

**DOES OBESITY EXIST IN DEVELOPING COUNTRIES?
EVALUATION OF A RURAL CLINIC POPULATION IN THE DOMINICAN REPUBLIC**

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Abstract

Background

In the 1980s, the United States (US) and Europe witnessed a rising obesity rate mostly due to a poor-quality diet and lack of physical activity, while developing nations struggled with malnutrition and starvation. Now, there is a growing obesity prevalence in developed and developing countries. According to the World Health Organization, in 2014, more than 1.9 billion adults were overweight and 600 million of them were obese while 41 million children under the age of 5 were overweight or obese. Therefore, we are also seeing an increased prevalence of obesity related comorbidities like diabetes and hypertension.

Objective

To determine the obesity rate in the bateyes of the Dominican Republic (DR) and compare that to the obesity rate in the US in order to determine necessary interventions to prevent further complications from the growing obesity epidemic.

Methods

Patients were evaluated in mobile clinics in the bateyes in the DR during two, one-week long medical service trips in 2016 by University of Arizona College of Medicine Phoenix Global Health teams. During triage, vital signs, height, and weight were obtained on all patients over the age of 2 years. A retrospective chart review was performed to collect patients' age, sex, height, and weight. The body mass index (BMI) was calculated for each patient. Pediatric (<18 years) patients' BMI was recorded as a percentile based on age. Simple descriptive statistics were used to evaluate the rates of obesity in the bateyes. These rates were then compared to the rates in the United States, using the 1 Sample Test of proportion to compare percentage differences in obesity rates.

Results

A total of 403 patients were evaluated, including 152 children under 18 years of age, and 179 female adults, 18 years of age or older. In the adult population, 44.22% of the patients were normal weight, 29.08% were overweight, and 17.13% were obese (Figure 2). In the pediatric population, the findings are similar to adults where a majority of the patients were normal weight, but only 12.50% of the pediatric patients were overweight and 12.50% were obese (Figure 3). Our results showed a 3.6% difference in overweight children and a 4.4% difference in obese children when comparing the percentage of children in the bateyes who are overweight to the percentage of children in the US (Figure 6).

Conclusion

These results indicate a growing obesity epidemic in the rural farming villages in the DR that is similar to the trend in the US. We hope to implement public health interventions by educating this population about the dangers of obesity and its associated comorbidities, including coronary artery disease and diabetes. Since our clinic population is primarily women and children, we hope to begin these programs during pregnancy and childhood to encourage lifelong healthy eating habits in children and young mothers and stop the growing obesity trend.

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Introduction & Significance

During the 1980s, developed countries such as the United States and Europe experienced a rising obesity rate due to a poor-quality diet and sedentary lifestyle.⁵ The opposite occurred in developing countries, where malnutrition and starvation were the growing public health concerns. Thirty years later, many epidemiologic studies now demonstrate a growing obesity prevalence within developing countries as well as developed countries.^{6,7} According to the World Health Organization (WHO), worldwide obesity has nearly tripled since 1975. In 2016, more than 1.9 billion adults were overweight and 650 million of these were obese, while 41 million children under age 5 were overweight or obese. Unfortunately, the increasing prevalence of overweight and obesity are expected to continue in all age groups.⁸ In Latin America specifically, there are several variables thought to be contributing to the obesity problem. Diet is thought to be the primary issue and studies document there has been a shift in the Latin American diet towards low nutrient density foods and sugary beverages. In addition, Latin Americans have started to eat away from the home more often and have increased snacking. All of these variables are thought to be causing the shift toward obesity in these countries.⁹

Obesity and overweight are risk factors for several comorbidities including cardiovascular disease, diabetes, hypertension, dyslipidemia, gallstones, cancers of the breast, endometrium, and genitourinary tract, and musculoskeletal problems.^{10,11,12,13} Therefore, we expect to see a concurrent rise in these comorbidities as overweight and obesity are on the rise. This brings a growing epidemiologic and financial burden to both developed and developing countries.¹⁴ The medical costs of diabetes alone in the US is significant, increasing from \$44 billion to \$92 billion in 5 years. In Latin America, it is estimated to cost around \$550 per person for a year of diabetes care.¹⁵ While it is difficult to provide fresh produce and high nutrient quality food to the remote populations in developing countries, it is even more difficult to provide healthcare in remote areas for these expensive obesity related chronic conditions.

Over the years, the University of Arizona College of Medicine Phoenix (UACOMP) Global Health Interest Group (GHIG) have witnessed these changes as they travel to the Dominican

Republic biannually to run mobile primary care clinics in the bateyes of San Pedro de Macorís. The bateyes are small sugar cane farming villages that are remote and lack access to potable water, sanitation, electricity and healthcare. The purpose of the trip is to provide a primary care physician and a medical home for the people of the bateyes, along with bringing medications and supplies a few times a year. Since the inception of these trips, the group has observed an increasing number of patients who are overweight, along with an increased prevalence of diabetes and high blood pressure in this population. Due to these observations, we reviewed our current patient population demographics in order to determine the scope of the problem and appropriately plan for future trips.

Our objective was to determine the prevalence of obese and overweight patients in the bateyes of the Dominican Republic (DR) that we provide care for and compare this to the prevalence in the US in order to develop appropriate interventions to prevent further long-term health complications that come from a lifetime of obesity.

Materials and Methods

This study was a retrospective chart review. A “Determination of Human Research” form was submitted to the UACOMP Institutional Review Board (IRB) and the study was found to not be human research given the use of deidentified patient data. Patients were evaluated in mobile clinics in the bateyes in the DR during two, one-week long medical service trips in 2016 by University of Arizona College of Medicine Phoenix Global Health teams. During triage, vital signs, height, and weight were obtained on all patients over the age of 2 years. Exemption criteria included pregnancy or inability to take appropriate measurements (e.g. older patients unable to stand). Pediatric (<18 years) patients’ BMI was recorded as a percentile based on age.

The original patient health information was entered into the electronic health record system, PracticeFusion (<https://www.practicefusion.com/electronic-health-record-ehr/>) during the medical service trips. Only the attending physician had access to the original patient information. The patient information was then deidentified and compiled into a spreadsheet to include only the age, sex, height, and weight of each person evaluated in clinic. The body mass index (BMI) was calculated for each patient by taking the patient's weight in kilograms and dividing by the square of their height in meters ($BMI = \text{kilograms}/(\text{meters})^2$). Adults were categorized into underweight, normal weight, overweight, or obese based on the most commonly used definitions established by the World Health Organization (WHO) in 1997 and published in 2000 (Refer Table 1, page 11). Obesity was defined as $BMI > 30$ and not divided into subcategories due to ease of calculation since our sample size was small. Pediatric patients were categorized into percentiles based on age according to the Centers for Disease Control (CDC) BMI growth charts (Refer Table 2, page 12). Simple descriptive statistics were used to evaluate the BMI status of the patients in the bateyes. These rates were then compared to the rates in the United States, using the 1 sample t test of proportion to compare percentage differences in obesity rates in the US versus the bateyes in the DR.

Results

A total of 403 patients were evaluated, including 152 (37.7%) children under 18 years of age, and 179 (44.4%) female adults, 18 years of age or older. In our study, 52.36% of the clinic population in the bateyes was found to be normal weight while 22.83% of the population was overweight and 15.38% were obese (Figure 1). In the adult population (age ≥ 18 years), 44.22% of the patients were considered normal weight, while 29.08% were overweight and 17.13% were obese (Figure 2). In the pediatric population, the findings were similar to adults where a majority of the patients were normal weight, but only 12.50% of the pediatric patients were overweight and 12.50% were obese (Figure 3).

When comparing the United States (US) and DR populations, it was found that the DR population had a higher percentage of overweight people but a lower percentage of obese people. In the DR, 54.8% of the adults were found to be overweight compared to 31.1% of the US population. Obesity affected 23% of the DR adult population versus 35.7% of the US adult population (Figure 4).

When evaluating the difference in the rates of obesity and overweight in the US versus the DR clinic population, there was no statistically significant difference between the US and DR clinic female populations. However, there was a statistically significant ($p < 0.05$) difference between the two male populations (Figure 5). This was likely due to the smaller sample size of adult males that were evaluated in the DR clinic ($n=72$). In the pediatric population, the difference in rates of obesity and overweight between the US and DR clinic children did not reach statistical significance (Figure 6).

As seen in these figures, the bateyes' clinic population mirrored that of the US population in both obesity and overweight prevalence with no statistically significant difference between the two populations for the pediatric and adult female groups.

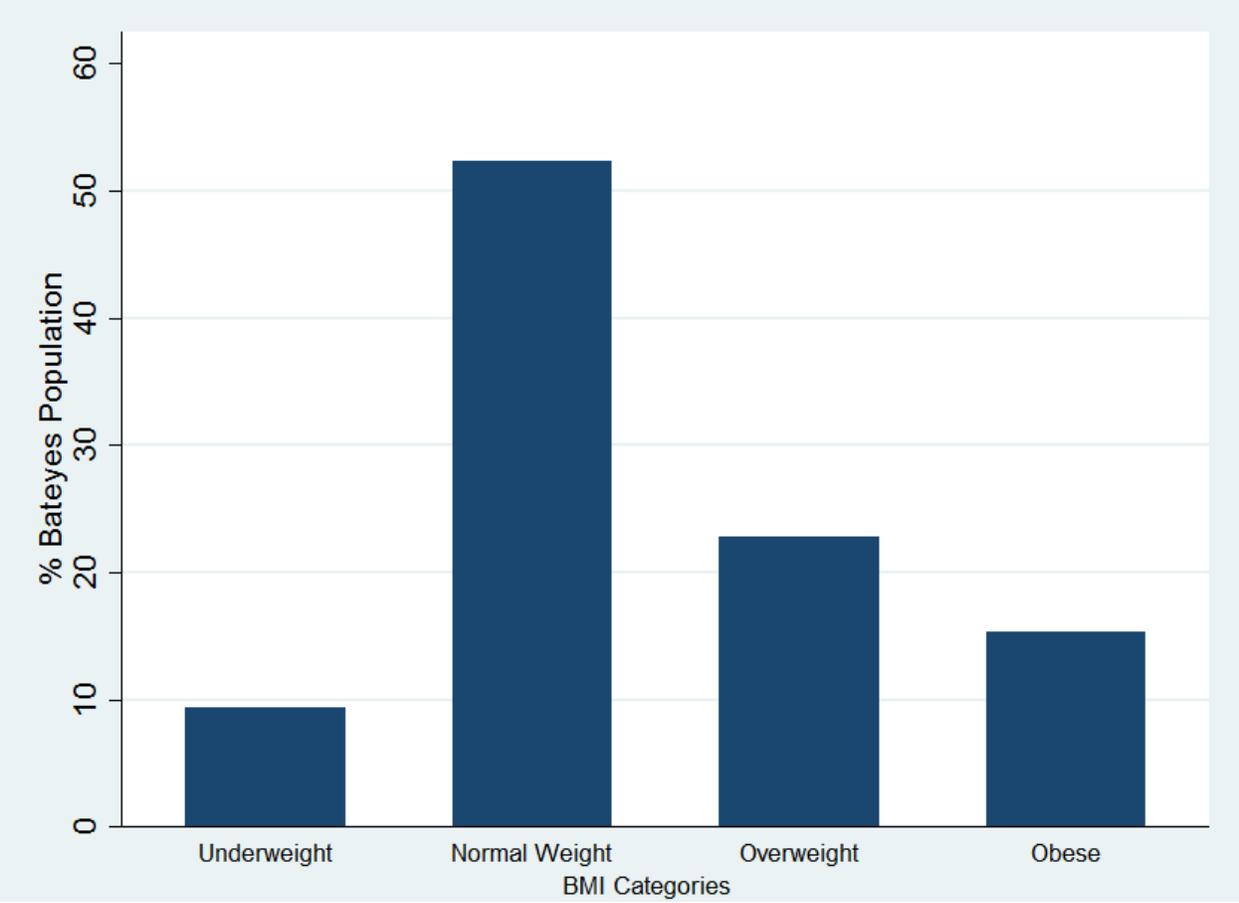


Figure 1: Percentage of underweight, normal weight, overweight, and obese patients in the bateyes population (adult and pediatric)

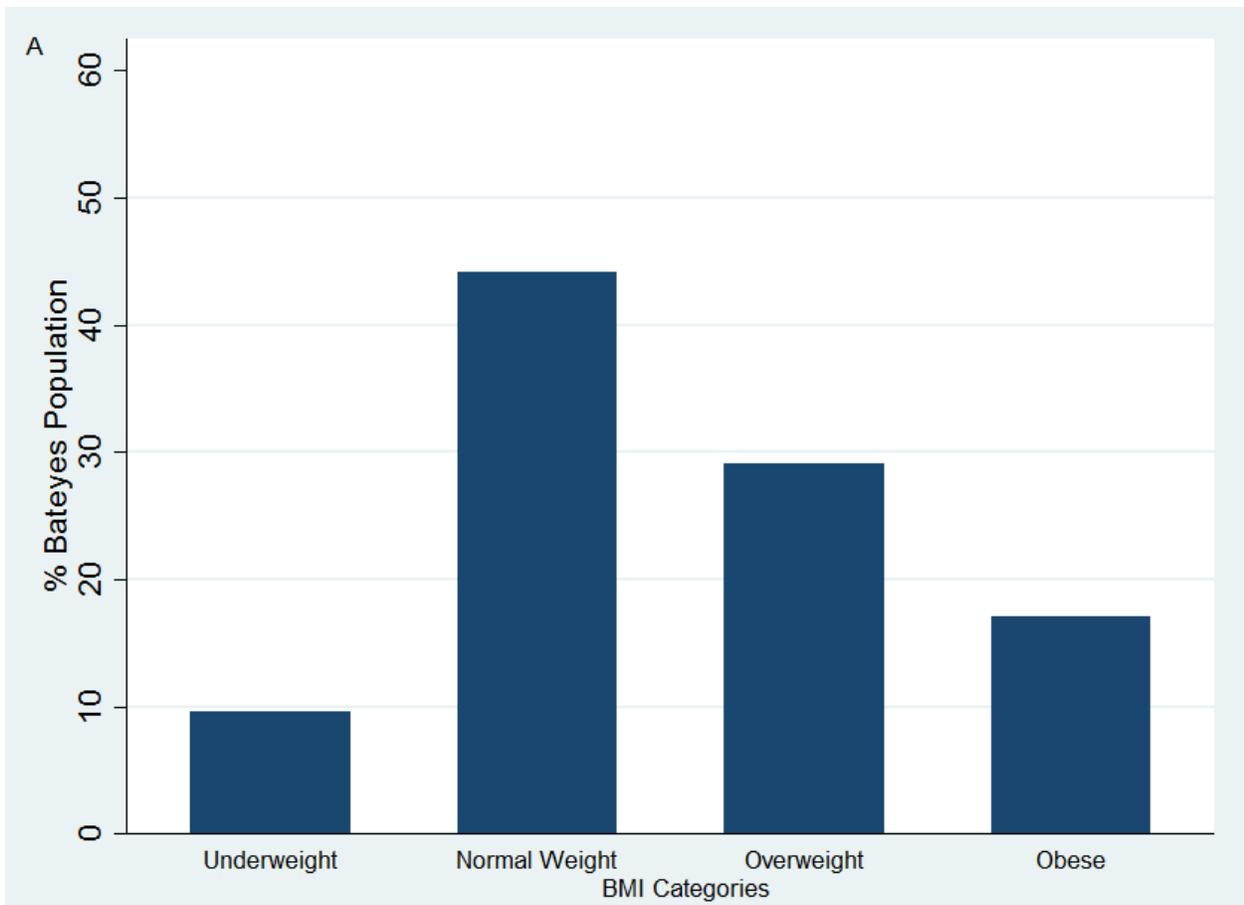


Figure 2: Percentage of underweight, normal weight, overweight, and obese patients in the bateyes *adult* population

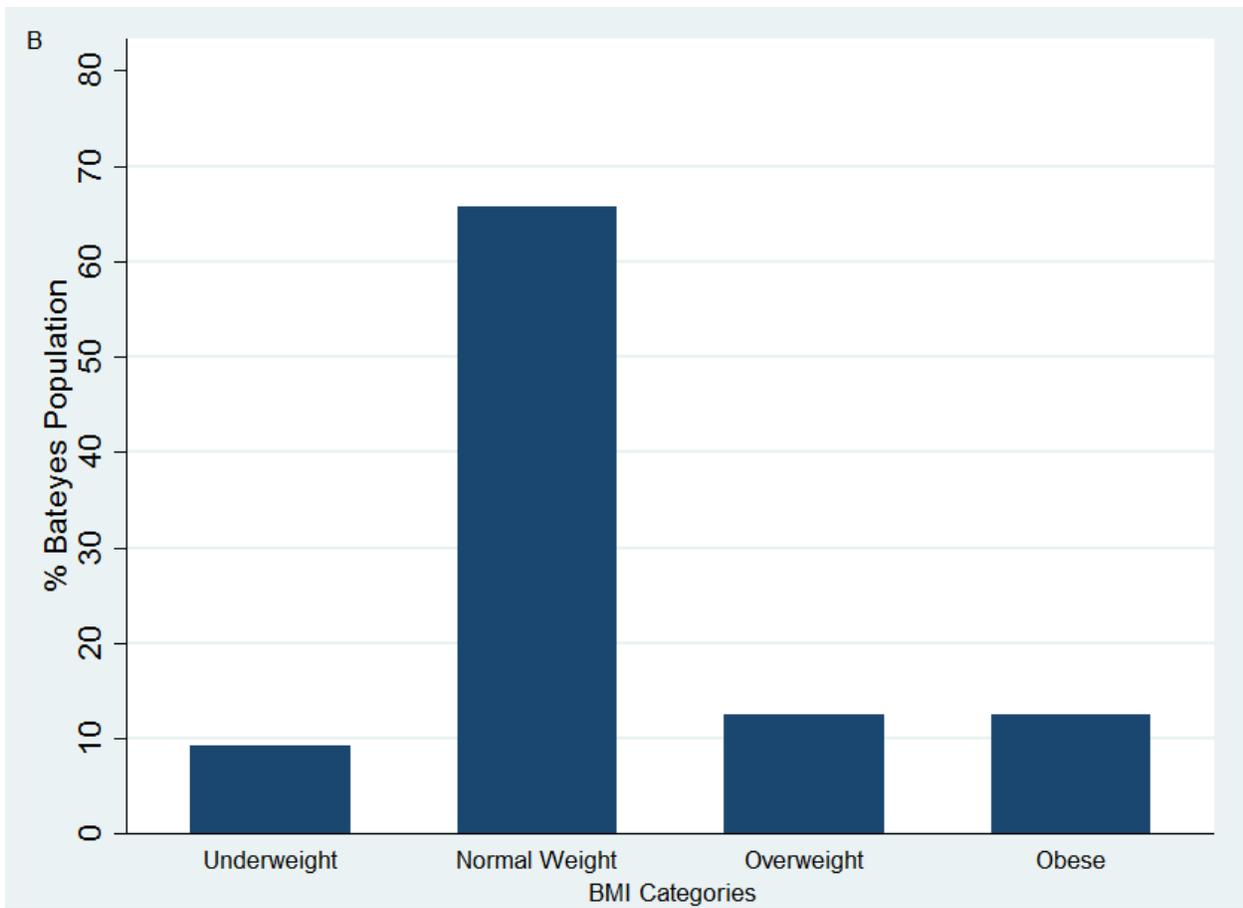


Figure 3: Percentage of underweight, normal weight, overweight, and obese patients in the bateyes *pediatric* (age < 18yo) population

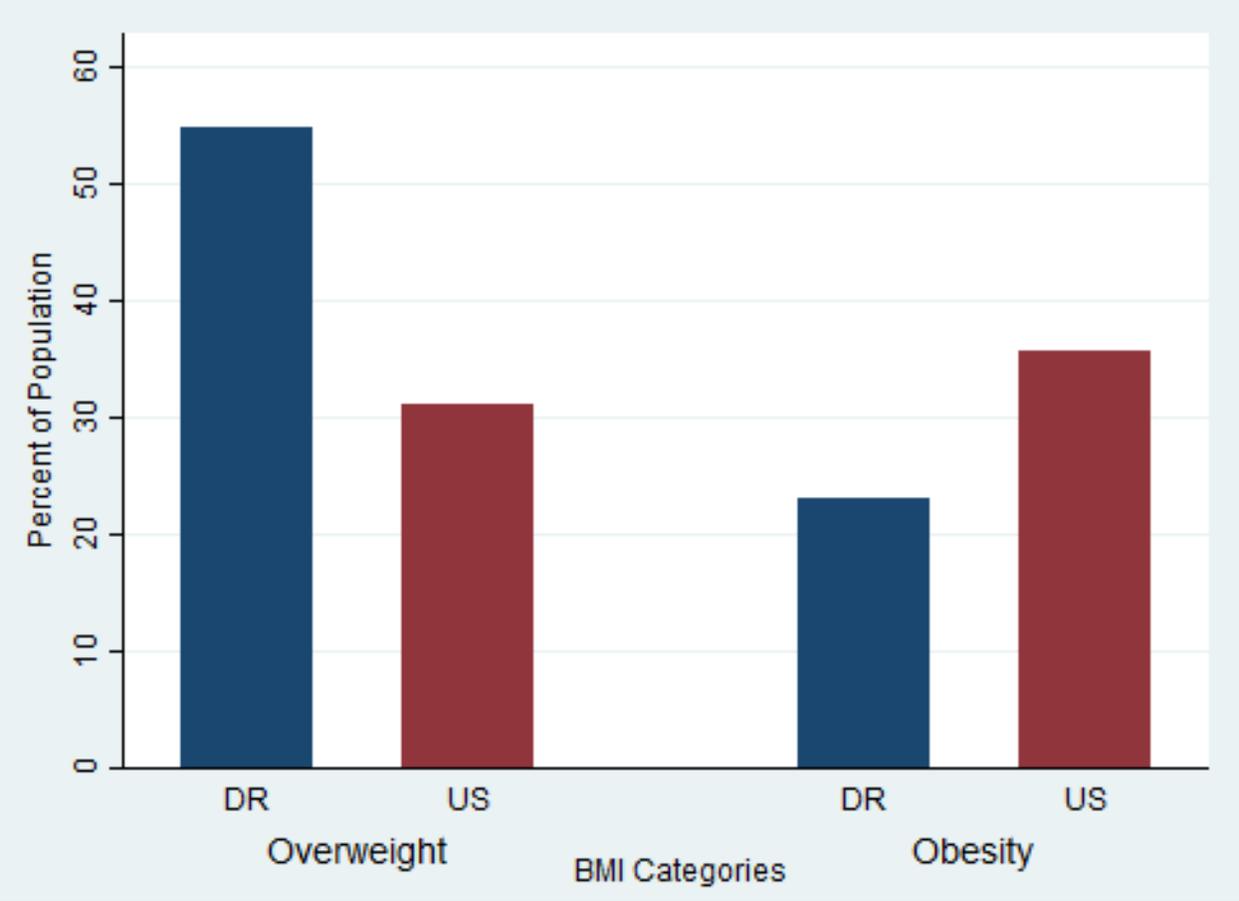


Figure 4: Percentage of DR population versus US population within the categories of overweight and obesity ^{1,2}

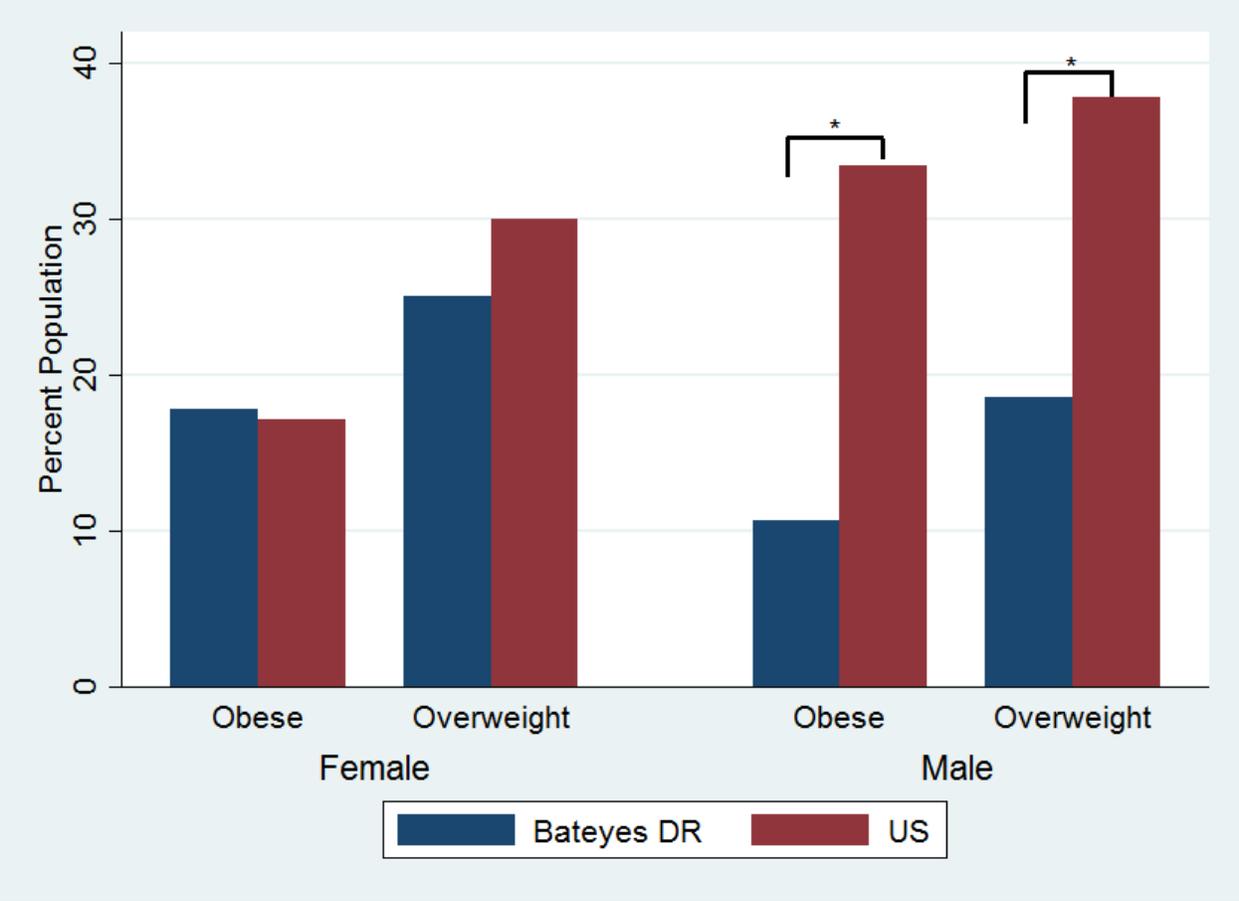


Figure 5: Difference in prevalence of obesity and overweight between men and women in the US versus men and women in the bateyes in the DR (* denotes statistical significance)

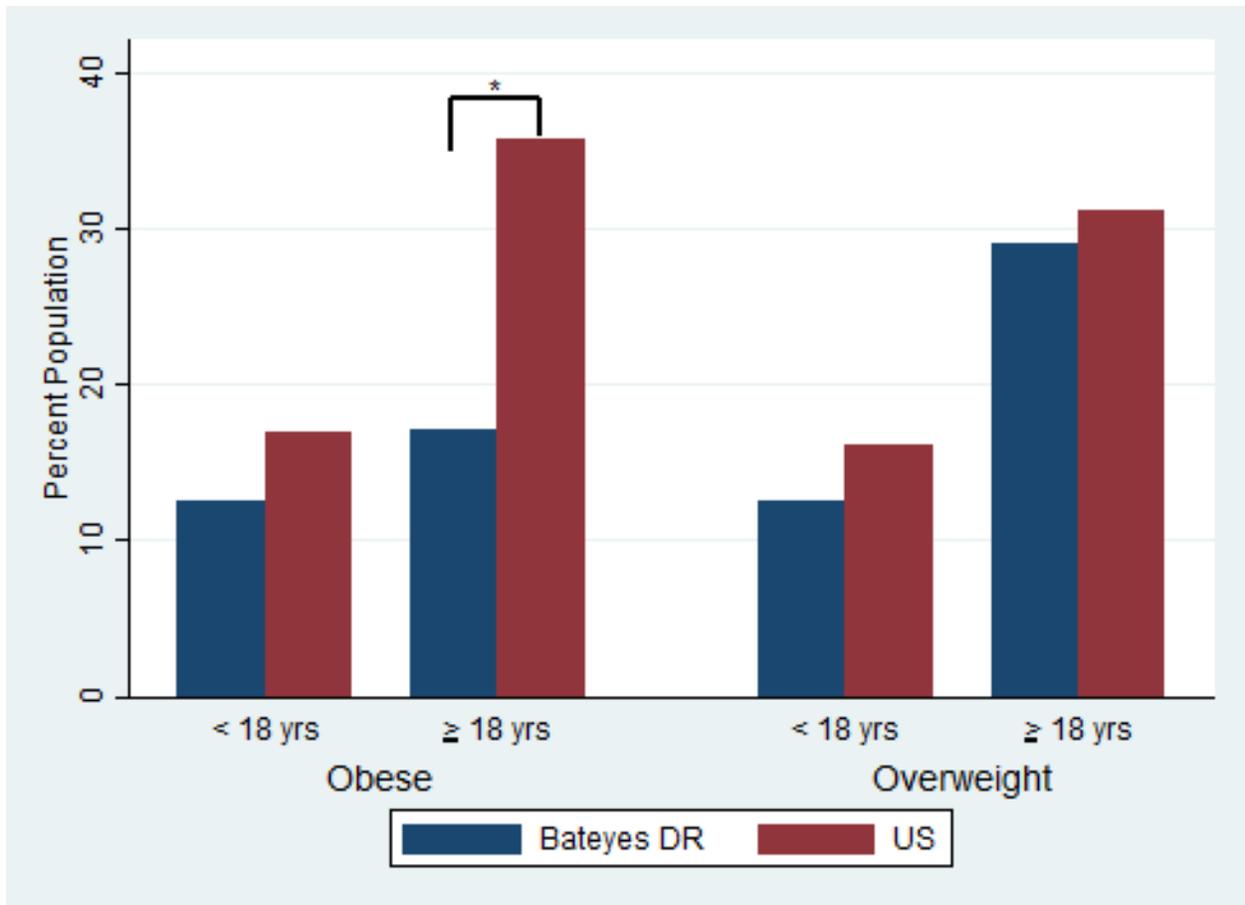


Figure 6: Difference in prevalence of obesity and overweight patients in US versus bateyes in the DR in the pediatric and adult population (* denotes statistical significance)

BMI	Classification
< 18.5	Underweight
18.5 - 24.9	Normal weight
25.0 - 29.9	Overweight
30.0 - 34.9	Class I obesity
35.0 - 39.9	Class II obesity
≥ 40.0	Class III obesity

Table 1: BMI categories ³

Weight Status Category	Percentile Range
Underweight	< 5th percentile
Normal or healthy weight	5th percentile - < 85th percentile
Overweight	85th percentile - < 95th percentile
Obese	≥ 95th percentile

Table 2: BMI percentiles for pediatric population ⁴

Discussion

Overweight and obesity are a worldwide problem. According to the WHO, they are linked to more deaths worldwide than underweight. In addition, there are more people who are obese than underweight in every region except for sub-Saharan Africa and Asia. The worldwide obesity rate has almost tripled since 1975 and the prevalence in children and adults continues to rise.¹⁶ Global Alliance for Improved Nutrition reported an increase in prevalence of overweight and obesity in males and females across all age groups in the Dominican Republic between 1980 and 2013.¹⁷ Other studies also revealed an increase in prevalence of obesity in children and adults across most Latin American countries in both rural and urban settings that mimics trends in the US and Europe.¹⁸ Although previous studies evaluated the obesity epidemic in Latin America, there have been no reported studies on our specific clinic population in the bateyes of San Pedro de Macorís.

The WHO believes that the rise in obesity is likely due to an increased intake of energy-dense foods high in fat combined with a decrease in energy expenditure because of less physical activity in daily life worldwide. The latter is most likely the result of increased urbanization that has led to an increased number of sedentary jobs along with people having access to multiple modes of transportation. In low to middle income countries, children are consuming more high fat, high sugar, high salt, energy dense, and micronutrient foods, which may be cheaper and more readily available, but provide little nutritional value. This is especially concerning in the pediatric population as studies have shown that most people develop their eating habits during childhood. Therefore early prevention at a young age is key to ensuring healthy lifelong eating habits.¹⁹ However, for populations that live in remote locations, regardless of financial status, it is difficult to make healthy food choices when limited varieties of foods are made available to you, like our bateyes population.

Our study suggests that there is not a statistically significant difference between the US and the DR clinic population when it comes to being overweight or obese in children and the adult female population. The lack of statistical significance demonstrates a minimal difference between the two countries, suggesting that the prevalence of being overweight in the DR is

similar to the US. In children specifically, there is a small statistically insignificant percentage difference between being overweight and obese as a child in the bateyes compared to US children. This contradicts what most may commonly believe, given that the US is a developed country with ready access to a variety of foods and the people of the bateyes lack access to enough food. In developed countries, overweight and obesity are a result of excess caloric intake due to an abundance of food availability. However the etiology of obesity in developing countries such as the Dominican Republic are usually not attributed to overnutrition, but rather the coexistence of undernutrition along with overweight and obesity.²⁰ This is referred to as the “double burden of malnutrition,” most commonly seen as undernutrition among children and overnutrition in adults.²¹ This phenomenon can be seen on an individual, household, and population level. For example, a person might be overweight but suffer from nutritional deficiencies due to a lack of intake of healthy, nutritional, quality foods. In addition, in one household, there may be a mother who is overweight and a child who is underweight. Treatment for all of these cases is simply providing a well-balanced nutritional diet to all members of a household and community along with increasing regular physical activity. This has proven to be quite difficult in remote area of the world with little access to nutritional choices.

After 18 years of age, the adults of the bateyes have a small 2% difference in prevalence of overweight when compared to the prevalence in the US. This increase in percentage of overweight adults compared to children could be due to metabolic changes as one ages, but also could be attributed to having access to only processed foods since childhood. Evidence has shown that undernutrition early in life, including in utero, may predispose children to obesity and noncommunicable chronic diseases like diabetes later in life. This relationship is important to understand because overweight mothers often have children who are overweight or obese.²² This is a difficult situation due to the remote location of the bateyes and a cost barrier as well as access to healthier food options. Trip participants observed community members often consuming readily available processed snacks and sodas at nearby convenience stores located in most bateyes. Fresh fruits and vegetables are not sold in the convenience stores and refrigeration is not an option for many since electricity is not readily available in this remote

area of the country. Finding solutions to these larger public health and infrastructure issues is much more difficult than one would think.

In addition, over the last several years, clinic physicians and students noticed an increased number of patients who were being diagnosed with obesity related illnesses such as hypertension and diabetes. The team even altered their medication supply and brought increased amounts of both antihypertensive and diabetic medications in order to treat a growing number of patients with these diseases. This led to a growing concern for continuation of care beyond the medical service trips from our team of healthcare providers. These patients with chronic medical conditions necessitating multiple medications at times, needed more frequent follow up than twice per year. Finding local clinics and providers to not only monitor these patients and their conditions but also provide medications to control the conditions, has proven to be very difficult in these remote villages. We have teamed up with local community providers to improve access to care but there is still a lot of work to be done to improve the care coordination.

Although major changes on a global and political front are required to tackle the worldwide obesity crisis, we have interventions that we hope to implement in our bateyes' population. We hope to provide education about healthy nutritional diets, proper portion control and exercise, in order to instill a healthy lifestyle throughout these villages. This will help to prevent the development of chronic conditions such as diabetes in a population that also has minimal access to healthcare. Given our population's remote location surrounded by farmland, teaching our patients how to grow their own food such as legumes, grains and vegetables, could help mitigate the lack of access to grocery stores and also introduce a skill that can be passed on to generations to come. Future attendees of the GHIG DR trips, will also continue to observe lifestyle factors that could increase the incidence of obesity within these villages and educate appropriately.

Limitations

We acknowledge the limitations of our study, including that it is a retrospective chart review with a small sample size. There was a large difference in rates of obesity and overweight among the male population in the bateyes and the US. This was likely due to a small sample size (n=72). A majority of our patients were females and children and we suspect that many of the male villagers are away from home and working during clinic hours. To mitigate this, we may want to provide after-hours clinics in the future in order to reach a larger male population and determine their health factors. In addition, we hope to continue adding to our database over time in order to trend our population's BMI. We also did not take any food surveys from our patients and relied on our own observations. Therefore, we could consider implementing surveys during our triage in order to get a more accurate representation of what our patients eat. Our small sample size may not reflect the population as a whole. It is possible we saw mostly sick patients who are overweight or obese and therefore have chronic diseases that needed treatment. We would need a larger sample size to account for the population as a whole. With time, we hope that more and more of the community members will come to our clinic, even if they are healthy. This will provide us with data that is more representative of the entire community.

Conclusions / Future Directions

We plan to create a program that teaches our patient population about the importance of physical activity and consuming healthy nutritional foods in preventing overweight and obesity. In addition, we will implement public health intervention strategies to inform our clinic population about the dangers of obesity, including heart disease, diabetes and stroke. Since our clinic population is primarily women and children, we hope to begin these programs during pregnancy and childhood to encourage lifelong, healthy eating habits from an early age in order to stop the growing trend of obesity. We also hope to implement education on how to garden and grow one's own vegetables, legumes, and grains so they do not have to rely on access to grocery stores.

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