The obesity gap: An investigation using the behavioral risk factor surveillance system data for Ohio

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Article Info	ABSTRACT
	This investigation examined potential predictors of obesity and whether an "obesity gap" is present for different demographic groups. The behavioral risk factor surveillance system (BRFSS) data was used for this investigation. This secondary data set provides self-reported and measured biometric information on residents from each state in the United State of America. Results indicated that different income level is not related to body mass index (BMI). However, BMI was significantly different if the individual had a previous diagnosis of diabetes. BMI was also found to be significantly different for different races, as well as the interaction between race and diabetes are associated with BMI.

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1. INTRODUCTION

Some research has concluded that the increases in BMI are occurring more in Black populations than in other groups [1]. Conway *et al*. examined data from the Southern Community Cohort Study of more than 38,000 individuals across a seven-year period. Their findings suggest that the incidence of diabetes and obesity is higher for Black community members relative to White community members after the initial baseline data collection. These morbidities were found more prevalent with low income persons and individuals with lower educational levels. Conway *et al*.'s results suggest that the indicators of who was diagnosed with diabetes and obesity were more pronounced for Black community members than they are for White community members.

Krueger [2] suggest that these disparities in obesity and the morbidities associated with obesity include biological factors, behavioral factors, and environmental factors. Their review of the extant literature identifies issues such as sleep deprivation, poor diets, and lack of physical activity, social networks, and neighborhood settings as all contributing to the obesity epidemic. Krueger *et al.* noted that existing research has suggested that living in a more affluent community can lower the likelihood of suffering from diabetes or obesity. And, individuals with more income have nutrition, medical care, gym access, and counseling resources that can help them to avoid becoming or remaining obese.

The research is somewhat mixed on whether obesity is an issue of race or income. Link [3] conducted a community-based epidemiological survey of a diverse area of Boston that included relatively equal numbers of Black, Hispanic, and White individuals. They examined several variables, including age, gender, socio-economic status (SES), obesity, high blood pressure, physical activity, health insurance status,

and family history of morbidities. They concluded that when you consider all the potential indicators, income level was more predictive of obesity and diabetes than race.

Obesity is an increasingly common problem with serious and costly consequences [4-10]. The obesity trends are consistent throughout the United States and other countries and are associated with a number of morbidities [11-25]. Understanding if obesity is more associated with race, SES, and morbidities such as diabetes, in the State of Ohio, can provide information needed to support effective public service campaigns. That is the objective of this investigation.

2. RESEARCH METHOD

Participant Population: The current investigation used data from the 2016 Behavioral Risk Factor Surveillance System. The BRFFS is a survey that is conducted by each state in the United States. The survey administration is supported by the centers for disease control and prevention (CDC). The BRFFS is administered to adults to understand the current health and behaviors of each state's population. The BRFSS data is weighted so that it is more representative of the families and household in each state. The guidelines for the BRFSS and the data are publicly available. The specific data being used for the current investigation focuses on folks with diabetes. However, if the participant indicated that they were currently pregnant, the data was excluded from the analysis to avoid the confounding impact of gestational diabetes.

Study Measures: The primary variables of interest are body-mass index (BMI), level of income, race (based on a five-category indicator), and diabetes diagnosis. BMI was a computed value in the available data. Level of income was based on the following categories: <15K, 15-25K, 25-35K, 35-50K, and more than 50K. Race was indicated accordingly: 1=White, Non-Hispanic, 2=Black, Non-Hispanic, 3=Other, Non-Hispanic, 4=Multiracial, Non-Hispanic, and 5=Hispanic. Lastly, the Diabetes diagnosis variable is based on a 1=Yes, and 0=No response. All other levels of response (e.g., I don't know) were not included in the analyses. If a participant indicated that they were currently pregnant, their data was not included in the analyses. If a participant indicated that they were diagnosed with diabetes while pregnant, their data was not included in the analyses. These analysis parameters resulted in a final sample size of n=1154.

Data Analysis: The basic descriptive statistics are computed for BMI. Frequencies and percentages are presented for race, income, and diabetes diagnosis. A correlational analysis is conducted to assess the variables' relationship to BMI. A 2X5X5 factorial analysis of variance is computed to assess if differences in BMI is found for different levels of income, different race, and whether a person has previously diagnosed with diabetes. Data analyses were conducted without additional weighting of the data.

3. RESULTS AND DISCUSSION

Sample characteristics: Characteristics of the sample are summarized in Tables 1 and 2. As indicated in Table 1, White people represent 89% of the sample, followed by 6% Black individuals. Less than 20% of participants indicated that they have received a diagnosis of diabetes (n=1491). The sample data suggests that most individuals fall into the $50K or more income range (42%) followed by the $15K-25K income range (20%).

Table 1. Diabetes diagnosis by race and income level

Race	Diabetes	
	Yes	No
White	1305	6205
Black	108	425
Other, Non-Hispanic	28	147
Multiracial, Non-Hispanic	24	68
Hispanic	26	105
Income		
<15K	223	590
15-25K	392	1265
25-35K	220	865
35-50K	230	1075
50K or more	426	3129

As indicated in Table 2, the greatest representation of Black participants are represented in the $15-25K or more income level (24.4%), White participants are most represented in the $50K or more income level (44%) followed by the $15K-25K income level (19%). A Zero order correlation was computed between BMI, diabetes diagnosis, race, and income. The results of this analysis are presented in Table 3.

Table 2. Race by income level

Race	<15K	15-25K	25-35K	35-50K	50K or more
White	723	1542	1009	1247	3501
Black	121	141	93	97	127
Other, Non-Hispanic	25	41	19	21	83
Multiracial, Non-Hispanic	12	30	14	13	30
Hispanic	15	33	21	12	38

Table 3. Correlation between BMI, race, and income

Variable	BMI	Diabetes diagnosis	Race/ethnicity
Diabetes diagnosis	-.28**		
Race/ethnicity	0.02	-.03**	
Income categories	-.07**	.14**	-.09**

Note: ** indicates $p < .01$, * indicates $p < .05$. BMI and Diabetes based on Pearson's
Correlation: Analysis with Race and Income based on Spearman's correlation.

As indicated above, there is a significant relationship between BMI and diabetes diagnosis for this sample of data. Additionally, there is a small negative significant correlation between BMI and income category and a significant correlation between race/ethnicity and diabetes diagnosis. The Factorial Analysis of Variance analyses was conducted to examine if the sample of BRFSS data from Ohio demonstrated different levels of race, income, or a diagnosis of diabetes were associated with the individuals BMI. The results of the factorial analyses suggest that there is a significant interaction between race, income and diagnosis of diabetes, $F(16.8415)=2.31$, $p=0.002$ The results of this tests of between subjects effects analyses are presented in Table 4.

Table 4. Between subjects effects estimates

Source	Type III Sum of squares	df	Mean square	F	Sig.
Corrected Model	33354.10	49.00	680.70	17.77	0.000
Intercept	422143.84	1.00	422143.84	11021.77	0.000
Income	163.85	4.00	40.96	1.07	0.370
Race	190.31	4.00	47.58	1.24	0.291
Diabetes	1529.26	1.00	1529.26	39.93	0.000
Income * Race	1003.26	16.00	62.70	1.64	0.052
Income * Diabetes	343.64	4.00	85.91	2.24	0.062
Race * Diabetes	352.48	4.00	88.12	2.30	0.056
Income * Race * Diabetes	1417.22	16.00	88.58	2.31	0.002

Note: R Squared=0.089. Bolded items present statistically significant results at the $\alpha=p<0.05$

The Post Hoc analyses indicates that BMI differences on race are revealed between Black and other, Non-Hispanics (MD=1.51 difference in BMI), followed by difference between Black and White (MD=0.51 difference in BMI). The Average BMI for the White, Black, and other individuals with diagnosis of diabetes is presented in Table 5.

Table 5. Average BMI of those with diabetes diagnosis

	White	Black	Other
<15K	35.1	34.0	39.8
15-25K	32.7	33.4	26.0
25-35K	32.8	32.3	29.7
35-50K	31.6	31.4	32.2
50K or more	32.4	30.6	25.2

As indicated above, Black individuals are likely to be diagnosed with diabetes at lower average BMI. This trend increases as the income level of the Black individuals increases. A graphical representation of the interaction between race and diabetes diagnosis on BMI is presented in Figure 1.

The results of the current investigation provide some insight into the relationship between BMI, a diabetes diagnosis, income level, and race for the individuals included in the provided data set. Similar to previous research, these results suggest that there are significant differences in BMI across different races, and significant differences in BMI based on a prior diagnosis of diabetes [1-3, 15, 26]. However, results did

not support a finding of significant differences in BMI across different income levels [3]. Results indicate that Black participant with a prior diabetes diagnosis have the highest average BMI, whereas the White and Hispanic participants with a prior diabetes diagnosis have the lowest average BMIs. These results are preliminary and based on a limited subset of data for the State of Ohio. Additionally, the data was analyzed without applying weighting.
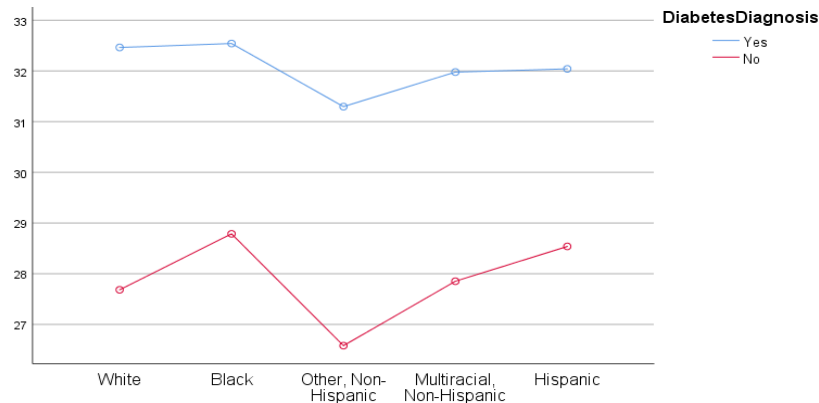

Figure 1. Race and diabetes levels on average BMI

Helping the Black community to avoid obesity and diabetes will require a multi-level intervention plan that focuses on awareness, adaption, and availability. Psycho education of the Black community is necessary in order to prevent obesity and diabetes. Blacks need information on basic nutrition topics such as servicing sizes and reading food labels; how to choose a diet that is low in total fat, saturated fat, and cholesterol; how to choose beverages and foods low in sugar; how to prepare foods with less salt, eat a variety of grains daily; and eat a variety of fruits and vegetables daily [27]. Health care professionals also need to be aware that obesity is highly comorbid, particularly for Black women, and the other effects of obesity and diabetes on the health of Blacks. Stress and negative life events experienced due to a shared sociocultural group status, as well as cultural beliefs and values may be important in understanding and treating Blacks [28]. Health Care Professions can use the information about their current clients who are being treated for obesity and diabetes to identify segments of the population and community that should be targeted for educational programs and health promotion channels to reach the target group [27].

Health Care Professionals must become aware of interventions that are adaptable to Blacks. Culturally adapted interventions are an important way to acknowledge sociocultural factors and produce expected outcomes within a specific group [28]. An example of an empowering and effective culturally adapted intervention program is B'more Healthy Communities for Kids (BHCK). The B'more Healthy Communities for Kids (BHCK) trial is a multi-level child obesity prevention intervention, supported as part of an U54 grant to the Johns Hopkins Bloomberg School of Public Health to fund the Johns Hopkins Global Obesity Prevention Center. The BHCK intervention is guided by social cognitive theory (SCT), social ecology, and systems theory This intervention prevents childhood obesity by working at multiple levels of the food and social environments to increase access to, demand for, and consumption of healthier foods. BHCK works to create systems-level change by partnering with city policymakers, multiple levels of the food environment (wholesalers, corner stores, carryout restaurants), and the social environment (peers and families). In addition, extensive evaluation will be conducted at each level of the intervention to assess intervention effectiveness via both process and impact measures [29]. In developing awareness, African-American populations may be more comfortable discussing sensitive topics as cultural congruence with other African- Americans [30].

This final intervention to prevent obesity and diabetes within the Black population will include working at multiple levels of the food and social environments to increase access to, demand for, and consumption of healthier foods [15, 18-29]. Increasing the access Blacks have to supermarkets can improve diet quality, fat intake, fruit and vegetable consumption, and decrease the disparities in obesity rates among groups [29]. Store owners in Black communities also need to be aware and educated on how to make foods available to decrease the impact of diabetes and obesity within the Black community. A program like BHCK, begins with a series of storeowner trainings which aim to improve their knowledge of healthier food options

and self-efficacy to be able to stock, prepare and sell their foods is needed to address change at the small food source level.

4. CONCLUSION

Consistent with the extant research, finding that there is a relationship between BMI, diabetes and race. The investigation did not find a significant difference across income level. This is likely due the fact that the available data included a balance of individuals from all economic levels, as indicated in Table 5. The results of this investigation suggest that those in the caring professions have a duty to help individuals from the Black community understand the role of nutrition and exercise in avoiding obesity and subsequently diabetes. Public health programs and medical support can help to ameliorate the impact of obesity and diabetes, with focus on stress reduction, good nutrition, exercise, and community support. To become part of the solution for reducing obesity and diabetes, multi-level, multi-component interventions are needed due to the multi-factorial nature of obesity, and its proven links to both the social and built environment. While obesity is a real problem in the United States, reducing the obesity and diabetes prevalence in the Black community will improve the overall quality of life for those communities.

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