



# HHS Public Access

Author manuscript

*J Community Health*. Author manuscript; available in PMC 2016 June 01.

Published in final edited form as:

*J Community Health*. 2013 April ; 38(2): 338–348. doi:10.1007/s10900-012-9619-z.

## Are Obese Women More Likely to Participate in a Mobile Mammography Program?

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### Abstract

Mobile mammography services are typically offered as a means to increase access and adherence to mammography screenings. As mobile mammography becomes a viable strategy to increase screening, a 3 year study of such a state-wide program in WV found surprisingly high rates of obesity within the study population. Thus, the objectives were to: (1) describe the demographic characteristics and comorbidities of women who utilized the WV program, and (2) determine the association between body mass index (BMI) and personal health and screening history, preventive care and wellness behaviors, nutrition and exercise behaviors, and demographics. Data collected from 1,099 women, age 40 and above, were analyzed using descriptive statistics, bivariate analyses, and a multivariate regression model. The majority (60.4 %) were married, had an income <\$25,000 (59.2 %), and had health insurance (53.5 %). Major comorbidities were hypertension (49 %) and high cholesterol (43.9 %). Based on BMI scores, 884 participants were either overweight (26.6 %), mildly obese (27.7 %), moderately obese (15.1 %), or severely obese (11.1 %). Bivariate analyses indicated that increasing BMI was significantly associated with factors such as having hypertension or diabetes, limited daily activities, perceived health, and not smoking or drinking. The regression model was significant ( $p < 0.001$ ;  $R^2 = 0.425$ ) indicating that women who engaged in preventive care behaviors were less likely to be obese than those who did

not. The WV mobile mammography program appeared to attract women who were disproportionately obese and had multiple comorbidities, thus providing a great opportunity for targeted interventions related to improving preventive care and screening behaviors.

## Keywords

Obesity; Mobile mammography; Breast cancer; Mammography screening

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## Introduction

Mobile mammography services are typically offered as a means of increasing access to mammograms and improving adherence to mammography screening guidelines. Historically, the majority of studies on mobile mammography programs and the women who utilize them have focused on how these services affect access to care among their targeted population [1–3]. Reported studies have shown that mobile mammography can increase mammography utilization in rural, urban, and medically underserved populations [4–6]. Rural communities have increasingly begun to use mobile mammography units as a means to improve access and adherence to mammography screenings. Previous research has shown that rurally-located women who have to travel far to get mammography screenings are more likely to get screened if they had access to a mobile mammography unit [4, 6–8]. Aside from these factors, little is known about the characteristics of these women and how they may differ from one another.

There are ongoing mobile mammography programs in states such as Arkansas, Georgia, Ohio, Louisiana, and West Virginia (WV) that have aimed at providing mammography services to women in rurally-located, medically underserved areas. Of these states, WV is the only state that has published research pertaining to the characteristics of those who receive mobile mammography services [8]. The WV program is called the Bonnie Wells Wilson Mobile Mammography Program (Bonnie's Bus), which was established in May 2009, to provide mammography screenings in rural areas throughout West Virginia and surrounding areas. The mobile mammography unit is a camper-like, 40 feet long bus equipped with a patient-education area, restroom, waiting area, and a digital mammography machine used for mammography screenings. The long term goal of Bonnie's Bus is to provide mammography services and develop targeted educational programs and interventions that will increase recommended routine screening rates and persistence among WV women. Since the mammograms are not free, collaborative efforts have been established between the West Virginia Breast and Cervical Cancer Screening Program (WV BCCSP) and third party payers (such as Medicaid and Medicare) to ensure that all women who qualify for WV BCCSP receive mammography services. For women who lack insurance, other payment options are available.

A recent study by Vyas et al. evaluated characteristics (demographic, access to care, health related behavioral, self and family medical history, psychosocial) of Bonnie's Bus participants to determine the factors influencing their self-reported adherence to mammography screening guidelines [8]. Vyas et al. [8] found that 46.2 % of the study

population were adherent to mammography screening guidelines. Women age 50 years and above, who were extremely obese (body mass index [BMI] 35–39.99) and morbidly obese (BMI ≥ 40), who had a family history of breast cancer, who had breast problems and who were adherent to Pap test, who had previous screenings (blood glucose, blood cholesterol, and blood pressure) and who had little knowledge about mammography screening were more likely to be adherent to mammography screening guidelines [8]. In addition, 79 % of the population was identified as either overweight or obese [8], a rate much higher than the state (61 %) and national (57 %) rates [9]. However, it remains unknown why a large proportion of women thus far who have participated in this program were overweight or obese.

In comparison to previous research, overweight or obese women are less likely to undergo mammography screenings than women of normal weight [10–17]. Additional research has shown an underutilization among overweight and obese women in preventive care services, such as colon cancer screening [18–21] and pap tests [10, 12, 15, 20, 22–26]. In contrast, receipt of preventive care services was similar or greater in overweight and obese women for immunizations, cholesterol screening, and diabetes care [10]. This was consistent with Vyas et al. [8] reporting that these women tend to receive screenings (i.e. cholesterol, blood glucose, and blood pressure) that aid to identify obesity-related conditions. However, it remains unknown why in a state which has the 2nd highest rate of obesity in the nation and is highly prevalent among much of the adult population [27], that a disproportionate number of overweight and obese women participated in the Bonnie's Bus program [8]. With the higher obesity rates in the Bonnie's Bus study population, it is important to further investigate the characteristics of the women who are utilizing the services and if they are representative of rurally-located women. Thus, the objectives of the study are: (1) to describe the demographic characteristics and comorbidities of women who utilized Bonnie's Bus, and (2) to determine the association between BMI and personal health and screening history, preventive care and wellness behaviors, nutrition and exercise behaviors, and demographics.

## Methods

### Study Population

This was a cross-sectional study, consisting of women residing in WV or surrounding counties of Pennsylvania and Ohio, who participated in Bonnie's Bus, and completed the Bonnie's Bus Mammography Screening and Preventive Care Survey (BBMSPCS). Data used for the analyses were collected from September 2009 through December 2011. Of the 2,576 women who received mammography screenings during the study period 1,358 (52.7 %) consented to complete the BBMSPCS survey. Of the 1,358 women, 259 were excluded from the analyses because 106 women did not provide sufficient information to calculate their BMI, 95 had taken the survey more than once during the study period; therefore only the initial survey that included their BMI information was included, and 58 were below the age of 40 or did not provide their age or birth date. Only women age 40 and above were included in the analyses, which was based on the 2002 US Preventive Services

Task Force recommendations for mammography screening every 1–2 years for women age 40 and above [28]. Therefore, the final sample size was 1,099.

Given the response rate of 52.7 %, survey respondents were compared to non-respondents on a variety of sociodemographic factors to evaluate non-response bias. Significant differences were found for employment status ( $\chi^2 = 25.472, p < 0.001$ ), health insurance ( $\chi^2 = 330.763, p < 0.001$ ), marital status ( $\chi^2 = 38.148, p < 0.001$ ), and age ( $\chi^2 = 52.279, p < 0.001$ ). Non-respondents were more likely to be unemployed, less likely to have insurance and be married, and slightly younger than those in each age group compared to respondents. No significant differences were found for BMI ( $\chi^2 = 1.343, p = 0.854$ ), which indicated that respondents were similar to non-respondents on the key dependent variable.

### Description of the BBMSPCS

Data was collected utilizing the BBMSPCS. It was created in an effort to gather data on women who receive mammography screenings from Bonnie's Bus. The BBMSPCS was originally created in 2009 and modified again in 2010 by Mary Babb Randolph Cancer Center researchers of West Virginia University (WVU). It is a six page questionnaire and consists of ten sections including portions derived from the Behavioral Risk Factor Surveillance System (BRFSS), Attitudes to Breast Screening (Mammography) in Women with a Family History of Breast Cancer, and the Breast Imaging Questionnaire. The sections include history on personal health, cancer risk assessment and screening, preventive care and wellness, nutrition and exercise, menstrual and pregnancy, and dental, smoking, and alcohol consumption. Other items include family history of cancer, cancer risk assessment and screening, views on breast cancer, breast cancer awareness, and demographical information. The BBMSPCS has been tested for validity and reliability. Both the consent form and BBMSPCS are approved by the WVU Institutional Review Board.

### Description of Variables and Coding

The main outcome of the study was BMI. BMI was calculated based on the height and weight that was provided by each participant. The BMI formula is  $\text{BMI (lbs/inches}^2\text{)} = (\text{weight in pounds}/(\text{height in inches}^2)) \times 703$ . BMI included five categories which were: (1) underweight/normal [BMI 14–24.99] (2) overweight [BMI 25–29.99] (3) mildly obese [BMI 30–34.99] (4) moderately obese [BMI 35–39.99], and (5) severely obese (BMI 40).

Independent variables included personal health and screening history, preventive care and wellness behaviors, nutrition and exercise behaviors, and demographics. Personal health and screening history included: last mammography screening (never, within past year, within past 1–2 years, within past 2–5 years, 5 or more years); last clinical breast exam (never/5 or more years, within past year, within past 1–2 years, within past 2–5 years); last pap test (never/5 or more years, within past year, within past 1–2 years, within past 2–5 years); hormone replacement therapy (HRT) (currently taking, took in the past, no); last blood cholesterol test (never, within past year, within past 1–2 years, within past 2–5 years, 5 or more years); and last blood pressure reading (never, within past 6 months, within past 6–12 months, within past 1–2 years, 2 or more years). Personal health conditions (comorbidities) were coded (yes or no) to determine if a doctor ever told them that they had one or more of

the 20 conditions listed (allergies, bone loss, seizures/epilepsy, mental health issues, thyroid disease, breast problems, heart problems, hypertension, circulatory problems, varicose veins, lung problems or tuberculosis, liver disease/hepatitis, kidney disease, diabetes, hormone problems, ovaries (tubes or uterus) problems, vaginal infections, sexually transmitted disease, cancer, high cholesterol).

Preventive care and wellness behaviors included: health insurance (yes, no); last routine checkup (never/5 or more years, within past year, within past 2 years, within past 2–5 years); visit to a general doctor in past year (yes, no); visit to an OB/GYN in past year (yes, no); unable to see an OB/GYN in past year due to cost (yes, no); limitations in daily activities (yes, no); perceived general health (poor/fair, good, very good/excellent); perceived weight (underweight/about the right weight, overweight); unable to get medication in past year due to cost (yes, no); current smoker in past year (not at all, some days/everyday); and alcohol consumption in past year (yes, no). Nutrition and exercise behaviors included: number of days per week eat five servings of fruits or vegetables (never, 1, 2, 3, 4 or more); number of days eat at least three servings of dairy (never, 1, 2, 3, 4 or more); and number of days engage in at least 30 min of exercise or physical activity (never, 1, 2, 3, 4 or more). Demographic information included: race (White, Other (Black, Asian, Native Hawaiian/Pacific Islander, American Indian)); age (40–49, 50–59, 60–69, 70 and above); education (less than high school, some high school, high school graduate/GED, technical school/some college, college graduate); marital status (never married/partnered, married, divorced/separated, widowed); employment (employed for wages, self-employed, out of work for less than or more than one year/student, homemaker/retired, unable to work); and family income (<\$25,000, between \$25,000–50,000, \$50,001 and above).

## Statistical Analyses

Descriptive statistics were used to describe the characteristics and preventive care behaviors of the study population. Chi-square statistics were utilized to determine the significant associations between BMI and personal health and screening history, preventive care and wellness behaviors, nutrition and exercise behaviors, and demographics. A multivariate regression model was used to examine significant associations between BMI and significant variables resulting from the Chi-square analyses. Significant values with a  $p$  value <0.05 will be discussed. Variables missing data of 10 % or more were not included in the bivariate analyses or the multivariate regression model. Analyses were performed using SPSS 20.

## Results

### Description of Study Population

Table 1 describes the characteristics of the study population of 1,099 women age 40 and above who were included in the analyses. Women were predominately Caucasian (94.4 %). The mean age was 54 years, with 39.2 % in the 50–59 age group and 32 % in the 40–49 age group. Most women (60.4 %) were married, reported an annual income less than \$25,000 (59.2 %), and had health insurance (53.3 %). Less than half (48.9 %) either completed high school or received a GED, and 40.9 % were employed for wages. Vast majority did not smoke (71.1 %), did not drink alcohol (70.2 %), and reported their health status as good to

excellent (75 %). Within the past year, 95 % had a blood pressure reading, 84.2 % visited a general doctor, 54.7 % had a routine check-up, 49.5 % had a blood cholesterol test, 43.6 % had a clinical breast exam, and 35.8 % had a pap test. Thirty-seven percent had a mammogram within the past 1–2 years, while 11.6 % had a mammogram with the past year. For four or more days per week, 40.2 % ate at least five servings of fruits and vegetables, 47.0 % had at least three servings of dairy, and 28.8 % exercised or engaged in physical activity at least 30 min. Only 23 % were limited in daily activities due to physical, mental, or emotional problems. In addition, 884 of the 1,099 participants were either overweight (26.6 %), mildly obese (27.7 %), moderately obese (15.1 %), or severely obese (11.1 %).

### Comorbidities

Table 2 is a list of comorbidities reported among the study population. Top comorbidity were hypertension (49.0 %), high cholesterol (44.3 %), and allergies (43.3 %). Other comorbidities ranged from thyroid disease (18.1 %) to seizures/epilepsy (2.0 %).

### Association between BMI and Individual Characteristics

Table 3 reports the bivariate significant associations between BMI and personal health and screening history, preventive care and wellness behavior (including nutrition and exercise), and demographics. For personal health and screening history, significant associations were found between BMI categories and history of thyroid disease ( $\chi^2 = 109.777$ ,  $p = 0.030$ ), hypertension ( $\chi^2 = 109.777$ ,  $p < 0.001$ ), diabetes ( $\chi^2 = 92.184$ ,  $p < 0.001$ ), high cholesterol ( $\chi^2 = 17.784$ ,  $p = 0.001$ ), allergies ( $\chi^2 = 10.753$ ,  $p = 0.029$ ), HRT ( $\chi^2 = 16.056$ ,  $p = 0.042$ ), and last blood cholesterol test ( $\chi^2 = 37.012$ ,  $p = 0.002$ ). For those women who participated in preventive care and wellness behaviors, significant associations were found between BMI and limited daily activities ( $\chi^2 = 29.591$ ,  $p = 0.001$ ), perceived general health ( $\chi^2 = 95.391$ ,  $p < 0.001$ ), perceived weight ( $\chi^2 = 468.101$ ,  $p < 0.001$ ), unable to get medicine due to cost ( $\chi^2 = 12.343$ ,  $p = 0.007$ ), visit to a general doctor in past year ( $\chi^2 = 12.405$ ,  $p < 0.001$ ), smoking status ( $\chi^2 = 32.871$ ,  $p < 0.001$ ), and alcohol consumption ( $\chi^2 = 23.359$ ,  $p < 0.001$ ). For nutrition and exercise, number or days per week of exercise or physical activity ( $\chi^2 = 70.267$ ,  $p < 0.001$ ) was significantly associated with BMI. In addition, demographic characteristics, including age ( $\chi^2 = 22.458$ ,  $p = 0.033$ ) and marital status ( $\chi^2 = 21.169$ ,  $p = 0.048$ ), were significantly associated with BMI.

Significantly associated variables were entered into a multivariate regression model using a 2-sided significance level of 5 %, with BMI as the dependent variable. The model produced  $R^2 = 0.404$ ;  $F(17, 769) = 30.620$ ,  $p < 0.001$  (Table 4). Significant associations with BMI included hypertension ( $p < 0.001$ ), diabetes ( $p < 0.001$ ), HRT ( $p = 0.003$ ), age ( $p = 0.013$ ), perceived general health ( $p < 0.001$ ), perceived weight ( $p < 0.001$ ), days per week of exercise or physical activity ( $p = 0.010$ ), smoking status ( $p < 0.001$ ), and alcohol consumption ( $p = 0.005$ ). Women who had hypertension, diabetes, negatively perceived their general health and weight, did not have HRT, did not engage in exercise or physical activity, and did not smoke nor drink were more likely to be overweight or obese compared to those who were underweight or normal weight.

## Discussion

Few studies have examined characteristics of women who attend mobile mammography services [1–3, 8]. After a recent study of women participating in an ongoing mobile mammography program in a rural, medically underserved state observed that disproportionately number of the women were either overweight or obese [8], this study sought to investigate this finding. The study focused on describing the characteristics of the Bonnie's Bus state-wide study population and determining significant factors contributing to the extremely high overweight and obesity rates.

Overall, 80.5 % of the study population was either overweight or obese. This was a much higher rate obtained for women age 40 years and over in the U.S. (57 %) and the state of WV (61.1 %) [9]. In 2010, it was reported that WV had the 2nd highest rate of obesity in the nation [29], an increase from 3rd highest in 2009 [30]. Contrary to previous research on the lack of mammography screenings in overweight and obese women [10–17], it appeared that women who were disproportionately overweight or obese were more likely to participate in Bonnie's Bus program. The findings were consistent with a study conducted through the Well-Integrated Screening and Evaluation for Women Across the Nation (WISEWOMAN program), in which women were recruited through the WV BCCSP via clinics, mailings, and community health fairs [31]. Rye et al. [31] found that 84 % of the WV WISEWOMAN population were either overweight (BMI 25–29.9 [24.1 %]) or obese (BMI ≥ 30 [59.8 %]). In addition, lack of will-power and support appeared to be the dominant physical activity barriers [31].

Hypertension, high cholesterol, allergies, and diabetes were among the frequent comorbid conditions reported in this study population. Research has shown that hypertension, high cholesterol, and diabetes are generally recognized in overweight and obese populations [29, 32–34]. Being overweight or obese not only increases the risk for heart disease and stroke but can result in additional comorbidities such as cardiovascular-related diseases, allergy-related symptoms, certain types of cancers, and other health problems [29, 33–36]. A similar association between obesity and obesity-related comorbidities has been documented among women living in the Appalachian region [29, 37]. Wide sections of the Southeast, Appalachia, and some tribal lands in the West and Northern Plains have the nation's highest rates of obesity and diabetes [27]. In many counties of these regions, rates of obesity prevalence is more than 30 % and diagnosed diabetes exceed 10 % [27].

Consistent with previous research, we found that limited daily activities [38, 39], perceived weight, perceiving health [40, 41], none or few number of days per week of exercise or physical activity [30], never used HRT, and not smoking nor consuming alcohol [30, 35] were significantly associated with higher BMI values. In 2010, 30.5 % of WV adults reported no leisure time physical activity in the past month [30]. Overweight and obese individuals may be less likely to engage in physical activity [42]. Schoenberg, Hatcher, and Dignan (2008) found that WV women were not as concerned about obesity and exercise as they were about drug/medication dependence, cancer, diabetes, heart disease, and smoking [43]. Women who perceive their health as poor or fair may feel that they cannot improve, and may not engage in activities that can change their self-perception [44]. Most women

(79.7 %) correctly identified that they were overweight demonstrating that they are aware of the issue. With 71.8 % of the study population not using HRT, the association may be due to age and not directly due to the non use of HRT among these women.

Last visit to a general doctor, last blood cholesterol test, age, marital status, and inability to get medicine due to cost were also significantly associated with being overweight or obese. Our findings show that the majority of women visited a general doctor in the past year and had their blood cholesterol checked within the past 2 years, which is consistent with past research in this area [8, 10]. As women age, they are more likely to gain weight and become overweight or obese [45]. Women who were married were more likely to be overweight or obese than those who were never married, divorced/separated, or widowed. Averett et al. found that women are generally heavier when married than during their never-married years, concluding that an increase in BMI associated with marriage translates into an increased likelihood of having a BMI in the overweight or obese category [46]. It has also been suggested that weight gain after marriage may occur in part because couples eat more often together due to shared meals and social obligations [46, 47]. Since only 42.9 % had health insurance, it was expected that the inability to get medication due to cost would be significant. However, it cannot be determined if this finding was due to not being able to pay for medication that was specifically related to a weight-related issue or paying for any type of medication in general.

Collectively, we found that hypertension, diabetes, age, negative perception of general health and weight, lack of engagement in exercise or physical activity, not using HRT, and not smoking nor drinking were significantly associated with being overweight or obese. Both hypertension and diabetes have been frequently documented among overweight and obese populations [29, 32, 33]. Lifestyle changes should be implemented in an effort to reduce these comorbid conditions. As a person ages, their body composition gradually shifts which slows their metabolism, making it easier to gain weight [48]. Some people also become less physically active as they get older, increasing the risk of weight gain [48]. Being physically active, maintaining a healthy weight, and eating a healthy diet are important components for sustaining a healthy lifestyle and reducing the risk of obesity. Based on the findings, women in the obese categories did not regularly engage in exercise or physical activity each week, and it continued to drop as the BMI categories increased. Regular physical activity 45–60 min per day prevents unhealthy weight gain and obesity, and regular exercise can markedly reduce body weight and fat mass without dietary caloric restriction in overweight individuals [49]. Past research has shown that negatively perceiving one's health [40, 41] and weight can impact their overall health. Depending on the person, one may either choose to improve their health or do nothing about it. Women who do not smoke or drink generally weigh more than those who do engage in these activities [29, 34]. This does not imply that women should smoke or drink to lose weight. It merely shows that the women may have some knowledge of the negative implications associated with this behavior. Further research is needed to explore these concepts.

While previous research has shown an underutilization of mammography screening in overweight and obese women [10–17], our study found that these women utilized Bonnie's Bus more than normal weight women. With 39 % of the study population being between the



ages of 50–59 years old, women in the age group 40–49 years may have been less likely to receive a mammogram due to the debate concerning the age in which women should start mammography screening [50]. Although we did not find significance between BMI and mammography screening, we found that 80.5 % of the study population was either overweight or obese. Lack of significance may be due to utilizing six categories to identify the last mammography screening and may change if categories were grouped differently. Furthermore, this is the first study to explore the significant factors associated with the overweight and obesity rates among those who participate in a mobile mammography program. The findings support the need to maintain a healthier lifestyle and engage in activities to promote weight loss.

### Strengths and Limitations

The study has several strengths. The study was the first study to examine significant factors contributing to the extremely high overweight and obesity rates found among women utilizing a mobile mammography unit. The study was conducted using primary data from an understudied population, which allows more data to be gathered among women in rural areas. In addition, significant differences were not found in BMI values between non-respondents and respondents, which indicate that differences would not change if non-respondents were included.

However, the study has several limitations. Since the study was based on self-reported data, information may be different if obtained from medical records. Self-reported information about the dates of the most recent screening is less reliable than information about whether or not a woman ever had a screening [51]. The results may only be generalizable to women who are located in similarly rural, medically underserved areas. In addition, non-respondents were more likely to be unemployed, less likely to be married or have insurance, and slightly younger; therefore, socio-demographic characteristics may differ if non-respondents had been included in the study.

Bonnie's Bus appeared to attract women who were disproportionately overweight and obese and had multiple comorbidities. Women who did not engage in preventive care behaviors were more likely to be overweight or obese compared to those that did engage in such behaviors. Future studies should include developing educational programs and targeted interventions linked to mobile mammography units to improve preventive care and screening behaviors.

### Acknowledgments

The project described was conducted under the auspices of the WV CoHORTS Center which is funded by a grant from the Agency for Healthcare Research and Quality (R24 HS018622). The content is solely the responsibility of the authors and does not necessarily represent the official views of the AHRQ.

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**Table 1**

Characteristics of the bonnie wells wilson mobile mammography program study participants

	N	Percent (%)
All	1,099	100
Race		
White	1,038	94.4
Other	42	3.2
Age		
40–49	352	32.0
50–59	431	39.2
60–69	269	24.5
70 and above	47	4.3
Education		
Less than high school	39	3.5
Some high school	82	7.5
High school graduate or GED	537	37.7
Technical school/some college	255	23.2
College graduate	153	13.9
Marital Status		
Married	664	60.4
Divorced/separated/widowed	322	29.3
Never married/partnered	49	4.4
Employment		
Employed for wages	449	40.9
Self-employed	61	5.6
Out of work less than or more than one year/ student	86	7.8
Homemaker/retired	337	32.5
Unable to work	102	9.3
Income		
<\$25,000	650	59.2
Between \$25,001–50,000	219	19.9
\$50,001 and above	125	11.4
Health insurance		
Yes	585	53.2
No	472	42.9
Body mass index (BMI)		
Underweight/normal	215	19.6
Overweight	292	26.6
Mildly obese	304	27.7
Moderately obese	166	15.1
Severely obese	122	11.1

	N	Percent (%)
Mammography screening		
Never	127	11.6
Within past year	127	11.6
Within past 1–2 years	408	37.1
Within past 2–5 years	233	21.1
5 or more years	159	14.5
Clinical breast exam (CBE)		
Never	29	2.6
Within past year	479	43.6
Within past 1–2 years	344	31.3
Within past 2–5 years	122	11.1
5 or more years	69	6.3
Pap Test		
Never/5 or more years	141	12.9
Within past year	393	35.8
Within past 1–2 years	344	31.3
Within past 2–5 years	170	15.5
Hormone replacement therapy (HRT)		
No	789	71.8
Yes, in the past	216	19.7
Currently taking	58	5.3
Blood cholesterol test		
Never	74	6.7
Within past year	544	49.5
Within past 1–2 years	348	31.7
Within past 2–5 years	101	9.2
5 or more years	31	2.8
Blood pressure reading		
Never/5 or more years	7	0.7
Within past year	1044	95.0
Within past 1–2 years	29	2.6
Within past 2–5 years	11	1.0
Last Routine Check-up		
Never/5 or more years	74	6.8
Within past year	601	54.7
Within past 1–2 years	316	28.8
Within past 2–5 years	53	4.8
Visit to general doctor in past year		
Yes	925	84.2
No	139	12.6
Visit to an OB/GYN in past year		

	N	Percent (%)
Yes	349	31.8
No	596	54.2
Unable to See OB/GYN in past year due to cost		
Yes	390	35.5
No	650	59.1
Limitations in daily activities		
Yes	248	22.6
No	29	2.6
Perceived general health		
Excellent/very good	340	31.0
Good	485	44.1
Fair/poor	264	24.0
Perceived weight		
Underweight/about the right weight	204	18.6
Overweight	799	72.7
Smoke (past year)		
Not at all	787	71.6
Some days/everyday	279	25.4
Alcohol (past 30 days)		
No	772	70.2
Yes	287	26.1
Days per week eat at least 5 servings of fruits or vegetables		
Never	46	4.2
1 day	101	9.2
2 days	146	13.3
3 days	278	25.3
4 or more days	442	40.2
Days per week eat at least 3 servings of dairy		
Never	43	3.9
1 day	131	11.9
2 days	132	12.0
3 days	217	19.7
4 or more days	517	47.0
Days per week get at least 30 min of exercise or physical activity		
Never	121	11.0
1 day	157	14.3
2 days	188	17.1
3 days	219	19.9
4 or more days	317	28.8

Nnumber, *GED* general educational development

Missing data (in percent) includes: race (2.4 %), education (3.0 %), marital status (5.8 %), employment (5.8 %), income (9.6 %), health insurance (3.8 %), mammography screening (4.1 %), CBE(5.1 %), Pap test (4.5 %),HRT(3.2 %), blood cholesterol test (0.1 %), blood pressure reading

(0.7 %), last routine check-up (4.9 %), visit to general doctor in past year (3.2 %), visit to OB/GYN in past year (14.0 %), unable to see OB/GYN due to cost (5.4 %), limitations in daily activities (3.1 %), perceived general health (0.9 %), perceived weight (8.7 %), smoke (3.0 %), alcohol (3.3 %), days per week eat at least 5 servings of fruits or vegetables (7.8 %), days per week eat at least 3 servings of dairy (5.3 %), and days per week get at least 30 min of exercise or physical activity (8.8 %). No missing values for age and BMI

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**Table 2**

Comorbidities of the bonnie wells wilson mobile mammography program study participants

	<b>Number (N)</b>	<b>%</b>
<b>1,099</b>		
Comorbidities		
Hypertension	539	49.0
High cholesterol	482	44.3
Allergies	476	43.3
Thyroid disease	198	18.0
Varicose veins	182	16.7
Ovaries, tubes, uterus problems	191	17.4
Diabetes	177	16.2
Vaginal infections	176	16.2
Bone loss (osteoporosis)	151	13.9
Breast problems	142	13.1
Heart problems	140	12.7
Lung problems or tuberculosis	110	10.1
Hormone problems	95	8.6
Circulatory problems	93	8.5
Mental health issues	87	7.9
Liver disease/hepatitis	33	3.0
Kidney disease	32	2.9
Sexually transmitted disease	25	2.3
Seizures/epilepsy	22	2.0

Study participants were asked to identify if they were ever told that they had one or more of the comorbidities listed in the above table

**Table 3**

Personal health and screening history, preventive care and wellness behaviors, nutrition and exercise history, and demographics by body mass index (BMI) of the bonnie wells wilson mobile mammography program study participants<sup>a</sup>

	Underweight or normal (BMI 14–24.99) N (%)	Overweight (BMI 25–29.99) N (%)	Mildly obese (BMI 30–34.99) N (%)	Moderately obese (BMI 35–39.99) N (%)	Severely obese (BMI 40) N (%)	Significant <i>p</i> -values <sup>b</sup>
Personal health and screening history						
Thyroid disease (yes)	28 (13.0)	46 (16.0)	68 (22.5)	28 (16.9)	28 (23.0)	<b>0.030</b>
Hypertension (yes)	59 (27.4)	112 (38.9)	168 (55.6)	107 (64.8)	93 (76.2)	<b>&lt;0.001</b>
Diabetes (yes)	11 (5.1)	31 (10.8)	47 (15.6)	36 (21.7)	52 (42.6)	<b>&lt;0.001</b>
High cholesterol (yes)	80 (37.2)	110 (38.3)	142 (47.0)	86 (52.8)	64 (52.9)	<b>0.001</b>
Allergies (yes)	95 (44.2)	110 (38.2)	137 (45.5)	67 (40.9)	67 (54.9)	<b>0.029</b>
Hormone replacement therapy (HRT)						<b>0.042</b>
Not currently taking	155 (72.8)	209 (73.9)	216 (74.2)	115 (71.4)	94 (81.7)	
Yes, in past	38 (17.8)	57 (20.1)	62 (21.3)	38 (23.6)	21 (18.3)	
Currently taking	20 (9.4)	17 (6.0)	13 (4.5)	8 (5.0)	0 (0)	
Preventive care and wellness behaviors						
Perceived general health						<b>&lt;0.001</b>
Poor/fair	41 (19.2)	42 (14.5)	69 (23.7)	65 (39.2)	47 (38.8)	
Good	81 (38.0)	125 (43.3)	140 (46.7)	79 (47.6)	60 (49.6)	
Very good/excellent	91 (42.7)	122 (42.2)	91 (30.3)	22 (13.3)	14 (11.6)	
Perceived weight						<b>&lt;0.001</b>
Underweight/about the right weight	147 (73.4)	49 (18.7)	5 (1.8)	2(1.3)	1 (0.9)	
Overweight	53 (26.5)	213 (81.3)	273 (98.2)	150 (98.7)	110 (99.1)	
Seen/talked to general doctor (yes)	168 (80.4)	238 (85.3)	259 (87.5)	148 (90.8)	112 (95.7)	<b>&lt;0.001</b>
Limited daily activities (yes)	41 (19.6)	52 (18.5)	65 (22.3)	46 (28.2)	44 (36.7)	<b>0.001</b>
Last blood cholesterol checked						<b>0.002</b>
Never	26 (12.5)	18 (6.3)	15 (5.3)	9 (5.6)	6(5.1)	
Within past year	85 (40.9)	133 (46.7)	169 (57.3)	84 (51.9)	73 (62.4)	
Within past 1–2 years	70 (33.7)	106 (37.2)	90 (30.5)	52 (32.1)	52 (62.4)	
Within past 2–5 years	14 (6.7)	10 (3.5)	8 (2.7)	11 (6.8)	3 (2.6)	
5 of more years ago	13 (6.2)	18 (6.3)	13 (4.4)	6 (3.7)	5 (4.3)	
Smoking status (past 12 months)						<b>&lt;0.001</b>
Not at all	123 (59.4)	217 (75.3)	227 (77.7)	121 (74.2)	99 (85.3)	
Some days/every day	84 (40.6)	71 (24.7)	65 (22.3)	42 (25.8)	17 (14.7)	
Alcohol consumption (past 30 days)						<b>&lt;0.001</b>
No	132 (64.1)	192 (68.1)	221 (75.4)	129 (80.6)	98 (83.1)	
Yes	74 (35.9)	90 (31.9)	72 (24.6)	31 (19.4)	20 (16.9)	

	Underweight or normal (BMI 14–24.99) N (%)	Overweight (BMI 25–29.99) N (%)	Mildly obese (BMI 30–34.99) N (%)	Moderately obese (BMI 35–39.99) N (%)	Severely obese (BMI 40) N (%)	Significant <sup>b</sup> p-values
Unable to get medicine due to cost (yes)	61 (29.3)	71 (25.5)	88 (30.3)	58 (36.9)	50 (42.7)	<b>0.007</b>
Nutrition and exercise behaviors						
Number of days per week exercise						<b>&lt;0.001</b>
Never	16 (8.2)	21 (7.8)	33 (12.0)	29 (19.1)	22 (19.8)	
1 day per week	24 (12.3)	37 (13.8)	48 (17.5)	23 (15.1)	25 (22.5)	
2 days per week	23 (11.8)	50 (18.6)	59 (21.5)	35 (23.0)	21 (18.9)	
3 days per week	39 (20.0)	65 (24.2)	52 (18.9)	40 (26.3)	23 (20.7)	
4 or more days per week	93 (47.7)	96 (35.7)	83 (30.2)	25 (16.4)	20 (18.0)	
Demographics						
Age groups						<b>0.033</b>
40–49 years old	79 (36.7)	80 (27.4)	97 (31.9)	63 (38.0)	33 (27.0)	
50–59 years old	76 (35.3)	123 (42.1)	109 (35.9)	62 (37.3)	61 (50.0)	
60–60 years old	50 (23.3)	70 (24.0)	85 (28.0)	38 (22.9)	26 (21.3)	
70 years old and above	10 (4.7)	19 (6.5)	13 (4.3)	3 (1.8)	2 (1.6)	
Marital status						<b>0.048</b>
Never married	13 (6.4)	7 (2.5)	12 (4.2)	9 (5.7)	8 (7.0)	
Married	122 (60.4)	179 (64.4)	183 (64.4)	110 (70.1)	70 (61.4)	
Divorced/separated	54 (26.7)	66 (23.7)	58 (20.4)	23 (14.6)	19 (16.7)	
Widowed	13 (6.4)	26 (9.4)	31 (10.9)	15 (9.6)	17 (14.9)	

*BMI* body mass index

Only significant variables are listed above ( $p < 0.05$ )

<sup>a</sup>Variables are reported as the frequency and percent relative to the column attribute

<sup>b</sup>Chi-square test was utilized to test association

**Table 4**

Results of the multivariate regression analysis based on the bonnie wells wilson mobile mammography program study participants ( $R^2 = 0.404$ )

Variable	Beta	t	p values	95 % CI
Allergies	0.047	1.604	0.109	[-0.150, 1.492]
Thyroid disease	0.033	1.163	0.245	[-0.428, 1.675]
Hypertension	0.192	6.101	<b>&lt;0.001</b>	[1.856, 3.617]
Diabetes	0.158	5.279	<b>&lt;0.001</b>	[1.972, 4.307]
High cholesterol	0.002	0.080	0.936	[-0.830, 0.901]
Hormone replacement therapy (HRT)	-0.088	-2.984	<b>0.003</b>	[-1.768, -0.365]
Perceived general health	-0.139	-4.117	<b>&lt;0.001</b>	[-1.951, -0.691]
Limited daily activities	-0.033	-1.043	0.297	[-1.639, 0.502]
Last time blood cholesterol was checked	-0.030	-1.009	0.313	[-0.667, 0.214]
Seen or talked to general doctor	-0.002	-0.057	0.955	[-1.344, 1.268]
Unable to get medicine due to cost	0.017	0.591	0.555	[-0.635, 1.182]
Days per week get exercise or physical activities	-0.074	-2.571	<b>0.010</b>	[-0.633, -0.085]
Perceived weight	0.384	12.891	<b>&lt;0.001</b>	[5.199, 7.067]
Smoking status	-0.107	-3.626	<b>&lt;0.001</b>	[-2.729, -0.812]
Alcohol consumption	-0.082	-2.845	<b>0.005</b>	[-2.117, -0.388]
Age	-0.078	-2.497	<b>0.013</b>	[-1.170, -0.140]
Marital status	-0.024	-0.816	0.415	[-0.791, 0.327]

Dependent variable was BMI value. Model produced  $R^2 = 0.404$ ;  $F(17, 769) = 30.620$ ,  $p < 0.001$ . Significant variables are highlighted in bold print