

A Web-Based Nutrition Education Study in Alabama Black-Belt Counties During the Covid-19 Pandemic

Tumwebaze J¹, Benjamin ACB², Dawkins NL²

¹Research and Development Corporation, West Virginia State University, Institute, WV, USA

²Department of Food and Nutritional Sciences, Tuskegee Institute, AL, USA

*Corresponding author: Tumwebaze J, Research and Development Corporation, West Virginia State University, Institute, 117 Integrated Research and Extension Building, WV 25112, USA. Tel: 3345249322, Email: joel.tumwebaze@wvstateu.edu

Citation: Tumwebaze J, Benjamin ACB, Dawkins NL (2022) A Web-Based Nutrition Education Study in Alabama Black-Belt Counties During the Covid-19 Pandemic. J Nutr Health Sci 9(1): 103

Abstract

Overweight and obesity continue to be health-related issues in Alabama Black-Belt Counties with rates ranging from 35 to 48%. We aimed to determine the impact of a web-based nutrition education and physical activity intervention on participants' health in Alabama Black Belt counties during the COVID-19 pandemic. Nutrition education was delivered to participants through a zoom online platform for 12 weeks. Participants' knowledge, attitudes, and practices as well as changes in nutrition knowledge, anthropometry, and blood pressure were determined through online surveys. Of the participants, (100%) indicated that overweight and obesity are a result of unhealthy lifestyles, whereas 90.7% reported that obesity increased the risk of high blood pressure (90.7%), diabetes (86.04%), and heart disease (90.7%). Results showed that participants' income was a significant determinant of their perception for the role of schools in fighting obesity ($\chi^2=0.04$). Similarly, data revealed that the age of participants was a significant factor for: their desire to learn more about obesity ($\chi^2=0.04$), perception of their knowledge of overweight and obesity compared to the average person ($\chi^2=0.01$), and the perception that they had an excellent knowledge of overweight and obesity ($\chi^2=0.05$). There were significant improvements in knowledge scores. Results showed a significant decline in waist circumference ($p<0.001$) and hip circumference ($p<0.02$); 60% of the participants showed a decline in bodyweight; 43% lost more than 1-5kg, while 9.8% maintained their baseline weight. Web-based virtual interactions may effectively substitute or complement face-face nutrition education and lead to a reduction of overweight and obesity in Alabama Black-Belt counties.

Keywords: Web-based, Black-Belt, Obesity, Anthropometry

Introduction

For decades distance education has been a choice for various knowledge exchange programs where students and lecturers interact in different physical locations using a variety of technologies [1-5]. At present, there is an increased demand for online education especially among older employed individuals who take advantage of its flexibility in schedule and location [6-8]. The need for online education became more pronounced in 2020 when the CDC instituted recommendations such as physical distancing, a limit to indoor space occupation, and quarantine of exposed persons as a countermeasure to the spread of COVID-19 [9]. To further reduce the spread of the COVID-19 disease, some U.S. States including Alabama, instituted home confinement and avoidance of social gatherings in addition to the CDC recommendations [10].

Researchers have reported that home confinement increases sedentary behaviors that are characterized by very low energy expending activities mainly performed in a sitting position [11-13]. Additionally, home confinement could lead to irregular eating patterns and frequent snacking - both of which are associated with higher caloric intake and an increased risk of obesity [14]. The increase in obesity is of public importance especially among African Americans in the Alabama Black Belt, where the average rate of obesity is higher than that of the U.S. adult population [15,16]. Counties in Alabama Black-Belt have among the highest rates of obesity in the nation ranging from 36% in Choctaw to 48.5% in Bullock [16].

A body of evidence links obesity to chronic diseases such as hypertension, diabetes, stroke, certain types of cancer, and cardiovascular disease – conditions that are the leading causes of death and that disproportionately affect African Americans [17-19]. These obesity-related chronic conditions may increase due to increased sedentary lifestyles during the COVID-19 pandemic [20-22]. The challenge existed to avoid excessive weight gain during the COVID-19 stay-at-home ordinance instituted by the CDC in early 2020. On a positive side, researchers have reported that the COVID-19 pandemic presents an opportunity to tackle unhealthy lifestyles associated with increased obesity [23].

However, there is scarcity of studies that aim to reduce the likely increase in obesity in Alabama Black-Belt counties during the COVID-19 pandemic. We aimed to determine the impact of a web-based nutrition education and physical activity intervention on weight, Body Mass Index (BMI), waist and hip circumference, blood pressure, and nutrition knowledge in Alabama Black-Belt counties during the COVID-19 pandemic. We hypothesized that web-based nutrition education would lead to improved nutrition knowledge and improvement in health parameters among participants in the Alabama Black-Belt counties.

Materials and Methods

Study Design

The study was approved by the Institutional Review Board of Tuskegee University for compliance to use human subjects. All residents of Alabama Black-Belt counties between the ages of 18 and 65 years-old and with access to internet were eligible participants. The snowball sampling technique was used to recruit participants because human interaction was not possible due to home confinement. During the snowball sampling, a recruited participant gave researchers a name of at least one potential participant, who in turn, provided a name of at least one more potential participant until the required sample size was obtained [24]. A recruitment form was designed using Google docs and emailed to prospective participants to capture their demographic information. Eligible participants included those that resided in Alabama Black-Belt counties, aged between the 18 and 65 years, and had a computer, tablet, or smartphone with internet access. Eligible participants who submitted the online recruitment form were emailed another Google docs weblink to a consent form which included the description of the study and seeking willingness to participate in the study. Participants consented by electronically signing and submitting the consent form to the researchers.

Survey Questionnaire

We developed a knowledge, attitudes, and perceptions (KAP) questionnaire using literature on obesity and lifestyles of African Americans in the Alabama Black-Belt region. The KAP survey was uploaded onto the Google docs web-based platform and the weblink to the survey was emailed to the consented participants. Participants completed the KAP survey and submitted it to researchers using a button at the end of the survey. Responses from the KAP survey were used to design nutrition education lessons.

Nutrition Education and Physical Activity

Nutrition education lessons were delivered to the participants through the Zoom teleconferencing platform twice a week for 12 weeks. The content for the lessons was based on existing literature and from KAP survey responses. The lessons were aimed at increasing participants nutrition and physical activity knowledge. Nutrition education topics included a basic understanding of the transtheoretical model of change, food components (proteins, fat, carbohydrates, vitamins, minerals, dietary fiber, and energy), food choices, physical activity (benefits and types), fruits and vegetables, influence of media on food choices, and meal planning options. In the first and 12th week of the nutrition education sessions, participants were emailed a weblink to nutrition knowledge questions formulated by researchers from the contents of nutrition education lessons. Through the questions, researchers sought to assess participants knowledge gain from the nutrition education lessons presented.

After the physical activity lesson, participants were advised to do physical exercises in their community following COVID-19 social distancing guidelines by the CDC. Content for the physical activity lesson was derived from the physical activity guidelines for Americans with a recommendation of moderate-intense activities lasting 25 to 30 minutes per day [25,26]. The physical activities were aimed at supplementing lessons on diet to help participants attain a normal BMI and blood pressure measurements.

Anthropometry

All participants who consented to the study were mailed a kit containing a blood pressure monitor, a digital weight scale, and a body tape measure for use in anthropometry and blood pressure measurements. In the opening session, participants were briefed on the use of the kit to monitor their health in accordance with the procedural manual of the National Health and Nutritional Survey [27]. Participants were advised to take all measurements in duplicate and with help from family members. They were instructed to take measurement at baseline, midpoint and again at the end of the 12th week; and to report the values using a Google form accessed through a weblink emailed by the researchers. The body mass index (BMI, in kg/m²) for each participant was calculated as a ratio of their weight in kilograms to their height in square meters. Values were exported into excel for analysis.

Statistical Analysis

All data including KAP surveys, anthropometry, blood pressure, and nutrition education were exported from Google docs into excel and later analyzed using Statistical Package for Social Scientists version 25. Results were reported as p-values and as descriptive statistics of mean, percentages, and standard deviations. Categorical data was cross tabulated and reported as Chi-square statistics.

Results

Demographics

A total of 117 participants registered for the study, 96 of whom were from 14 Alabama Black-Belt counties, Figure 1. Surveys from the non-Alabama Black-Belt county participants were excluded from the results. The highest number of participants resided in Macon (n=25), Montgomery (n=19), Bullock (n=15), and Dallas (n=14) counties. The participants consisted of 76% female, 24%

male. The age classification of participants was 18-34 years (19%), 35-54 years (42%), and 55+ (40%). The highest number of participants were within the income category of \$20,000 to \$40,000 (51%), followed by \$41,000 to \$70,000 (28%), and over \$70,000 income category (10.3%).

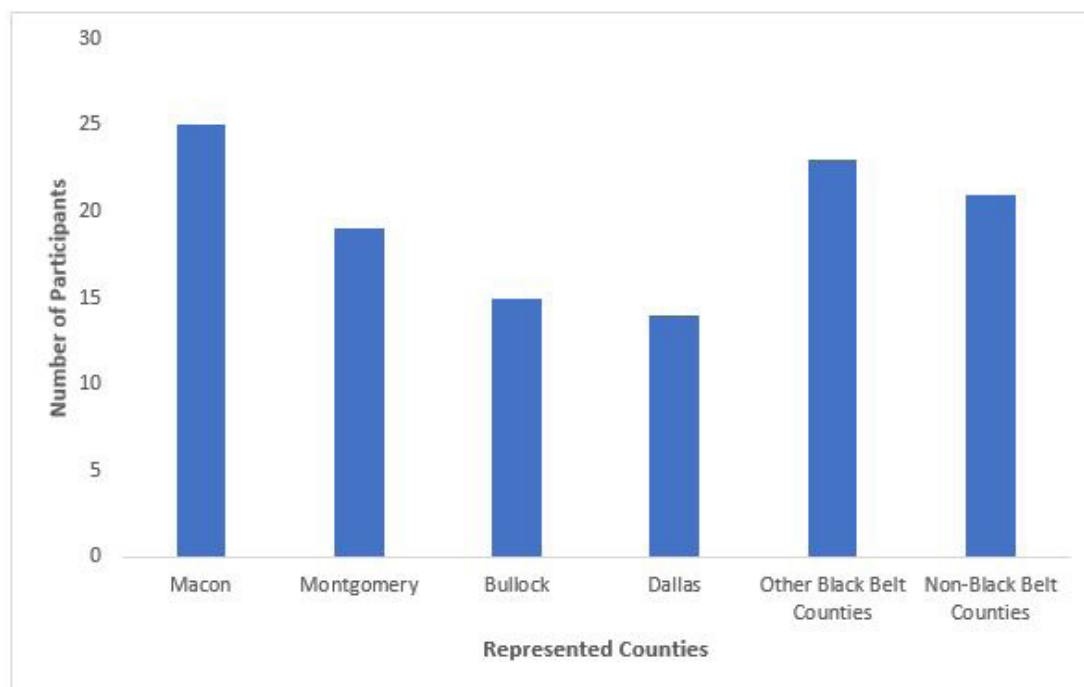


Figure 1: County representation of participants in the web-based nutrition education study, Alabama 2020.

Surveys

All the 96 surveyed participants were aware that obesity is at epidemic levels; and is impacted by consumption of excessive calorie dense foods; is determined by what we eat; and is a potential health problem. For other questions, participants agreed with several widely known facts about obesity and its related consequences with values of over 90% (Table 1).

Question	Frequency (%)	
	True	False
Overweight and obesity are reaching epidemic levels	100	-
Overweight and obesity are due to excessive calorie consumption	100	-
Moderate exercise 5 or more times a week can lead to substantial weight loss	89.7	10.3
Low carbohydrate diets and weight loss pills are the fastest way to lose weight	33.3	66.7
Understanding what and why you eat is a major factor for implementing weight control	100	-
Snacking before bedtime is a good weight management strategy	7.9	92.1
It is easier to lose weight when overweight than when morbidly obese	53.8	46.2
Are you aware of the increase in type two diabetes among obese children and adolescents?	92.3	7.7
Do you feel that overweight and obesity are potential health problems	100	-
The CDC estimates that about 6 in 10 Americans are overweight or obese. Would you say that your observation of society reflects this?	92.3	7.7

Table 1: Participants' Responses to the KAP Survey Questionnaire (n=96)

Selected sociodemographic characteristics were cross tabulated with participants' perceptions about overweight and obesity (Table 2). Chi-square results showed significant differences in responses based on age of participants for these statements: I would like to learn more about obesity ($\chi^2 = 0.04$), I know more about obesity than the average person ($\chi^2 = 0.01$), and I have an excellent knowledge of overweight and obesity ($\chi^2 = 0.05$). Crosstabulations of other sociodemographic characteristics with responses to obesity related statements showed no significant differences.

Statement	Chi Square (χ^2) values		
	Education level	Age category	Income level
I would like to learn more about obesity	0.15	0.04*	0.86
I know more than an average person about overweight and obesity	0.5	0.01*	0.97
I have an excellent knowledge of overweight and obesity	0.15	0.05*	0.15
I know a lot about overweight and obesity, but it is not a concern to me	0.33	0.36	0.91

*Values were significantly differently at $p < 0.05$.

Table 2: Crosstabulation of Participants' Response to KAP Questions and their Social Demographic Characteristics (n=96).

Participants' opinions of the roles played by various community stakeholders to fight obesity were cross tabulated with their sociodemographic characteristics, Table 3. The opinion of the participants for the role played by schools in fighting obesity varied significantly based on their income ($\chi^2=0.04$). There were no significant differences for all other crosstabulations for the role played to fight obesity. Similarly, the participants degree of support for obesity prevention policies were cross tabulated with their sociodemographic characteristics (Table 3 and Figure 2). Results showed that the support for more physical activity significantly differed by income level of participants ($\chi^2=0.04$). In a similar way, the support for increasing parents' nutrition education significantly differed based on age category ($\chi^2=0.02$), Table 3.

Question	Chi Square (χ^2) values		
	Age category	Education level	Income level
Role played to fight obesity:			
Government	0.76	0.54	0.17
Employers	0.66	0.61	0.17
Schools	0.62	0.63	0.04*
Healthcare providers	0.16	0.79	0.78
Support for obesity prevention policies:			
Ban unhealthy snacks from school vending machines	0.24	0.67	0.82
Limit tv ads of unhealthy food	0.20	0.27	0.79
Provide healthier school lunches	0.44	0.37	0.23
More physical activity in school curriculum	0.15	0.40	0.04*
Increase parents' nutrition education	0.02*	0.37	0.06

Table 3: Cross Tabulation of Participants' Opinions and their Sociodemographic Characteristics (n=96) s

However, Majority of participants strongly supported the ban of unhealthy snacks from school vending machines regardless of age category, education level, income category. This trend was similar for the support for the limit to television ads of unhealthy foods targeted at children (Figure 2).

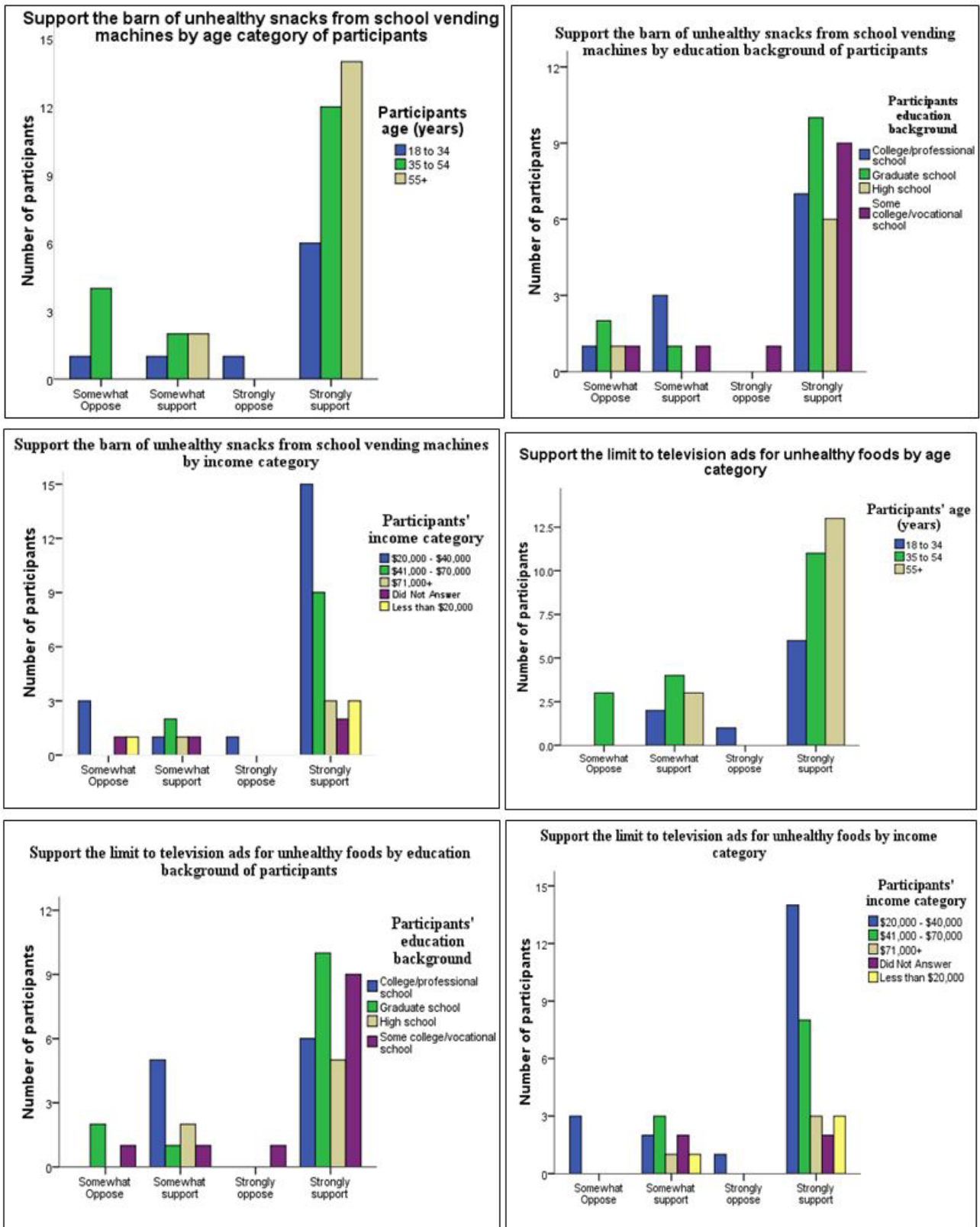


Figure 2: Participants’ support for strategies to fight obesity in Alabama Black-Belt counties.

Nutrition Education

There was a significant increase in mean knowledge scores from 51.1 ± 20.8 at baseline to 79.8 ± 10.4 at post study, Table 4. There were significant differences in baseline and poststudy scores for all questions except for questions 13, 15, and 18, where participants already had high scores at baseline.

	Question	Baseline	Poststudy	Pa
	Mean knowledge scores	51.1±20.8	79.8±10.4	<0.001
1	Nutrient that provides the most calories per gram.	25 (54.3)	37 (80.4)	<0.05
2	Proteins are found in both plant and animal foods.	10 (21.7)	35 (76.1)	<0.001
3	What foods contain the highest amount of saturated fat per gram?	20 (43.5)	34 (73.9)	<0.05
4	Fruits and vegetables should make up one fourth of your plate.	18 (39.1)	32 (69.6)	<0.05
5	Which of these foods provides complete proteins?	25 (54.3)	39 (84.8)	<0.04
6	Which of the following is a screening tool for overweight and obesity?	19 (41.3)	39 (84.8)	<0.001
7	Which of these methods can be used to determine the body mass index?	23 (50.0)	37 (80.4)	<0.05
8	Which of the following is a medical complication of obesity?	23 (50.0)	40 (87.0)	<0.01
9	Store brand foods contain more sodium per serving than name brands?	24 (52.2)	32 (69.6)	<0.05
10	Which of these is a way of saving more money at the store during shopping?	25 (54.3)	38 (82.6)	<0.04
11	Which type of milk contains the least amount of fat per gram?	21 (45.7)	34 (73.9)	<0.05
12	Canned fruits may contain as much nutrients as fresh fruits.	15 (32.6)	37 (80.4)	<0.001
13	In-season produce is usually cheaper than out-of-season produce.	38 (82.6)	40 (87.0)	<0.61
14	What is the main reason peanut butter should be eaten with bread?	18 (39.1)	40 (87.0)	<0.001
15	Which vitamin is required for good night vision?	38 (82.6)	44 (95.6)	<0.61
16	If an apple is equal to one fruit serving, how many servings will half an apple have?	12 (26.1)	32 (69.6)	<0.02
17	Which body mass index is considered normal?	33 (71.7)	41 (89.1)	<0.06
18	Which of the following foods will lead to a quick spike in blood glucose when eaten?	41 (89.1)	44 (95.6)	<0.66
19	Which of the following groups of people requires more protein?	28 (60.9)	40 (87.0)	<0.04

Table 4: Participants' Response to Nutrition Education Questions (n=46)

Anthropometry

Complete anthropometry data was obtained from 46 participants after cleaning for incompleteness, participant errors, and inaccuracy, Table 5. Even though the loss in weight was not significant after 12 weeks ($p=0.27$), 60% of the participants showed a decline in bodyweight; 43% lost more than 1-5 kg while 10% maintained their baseline weight. No significant changes in body mass index were observed ($p=0.24$). At post study there was a significant decline in waist circumference ($p=0.001$) and hip circumference ($p=0.02$). We observed non-significant increase in systolic and diastolic blood pressure.

Characteristic	Baseline	Post-study	p-value
Weight (kg)	94.3±27.9	92.8±25.8	0.27
Waist circumference (cm)	103.09±18.5	99.0±19.0	0.01
Hip circumference (cm)	112.9±18.7	109.7±19.8	0.02
BMI (kg/m ²)	33.3±9.2	32.7±8.7	0.24
Systolic BP (mmHg)	124.7±17.4	124.9±18.2	0.92
Diastolic BP (mmHg)	75.8±9.0	76.3±9.2	0.69

$p<0.05$

Table 5: Anthropometry and Blood Pressure Values of Participants (n=46).

Discussion

Surveys

Participants correct responses were in agreement with existing literature. For example, all participants responded that obesity is reaching epidemic levels, is due to excessive calorie consumption, and presents potential health problems. The later statements agree with other researchers who emphasized the causes, consequences, and severity of obesity [15,28,29]. Additionally, participants' responses showed an understanding of weight management knowledge such as having regular physical activity routines, avoidance of snacking before bedtime, and that weight management requires an understanding of one's diet. Similar weight control strategies have been associated with reduced body mass index [30-33].

Despite the displayed understanding of obesity and weight control strategies among participants in our study, the rate of overweight and obesity and related comorbidities in Alabama Black-Belt communities is among the highest in the nation [15]. Through cross-sectional surveys, researchers have reported increased sedentary lifestyle, increased snacking, and self-reported increase in obesity in different parts of the world during the COVID-19 pandemic [20,23,34,35]. As such, our program was necessary to deliver weight management and nutrition education lessons in the Alabama Black-Belt communities where residents are at a high risk of obesity and genetically predisposed to related chronic health conditions.

Although results from our study showed that participants were knowledgeable about obesity and its related comorbidities, knowledge may not be translated into behavior change – which may be the reason for the observed increase in obesity in Black-Belt counties over the years [15]. An important component of the education intervention was to bring awareness through the Transtheoretical Model (TTM) of the stages of change, thus allowing the participants to understand that change is difficult but can be achieved. Previous studies that included the TTM showed positive changes in eating behavior, physical activity, and alcohol intake [36,37].

Nutrition Education and Anthropometry

Positive outcomes were observed from the nutrition education lessons where values were significant for most lessons. Other researchers have explained that positive nutrition education outcomes were more probable when the messages were simple, practical, and when they targeted specific needs [38-40]. It can thus be inferred that participants in our study gained knowledge because the lessons were appropriate and mostly targeted the reduction of obesity and maintenance of weight. Additionally, a review of literature on success of nutrition education lessons concluded that motivation was key to retention of knowledge. For our study, survey results showed that participants understood their health issues and a need to make changes for positive health outcomes. This understanding and need could have been the motivation for participant enrollment and study completion.

Another motivation that could have driven positive nutrition education outcomes may be that most participants were aged between 35 and 54 years. This is the age range where chronic health conditions begin to manifest, and participants would be compelled to gain a better understanding and possible solutions to their health concerns. Other researchers explained that middle aged adults were motivated to learn because of their perceived health risk, but they further explained that the health belief model would be more appropriate to determine participants motivation [40-41]. Responses from our surveys showed that participants perceived obesity as a threat to their health. However, for our study the transtheoretical model was used to explain the steps in making a serious behavioral modification to experience meaningful change that will positively impact health outcomes. This was a necessary motivation for participants to make changes to their lifestyles.

The reductions in weight and BMI showed an improvement in these important biomarkers as they relate to improved health. Elsewhere, researchers reported increased nutrition knowledge, but not anthropometric measures, as the most successful outcome of nutrition education whereas behavioral change or anthropometric outcomes were quite variable [40].

There is scarcity of online nutrition education studies done in Alabama Black-Belt region during the COVID-19 pandemic but elsewhere, researchers conducted web-based nutrition surveys, and received anthropometric results different from the current study. Flanagan et al reported that more participants reported to gain weight than those who lost weight during the year 2020 stay-at-home orders instituted by the CDC [20]. However, Flanagan et al., did not include an intervention but instead used surveys to determine differences in participants' weights before and during the COVID-19 pandemic. In China, Yang et al. reported significant increase in overweight and obesity among students in china during the COVID-19 stay-home orders of 2020 [21]. Similar to Flanagan et al, Yang et al did not involve an intervention but conducted a longitudinal study with participants self-reporting their data before and during the COVID-19 pandemic [20,21]. In another retrospective study, researchers reported significant weight gain a month after the beginning of quarantine in Italy [22]. This weight gain was reportedly due to decreased physical activity and increased snacking, among other reasons [22]. Besides being retrospective non-intervention studies, a major similarity between the studies discussed here and our study is that all were online studies carried out during the COVID-19 pandemic.

Limitations and Recommendations

Unlike most online studies that rely on participants' memory, in our study a kit was provided to enable participants report their health biomarker measurements for the specific dates – thus limiting inherent participant memory errors. In addition, participants were provided with measurement instructions and were provided with phone and email contacts of researchers for continued assistance. However, some participants made errors while recording their individual data into the web-based Google docs forms and their data was not used for analysis leading to a decrease in reported data.

Another limitation was internet services: although it was encouraged that two or more participants could use the same electronic device for the meetings, and if possible, use audio or direct-call in, internet service providers are limited in some communities. As such, some participants were negatively impacted due to poor internet connectivity, especially during bad weather.

Conclusion and Implication for Research and Practice

The present study was necessary for two reasons: The prevailing high rates of overweight and obesity and their consequences among Alabama Black-Belt Counties; and the possible increase in overweight and obesity due to home confinement brought about the COVID pandemic. The observed reductions in weight, BMI, and significant reductions in waist and hip circumference indicate a possible success of web-based nutrition education in the Alabama Black-Belt counties. The web-based nutrition education may be improved to reach a large audience by extending digital skills and internet accessibility. Increase in web-based nutrition education may reduce costs associated with in-person face-to-face nutrition education such as limited time, and costs of travel to meeting venues for both the researchers and participants. To the best of our knowledge and from literature, we had the first web-based nutrition education study in the Alabama Black-Belt region, and it may provide a basis for related studies.

Acknowledgement

This work was supported by U54 Grant CA118623 from the National Cancer Institute.

References

1. Bozkurt A (2019) Intellectual roots of distance education: A progressive knowledge domain analysis. *Distance Educ* 40: 497-514.
2. Saykili A (2014) Distance education: Definitions, generations and key concepts and future directions. *Int J Contemp Edu Res* 5: 2-17.
3. Thoms B, Eryilmaz E (2014) How media choice affects learner interactions in distance learning classes. *Comput Educ* 75: 112-26.
4. Urh M, Vukovic G, Jereb E (2015) The model for introduction of gamification into e-learning in higher education. *Procedia Soc Behav Sci* 197: 388-97.
5. Bruder I (1989). Distance Learning: What's Holding Back This Boundless Delivery System? *Electronic learning* 8: 30-5.
6. Goodman J, Melkers J, Pallais A (2019) Can online delivery increase access to education? *J Labor Econ* 3: 1-34.
7. Erickson AS, Noonan PM (2010) Late-career adults in online education: A rewarding experience for individuals aged 50 to 65. *JOLT* 6: 388-97.
8. Githens RP (2007) Older adults and e-learning: Opportunities and barriers. *Q Rev Distance Educ* 8: 329.
9. Honein MA, Christie A, Rose DA, Brooks JT, Meaney-Delman D, et al. (2020) Summary of Guidance for Public Health Strategies to Address High Levels of Community Transmission of SARS-CoV-2 and Related Deaths. *Morb Mortal Wkly Rep* 69: 1860.
10. Alabama Public Health: Corona Virus Disease 2019: Order of the state health officer suspending certain public gatherings due to risk of infection by COVID-19
11. Hobbs M, Pearson N, Foster PJ, Biddle SJ (2015) Sedentary behavior and diet across the lifespan: an updated systematic review. *Br J Sports Med* 49: 1179-88.
12. Alomari MA, Khabour OF, Alzoubi KH (2020) Changes in physical activity and sedentary behavior amid confinement: the BKSQ-COVID-19 project. *Risk Manag Healthc Policy* 13: 1757.
13. Yamada K, Yamaguchi S, Sato K, Fuji T, Ohe T (2020) The COVID-19 outbreak limits physical activities and increases sedentary behavior: A possible secondary public health crisis for the elderly. *J Orthop Sci* 25: 1093.
14. Scully M, Dixon H, Wakefield M (2009) Association between commercial television exposure and fast-food consumption among adults. *Public Health Nutr* 12: 105-10.
15. Centers for Disease Control and Prevention, BRFSS (2019). Overweight and Obesity. *Adult Obesity Maps*.
16. Robert Wood Johnson Foundation, University of Wisconsin Population Health Institute. (n.d). *County Health Rankings & Roadmaps website*
17. The Centers for Disease Control and Prevention. *Healthy weight, nutrition, and physical activity: The health effects of overweight and obesity*.
18. Conway BN, Han X, Munro HM, Gross AL, Shu XO (2018). The obesity epidemic and rising diabetes incidence in a low-income racially diverse southern US cohort. *PloS one* 13: e0190993.

19. Hall ME, do Carmo JM, da Silva AA, Juncos LA, Wang Z, et al. (2014) Obesity, hypertension, and chronic kidney disease. *Int J Nephrol Renovasc Dis* 7: 75.
20. Flanagan EW, Beyl RA, Fearnbach SN, Altazan AD, Martin CK, et al. (2021) The impact of COVID-19 stay-at-home orders on health behaviors in adults. *Obesity* 29: 438-45.
21. Yang S, Guo B, Ao L, Yang C, Zhang L, et al. (2020) Obesity and activity patterns before and during COVID-19 lockdown among youths in China. *Clin Obes* 10: e12416.
22. Pellegrini M, Ponzio V, Rosato R, Scumaci E, Goitre I, et al. (2020) Changes in weight and nutritional habits in adults with obesity during the “lockdown” period caused by the COVID-19 virus emergency. *Nutrients* 12: 2016.
23. Hunter (2020) Special report. America gets cooking: The impact of covid 19 on Americans’ food habits. Focused study 2020.
24. Bhattacharjee A (2012) *Social science research: Principles, methods, and practices*.
25. Piercy KL, Troiano RP, Ballard RM, Carlson SA, Fulton JE, et al. (2018) The physical activity guidelines for Americans. *Jama* 320: 2020-8.
26. Piercy KL, Troiano RP (2018) Physical activity guidelines for Americans from the US department of health and human services: Cardiovascular benefits and recommendations. *Circ Cardiovasc Qual Outcomes* 11: e005263.
27. NHANES 2017-2018 Procedure Manuals.
28. Mitchell NS, Catenacci VA, Wyatt HR, Hill JO (2011) Obesity: overview of an epidemic. *Psychiatric clinics* 34: 717-32.
29. Centers for Disease Control and Prevention (2021) *Overweight and Obesity: Adult Obesity causes and consequences*.
30. Casazza K, Brown A, Astrup A, Bertz F, Baum C, et al. (2015) Weighing the evidence of common beliefs in obesity research. *Crit Rev Food Sci Nutr* 55: 2014-53.
31. Gouda M, Matsukawa M, Iijima H (2018) Associations between eating habits and glycemic control and obesity in Japanese workers with type 2 diabetes mellitus. *Diabetes metab Syndr Obes Targets Ther* 11: 647.
32. Shuval K, Leonard T, Murdoch J, Caughy MO, Kohl HW, et al. (2012) Sedentary behaviors, and obesity in a low-income, ethnic-minority population. *J Phys Act Health*. 10: 134-8.
33. Cohen SS, Matthews CE, Signorello LB, Schlundt DG, Blot WJ, et al. (2013) Sedentary and physically active behavior patterns among low-income African American and white adults living in the southeastern United States. *PloS one* 8: e59975.
34. Mattioli AV, Sciomer S, Cocchi C, Maffei S, Gallina S (2020) Quarantine during COVID-19 outbreak: Changes in diet and physical activity increase the risk of cardiovascular disease. *Nutr Metab Cardiovasc Dis* 30: 1409-17.
35. Zheng C, Huang WY, Sheridan S, Sit CH, Chen XK, Wong SH (2020) COVID-19 pandemic brings a sedentary lifestyle in young adults: a cross-sectional and longitudinal study. *Int J Environ Res Public Health* 17: 6035.

36. Armitage CJ (2009) Is there utility in the transtheoretical model? *Br J Health Psychol* 14: 195-210.
37. Hashemzadeh M, Rahimi A, Zare-Farashbandi F, Alavi-Naeini AM, Daei A (2019) Transtheoretical model of health behavioral change: A systematic review. *Iran J Nurs Midwifery Research* 24: 83.
38. Ha EJ, Caine-Bish N (2011) Interactive introductory nutrition course focusing on disease prevention increased whole-grain consumption by college students. *J Nutr Educ Behav* 43: 263-7.
39. Ireland DM, Clifton PM, Keogh JB (2010) Achieving the salt intake target of 6 g/day in the current food supply in free-living adults using two dietary education strategies. *J Am Diet Assoc* 110: 763-7.
40. Sahyoun NR, Pratt CA, Anderson AM (2004) Evaluation of nutrition education interventions for older adults: a proposed framework. *J Am Diet Assoc* 104: 58-69.
41. Marcus AC, Heimendinger J, Wolfe P, et al. (2001) A randomized trial of a brief intervention to increase fruit and vegetable intake: a replication study among callers to the CIS.

Submit your next manuscript to Annex Publishers and benefit from:

- ▶ Easy online submission process
- ▶ Rapid peer review process
- ▶ Online article availability soon after acceptance for Publication
- ▶ Open access: articles available free online
- ▶ More accessibility of the articles to the readers/researchers within the field
- ▶ Better discount on subsequent article submission

Submit your manuscript at

<http://www.annexpublishers.com/paper-submission.php>