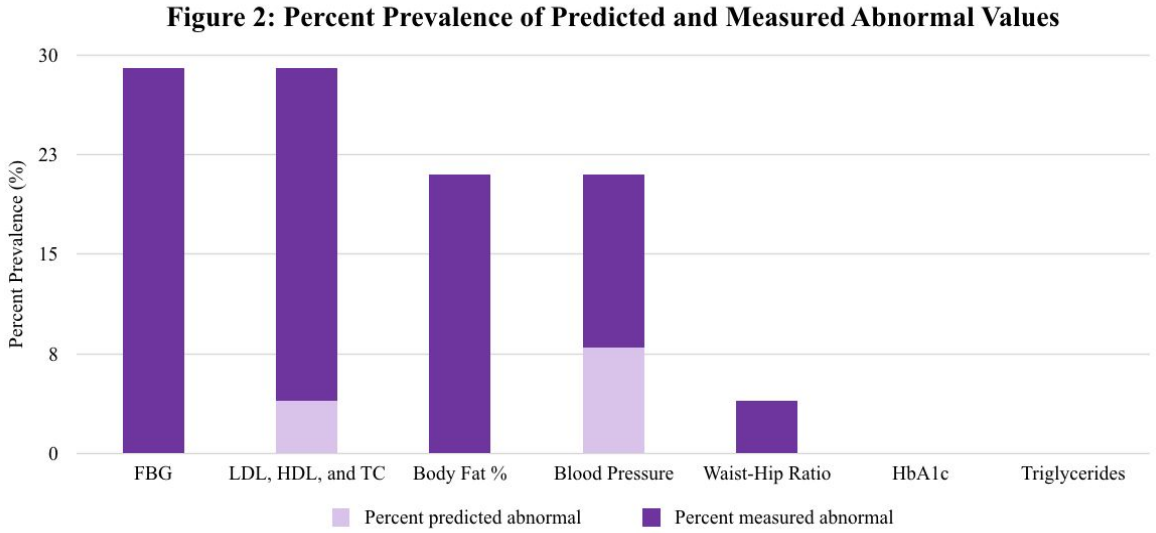
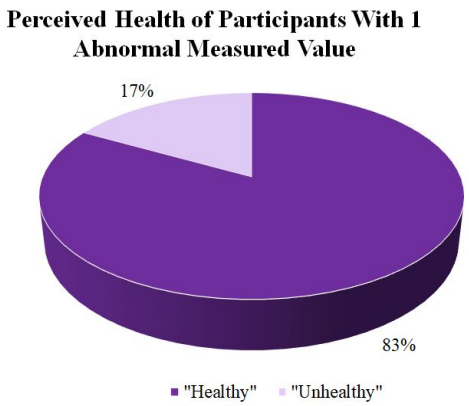


Figure 2. Figure represents the percent of study participants who predicted they would present a specific value outside of the normal range on the Health Perceptions Assessment Survey and the percent of participants who had a specific measured value outside of the normal range. *FBG* – fasting blood glucose. *LDL* – low-density lipoprotein cholesterol. *HDL* – high-density lipoprotein cholesterol. *TC* – total cholesterol. *HbA1c* – hemoglobin A1c.

Perceived Overall Health

When asked to assess their current health status, 92% of participants described themselves as *very healthy, healthy,* or *somewhat healthy*. Of the 50% of participants who presented with one or more abnormal measured values, 83% described themselves as *very healthy, healthy*, or *somewhat healthy*. Of the 29% of participants who presented with two or more abnormal measured values, 72% described themselves as *very healthy, healthy,* or *somewhat healthy*. These results are shown in **Figure 3a-b**.



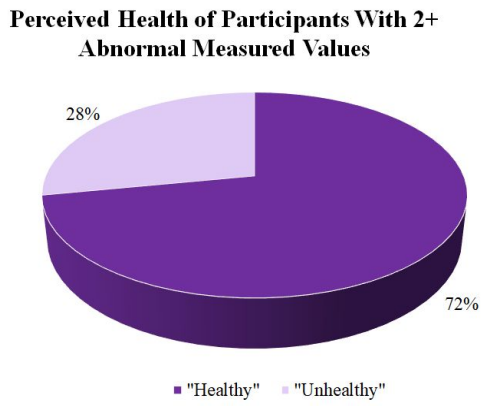


Figure 3a **Figure 3b**

Figure 3a. Figure represents the percentage of participants with one measured value outside normal limits who perceive themselves to be healthy or unhealthy. Of the 50% of participants who presented with one abnormal measured value, 83% described themselves as *very healthy, healthy,* or *somewhat healthy.*
Figure 3b. Figure represents the percentage of participants with two or more measured values outside normal limits who perceive themselves to be healthy or unhealthy. Of the 29% of participants who presented with two or more abnormal measured values, 72% described themselves as *very healthy, healthy,* or *somewhat healthy*.

Health Screenings and Lifestyle

The percentage of participants who reported their last physical or check-up to be more than one year ago was 44%. The percentage of participants who reported their last lipid panel and FBG reading as *never* or *I don't know* was 76% and 64%, respectively. Regarding diet, *no restrictions* was reported by eighteen participants, *vegetarian* by three, *pescatarian* by two, and *paleo* by one. Using questions about the frequency of consumption of certain food groups, the average Mediterranean diet score for all participants was 3.64 out of 7. Participants averaged less than one day/week for alcohol consumption, with 64% not consuming any alcohol. Participants also averaged two and a half hours/week of exercise, with 92% performing at least 30 minutes of exercise per week.

CHAPTER V

DISCUSSION

The purpose of this study was to compare the perceived health status of TCU students to their actual health status and to assess the overall health status of normal weight TCU students. Our results indicate discrepancies between perceived and actual health status as well as suboptimal health status among TCU students. Interestingly, the majority (50%) of participants presented with one or more abnormal measured values, which are risk factors for chronic disease. Of those participants, a large majority (72-83%) simultaneously described themselves as *healthy*. Although *healthy* is subjective, the high prevalence of chronic disease risk factors such as abnormal FBG, BP, and blood lipids in normal weight individuals is concerning. Therefore, this research indicates that individuals may be ignoring messages of lifestyle modifications that focus on reducing unhealthy behaviors because they are perceiving themselves as healthy, when in reality, they have risk factors for chronic disease.

The prevalence of at least one metabolic syndrome criteria among our participants was 52%, which is almost twice as high as recent similar research at other universities.[11,12] Occurrence was concentrated in three criteria only, elevated FBG, low HDL cholesterol, and high BP. Given our participants were all normal weight, it is surprising to see such a large increase in metabolic syndrome criteria. Though previous data shows that discrepancies between actual and perceived health status exist in American adults averaging 63 years of age, our results showed for the first-time discrepancies between actual and perceived health status in a college student aged population.[19] This is evidenced by the lack of awareness of abnormal measured values and simultaneous self-described *healthy* state.

Limitations

The small sample size of twenty-five students stands as a limit to this study, as it may not be representative of the national college-aged population. All participants were also of normal weight and it cannot be determined if they are or will be diagnosed with a chronic disease based on their prevalence of risk factors. Also, classification of health status is subjective to the individual, and may or may not be influenced by knowledge of chronic disease risk factors. Future research on health status and chronic disease risk factors in normal weight college student populations is warranted to address these limitations.

Practical Implications

In particular, the need for education on proper estimation of and the normal ranges for self-assessment of health is evidenced by gross misestimation of waist and hip measurements by at least one of our participants. There is a lack of education on waist and hip circumference and the implications of these measurements on health status among the general population. For example, one study demonstrated that 57% of women with normal weight, 18% of overweight women, and 23% of overweight men with high-risk waist circumference as determined by professional measurement falsely categorized themselves as low risk using self-measurement of their waist circumference.[23] If individuals were educated on measurements that indicate health status such as waist and hip circumference, BP, and FBG, it is likely they would go to a physician's office or seek preventative care for chronic disease.

Our results also indicate the need for thorough health assessment even in those who are normal weight based on BMI. It is clear that individuals of normal weight can possess risk factors for chronic disease, so they and health care providers should take caution not to assume

optimal health based solely on weight status. In doing so, annual check-ups and preventative care should be prioritized to identify abnormal health markers and address them before progression into disease occurs.

CHAPTER VI

CONCLUSION

The present findings indicate that despite the appearance and perception of health, a significant proportion of college-aged students may unknowingly be at risk for developing a chronic disease. Students ages 18-24 commonly present with at least one value that is outside of the normal reference range and indicative of a common chronic disease, and a significant portion of students with at least one altered value still regard themselves as *healthy* and do not recognize they are at a higher risk for chronic disease. There is a discrepancy between actual and perceived health status of college-aged individuals as demonstrated by a majority of participants presenting with altered health status values, the most common being fasting blood glucose, even though individuals overwhelmingly predict that they are generally healthy. Regardless of self-perceived health status, students should receive regular check-ups to identify and manage physiological markers of health. Meeting with primary care physicians regularly is an opportunity for individuals to improve their health literacy, resulting in a deeper understanding of their personal health and discussion of possible lifestyle changes. In addition, disseminating messages about healthy lifestyle habits to the general population should be prioritized among public health officials. Messaging should focus on risk-reduction that stresses that normal BMI or a positive self-perception of health are not accurate indicators of lack of disease.

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