

# Technology's role in promoting physical activity and healthy eating in working rural women: a cross-sectional quantitative analysis

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## ABSTRACT

**Aims:** This exploratory study evaluated sociodemographic predictors of healthy eating and physical activity (PA) in a sample of working rural women and their access to and interest in using technology for health promotion. **Settings and Design:** This study is a cross-sectional quantitative analysis. **Materials and Methods:** A 32-item questionnaire was administered to a convenience sample of  $N = 60$  women, working at a regional healthcare facility in the Pacific Northwest. **Statistical Analysis:** Descriptive statistics characterized PA and healthy eating, barriers and support for PA and healthy eating, and perceived role of technology for health promotion. Chi-square tests for categorical variables evaluated relationships between PA and healthy eating support with behavioral engagement. **Results:** Only 23% and 25% followed recommended PA and fruit and vegetable consumption guidelines. Those likely to engage in preventive care had higher income and education. Fewer respondents reported barriers to PA than for healthy eating (47% vs. 57%), and those reporting barriers were likely to have lower income and less than a high-school education. Sixty percent reported social support for PA and only 52% for healthy eating. A significant relationship was evident between PA support and PA engagement ( $P = 0.015$ ). Eighty-two percent used mobile phones to look up health information and 29% did so daily. Almost two-thirds (62%) reported likelihood of using online health information boards to support healthy eating and 45% for PA. **Conclusion:** Working rural women benefit from PA and healthy eating guidance. Attention to sociodemographic predictors may support a tailored digital healthcare approach to promote wellness in this community.

**Key words:** Healthy eating, physical activity, technology

**Key Message:** Rural women are not meeting recommended healthy eating and physical activity guidelines. Electronic and mobile health technology can support preventive care behaviors for dispersed communities, and working rural women appear ready to deploy technology to support healthy eating and physical activity engagement. Technologists must tailor electronic and mobile health tools to meet the social and economic needs of rural communities to assure maximal healthcare benefits.

## INTRODUCTION

Rural communities in the United States have an increased probability of being obese, physically inactive, and report

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higher incidences of chronic diseases.<sup>[1-4]</sup> Among menopausal women in particular, overweight status is linked to a number of chronic diseases including cardiovascular diseases, metabolic diseases, and some cancers;<sup>[5]</sup> targeting overweight middle-aged women can help to limit chronic disease occurrences.

A recent study revealed significant differences between rural and urban women in daily calories consumed, and daily fruit and vegetable (F/V) consumption.<sup>[6]</sup> To improve health status, the Centers for Disease Control and Prevention (CDC) and the US Department of Health and Human Services outlined recommended healthy eating options,<sup>[7]</sup> and recommended moderate-level physical activity engagement criteria.<sup>[8]</sup> However, research reveals barriers to healthy eating and PA for many adults living in rural communities. Insufficient time and knowledge to prepare healthy meals, and travel distances to access healthy food options are barriers to eating healthy.<sup>[9]</sup> Environment safety concerns and lack of PA facilities hinder PA engagement.<sup>[10,11]</sup>

Technology, including web and mobile-based tools, can provide coaching to support healthy eating,<sup>[12]</sup> and to engage in PA for those seeking guidance. Technology can also offer social connection to dispersed communities to overcome logistical challenges associated with accessing local markets and PA support.<sup>[13]</sup> To the knowledge of the investigators of this report, no study has evaluated middle-aged working rural women's perception of technology's role in supporting their healthcare practices, including engagement in preventive care behaviors to promote wellness. The objectives of this study were as follows: (1) to evaluate sociodemographic predictors of recommended F/V consumption and PA engagement among working rural women in the Pacific Northwest and (2) to evaluate the women's access to and interest in using technology for health promotion. The overall goal of this exploratory study was to elucidate the challenges to PA and healthy eating for working middle-aged rural women and to consider the role that digital healthcare tools might play in supporting preventive care.

## SUBJECTS AND METHODS

Study researchers partnered with Grays Harbor Community Hospital in Aberdeen, Washington. Electronic surveys were sent to a convenience sample of female employees ( $N = 237$ ), and 60 surveys were received back (25% response rate). The women held a variety of positions in the healthcare industry, including registered nurse, phlebotomist, medical recorder, clerk, nutrition services support staff, and environmental services staff.

## Instruments and data collection

Study researchers administered a 32-item questionnaire that comprised mostly of closed-ended questions. Items assessed were as follows: (1) CDC-recommended F/V intake, self-identified barriers to healthy eating, and social support for eating healthy; (2) PA engagement (general engagement, HHS-recommended PA engagement, frequency of engagement, social support for PA, and self-identified barriers to engagement); (3) access/use of technology (technology owned and used, use of technology to access health information, and frequency of accessing online health information); (4) online health information practices (likelihood of using online information to support healthy eating and PA). Study procedures and protocols were submitted to and approved by the University of Washington Institutional Review Board.

Survey administration commenced on September 2018 and concluded on October 2018. Eligibility criteria were as follows: (1) women employed in a local healthcare facility; (2) English-speaking; (3) older than 40 years of age; (4) owned or had access to a smartphone; and (5) self-identify as overweight or obese.

## Measured variables

### Physical activity engagement

This variable is defined as engaging in any PA as well as recommended PA criteria. The first assessment question was as follows: *Do you engage in any physical activity?* This outcome was treated as a dichotomized measure ("yes" = 1; "no" = 0). The second assessment question was as follows: *How often do you exercise (at least 30 min each day/5 days per week, less than recommended levels and more than recommended levels).*

### Barriers to physical activity engagement

This factor was identified as any event/situation that prevented PA engagement. The first assessment question was as follows: *Are there barriers to you engaging in any type of physical activity?* This outcome was treated as a dichotomized measure ("yes" = 1; "no" = 0). The second question asked the respondent to, *please list the barriers.*

### Support for physical activity engagement

This factor permitted respondents to identify an individual or individuals to whom they can speak about engaging in physical activities. The first assessment question was as follows: *Is there someone you speak to about being physically active?* This outcome was treated as a dichotomized measure ("yes" = 1; "no" = 0). The second assessment question was as follows: *If "yes" please identify the person* (respondents had forced-choice responses of "friends" "family," "neighbor," and "other").

### Healthy eating engagement

This factor was defined as respondents following recommended F/V daily consumption. The assessment question was as follows: *Do you eat at least two cups of fruits and three cups of vegetables each day?* This outcome was treated as a dichotomized measure (“yes” = 1; “no” = 0).

### Barriers to healthy eating

This factor was identified as any event/situation that prevented healthy eating engagement. The assessment question was as follows: *What are the barriers to you eating in a healthy way (including two cups of fruits and three cups of vegetables each day?).* Respondents were asked to write their identified barriers.

### Support for healthy eating

This factor permitted respondents to identify an individual or individuals to whom they can speak about eating in a healthy way. The assessment question was as follows: *Is there someone you speak with about eating healthy?* This outcome was treated as a dichotomized measure (“yes” = 1; “no” = 0). The second assessment question was as follows: *If “yes” identify the person (for example, “friend,” “family,” “neighbor,” and “other”).*

### Technology access and use for health information

This factor permitted respondents to outline ownership and use of health-based technologies. Questions asked

about ownership of mobile devices, personal computers, and other communication technology, using technology to access online health information, and likelihood of using technology to access health information.

## STATISTICAL ANALYSES

Descriptive statistics characterized outcome variables—PA engagement, barriers to engagement, support for PA engagement, healthy eating engagement, barriers to healthy eating, support for healthy eating, and technology use and access. Chi-square tests for categorical variables evaluated the relationship between PA engagement and support for engagement. Chi-square tests also evaluated the relationship between healthy eating and support for healthy eating engagement. Data were analyzed using STATA/IC (version 14.2; StataCorp LLC, College Station, TX, USA).

## RESULTS

### Patient characteristics

A total of 60 women completed the health survey. The mean age of respondents was 53 years (standard deviation [SD] = 8) and mean body mass index (BMI) was 32.2 (SD = 7.5). Respondents comprised mostly Whites (93%) and held a high-school education or higher (83%). Nearly half (48%)

**Table 1: Descriptive statistics by physical activity engagement measures (N = 60)**

Demographics	Total sample (N = 60) n (%)	Engage in PA	Recommended frequency*			Social support	Barriers
			<30	30	>30		
Total		45 (75.0)	11 (25.0)	10 (22.7)	8 (18.2)	36 (60.0)	28 (46.7)
Age							
40–50 years	24 (40.0)	14 (58.3)	4 (28.6)	2 (14.3)	2 (14.3)	15 (62.5)	11 (45.8)
51–60 years	23 (38.3)	19 (82.6)	6 (33.3)	6 (33.3)	3 (16.7)	11 (47.8)	11 (47.8)
61+ years	13 (21.7)	12 (92.3)	1 (8.3)	2 (16.7)	3 (25.0)	10 (76.9)	6 (46.2)
Age—mean (SD)	53.2 (7.9)	54.3 (7.9)	52.3 (7.6)	55.1 (7.2)	56.0 (8.3)	53.7 (8.8)	53.4 (8.0)
BMI—mean (SD)	32.2 (7.5)	30.2 (6.4)	33.9 (6.5)	29.9 (5.7)	27.9 (4.9)	31.7 (6.0)	32.3 (7.0)
Race							
White	56 (93.3)	42 (75.0)	10 (24.4)	10 (24.4)	7 (17.1)	34 (60.7)	28 (50.0)
Other	4 (6.7)	3 (75.0)	1 (33.3)	—	1 (33.3)	2 (50.0)	—
Household income							
\$20,000–\$35,999	5 (8.3)	3 (60.0)	—	—	2 (66.7)	2 (40.0)	3 (60.0)
\$36,000–\$50,999	8 (13.3)	4 (50.0)	1 (25.0)	1 (25.0)	2 (50.0)	3 (37.5)	3 (37.5)
\$51,000–\$75,999	13 (21.7)	10 (76.9)	3 (30.0)	2 (20.0)	1 (10.0)	8 (61.5)	6 (46.2)
\$76,000+	29 (48.3)	24 (82.8)	7 (30.4)	7 (30.4)	3 (13.0)	20 (69.0)	14 (48.3)
Employment status							
Employed full-time	47 (78.3)	34 (72.3)	10 (30.3)	7 (21.2)	6 (18.2)	29 (61.7)	21 (44.7)
Employed part-time	12 (20.0)	10 (83.3)	1 (10.0)	3 (30.0)	2 (20.0)	6 (50.0)	6 (50.0)
Education level							
High school or less	10 (16.7)	5 (50.0)	1 (20.0)	1 (20.0)	2 (40.0)	5 (50.0)	7 (70.0)
Higher than high school	50 (83.3)	40 (80.0)	10 (25.6)	9 (23.1)	6 (15.4)	31 (62.0)	21 (42.0)
Marital status							
Married or living with a partner	42 (70.0)	30 (71.4)	6 (20.7)	7 (24.1)	5 (17.2)	26 (61.9)	17 (40.5)
Single/never married	2 (3.3)	1 (50.0)	1 (100)	—	—	1 (50.0)	1 (50.0)
Widowed or divorced or separated	16 (26.7)	14 (87.5)	4 (28.6)	3 (21.4)	3 (21.4)	9 (56.3)	10 (62.5)

BMI = body mass index, SD = standard deviation, PA = physical activity

\*Recommended frequency (30 = at least 30 minutes of PA each day for 5 days each week; <30 = less than the recommended PA frequency; >30 = more than the recommended PA frequency)

reported a household income of \$76k/year and almost three-quarters (70%) were married or living with a partner [Table 1].

**Physical activity**

Three-quarters (75%) engaged in PA; however, only 23% followed CDC-recommended levels and 25% engaged in less than designated levels. Respondents most likely to engage in PA were 51–60 years of age (83%) as compared to those younger than 50 years of age (58%); had income over \$76k/year (83%) vs. respondents with income between \$36k/year and \$50k/year (50%); and had a high-school education or higher (80%) vs. those reporting less than high-school education (50%) [Table 1].

Approximately 47% reported barriers to PA engagement, which included lack of time and physical complaints such as chronic joint and back concerns. Lower income respondents, \$20k/year to \$36k/year, were likely to report more barriers relative to respondents making more than \$76k/year (60% vs. 48%). Also, respondents reporting less than a high-school education were likely to report barriers to PA engagement relative to those with more than a high-school education (70% vs. 42%) [Table 1].

Almost two-thirds (60%) reported a family member or a close friend as supporting PA engagement. Respondents who received social support had a higher income as they reported earning more than \$76k/year (69%) as compared to those earning less than \$36k/year (40%); worked full-time compared to part-time employment (62% vs. 50%); and had a high-school education or higher vs. less than a high-school education (62% vs. 50%) [Table 1].

Chi-square analyses ( $\chi^2$ ) revealed a significant relationship between talking with a family or close friend about PA and PA engagement ( $\chi^2 [1, N = 60] = 5.93, P = 0.015$ ). Respondents who talked with a family member or close friend about PA had a higher rate of PA engagement than those who did not speak with a family member or close friend (86.1% vs. 58.3%) [Table 2 and Figure 1].

**Healthy eating**

Only 25% reported adhering to CDC-recommended F/V consumption guidelines, with individuals earning \$51k/year–\$76k/year most likely to follow F/V guidelines (54%). Individuals with a high-school education or higher were

also more likely to report adhering to CDC F/V guidelines relative to those with less than high-school education (28% vs. 11%) [Table 3].

Over one-half (57%) experienced healthy eating barriers, whereas 52% reported support from family members and friends to eat healthy. Individuals earning between \$36k/year and \$51k/year experienced the most barriers to eating healthy. Individuals with a high-school education or less also experienced the most barriers (70%) compared to those with more than a high-school education (54%) [Table 3].

Reported barriers include lack of time and food allergies. Barriers were more likely to be reported for eating healthy than for engaging in PA (57% vs. 47%) and respondents were more likely to report more social support for engaging in PA than for eating healthy (60% vs. 52%) [Tables 1 and 3].

Chi-square analysis did not reveal a significant relationship between talking with family or close friends about eating healthy and engagement in healthy eating ( $\chi^2 [1, N = 60] = 1.61, P = 0.205$ ) [Table 4 and Figure 2].

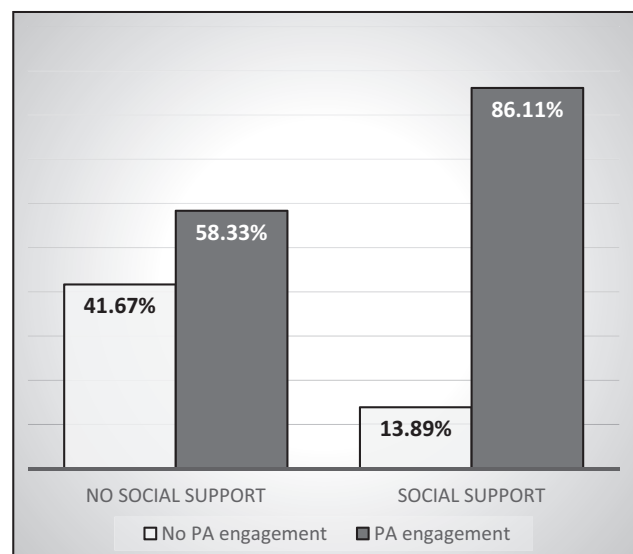
**Technology and preventive care**

The majority of respondents (97%) reported access to Internet and 90% owned a smartphone; 92% used their personal computers to look up health information and 82% used their mobile devices to do so. Almost one-third (29%) used their mobile devices to access health information multiple times each day. Respondents likely to use their computers to look up health information were 40–50 years old (40%), reported having a high-school and higher education (83.6%),

**Table 2: Physical activity engagement and social support**

Lack of Social Support	No social support		Social support	
	n (%)		n (%)	
No PA engagement	10 (41.7)	5 (13.9)		
PA engagement	14 (58.3)	31 (86.1)		

PA = physical activity



**Figure 1:** Association between engagement in physical activity and talking with a family member or close friend (social support) about physical activity engagement. The association between PA engagement and social support is statistically significant ( $P = 0.015$ )



**Table 3: Descriptive statistics by healthy eating engagement measures (N = 60)**

Demographics	Recommended F/V consumption*	Social support	Barriers
Total	15 (25.4)	31 (51.7)	34 (56.7)
Age			
40–50 years	6 (25.0)	15 (62.5)	13 (54.2)
51–60 years	4 (18.2)	11 (47.8)	15 (65.2)
61+ years	5 (38.5)	5 (38.5)	6 (46.2)
Age—mean (SD)	53.6 (9.7)	51.5 (7.8)	53.4 (7.4)
BMI—mean (SD)	28.2 (5.5)	32.2 (6.1)	32.7 (7.5)
Race			
White	14 (25.5)	30 (53.6)	31 (55.4)
Other	1 (25.0)	1 (25.0)	3 (75.0)
Household income			
\$20,000–\$35,999	1 (25.0)	2 (40.0)	1 (20.0)
\$36,000–\$50,999	–	3 (37.5)	7 (87.5)
\$51,000–\$75,999	7 (53.9)	7 (53.9)	6 (46.2)
\$76,000+	6 (20.7)	15 (51.7)	17 (58.6)
Prefer not to answer	–	3 (100)	2 (66.7)
Employment status			
Employed full-time	12 (25.5)	26 (55.3)	27 (57.5)
Employed part-time	3 (27.3)	5 (41.7)	6 (50.0)
Retired	–	–	1 (100)
Education level			
High school or less	1 (11.1)	4 (40.0)	7 (70.0)
Higher than high school	14 (28.0)	27 (54.0)	27 (54.0)
Marital status			
Married or living with a partner	10 (23.8)	24 (57.1)	25 (59.5)
Single/never married	–	1 (50.0)	1 (50.0)
Widowed or divorced or separated	5 (33.3)	6 (37.5)	8 (50.0)

BMI = body mass index, SD = standard deviation, F/V = fruit and vegetable

\*Recommended F/V consumption: adults eat at least 1½ to 2 cups per day of fruit and 2 to 3 cups per day of vegetables as part of a healthy eating regimen

and had a household income of \$76k+/year (52.8%). For respondents likely to use mobile devices to access health-based information, they were 40–60 years (81.6%), reported having a high-school or higher education (81.6%), and had a household income of \$76k+/year (51.1%) [Table 5].

Almost two-thirds (62%) reported a likelihood of using online information boards to support engagement in healthy eating; these respondents were between 40 and 50 years old (51.4%), with a high-school and higher education (86.5%), and a household income of \$76+k/year (50.0%) [Table 5].

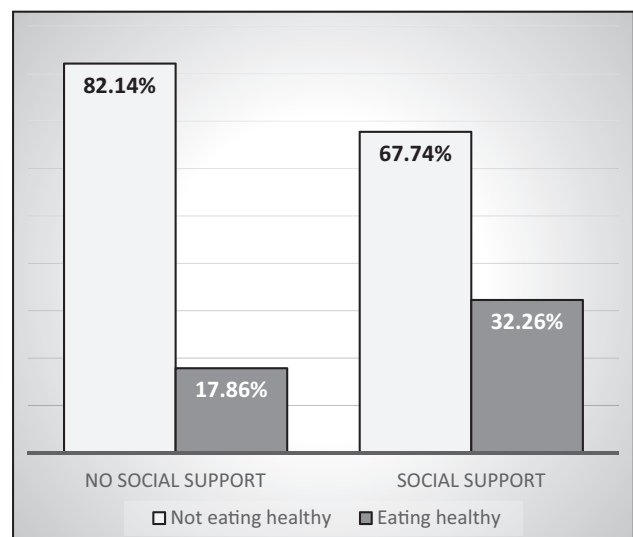
A little less than half (45%) of respondents reported interest in using online information source to support PA engagement; these respondents were between 40 and 50 years old (48.2%), with a high-school and higher education (74.1%), and a household income of \$76+k/year (50.0%) [Table 5].

## DISCUSSION

As reported in the literature,<sup>[14]</sup> rural communities are not meeting recommended PA and healthy eating guidelines and our study shows similar outcome for working women in northwest coast communities. Barriers to PA are associated with income and educational attainment as working women of a lower income status and with a lower education standing (high school or less) are likely to experience barriers to

**Table 4: Healthy eating and social support**

Lack of Social Support	No social support		Social support	
	n	(%)	n	(%)
Not eating healthy	23	(82.1)	21	(67.7)
Eating healthy	5	(17.9)	10	(32.3)



**Figure 2:** Association between eating healthy and talking with a family member or close friend (social support) about eating healthy. The association between eating healthy and social support is not statistically significant ( $P = 0.205$ )

PA. Moreover, supportive network for PA engagement is less available for those with socioeconomic challenges; however, our data revealed that a supportive network

**Table 5: Technology access and use (N = 60)**

Variable	n (%)
Access to Internet	58 (96.7)
Which mobile devices do you own?	
Smartphone	54 (90.0)
Laptop computer	42 (70.0)
Desktop computer	27 (45.0)
Tablet	40 (66.7)
Personal digital assistant	–
Other	1 (1.7)
None	2 (3.3)
Ever use computer to look up health information?	55 (91.7)
Ever look up health information using (mobile device)	49 (81.7)
Access and healthcare practices	
If you had access to online health information board about healthy eating tips, what is likelihood of using information?	
Likely	37 (61.7)
Neutral	8 (13.3)
Unlikely	15 (25.0)
If had access to online health information walking you through simple and easy PA, likelihood of using?	
Likely	27 (45.0)
Neutral	11 (18.3)
Unlikely	15 (25.0)

PA = physical activity

will predict PA engagement. Therefore, linking dispersed residents (particularly those with economic disadvantages) to other members of the community can potentially engage communities of working rural women.

The sociodemographic trends for nonengagement in healthy eating are similar to PA nonengagement. Working rural women with lower income and less than a high-school education report a reduced likelihood of following recommended daily F/V intake. In addition, our data revealed that the women appear to require more support to eat healthy than to be physically active, as they experienced more hurdles to engage in the former behavior. Previous research suggests that low-resourced rural women are willing to practice healthy eating, even in the face of barriers linked to income and living in dispersed rural communities.<sup>[15]</sup> Similar to the assertions in our study, the cited previous study emphasized the need to consider a variety of technological innovations in order to effectively reach traditionally underserved communities to support preventive care behaviors such as healthy food consumption and PA engagement.

Innovative technology including web and mobile-based tools have emerged as viable strategies to promote health behaviors.<sup>[16,17]</sup> A global positioning system (GPS) can effectively link communities to resources including farmer's markets and other healthy food sources. Health coaching apps can provide guided assistance to develop and maintain healthy eating and PA goals. Self-monitoring apps allow users to track caloric intake and PA in order to support

engagement. Social media platforms can help connect individuals with similar health goals as well as support healthy eating and PA objectives. The aforementioned tools can be coalesced into a single innovation for rural communities of women. An example of web-enabled technology providing comprehensive support is the *PatientsLikeMe* health network.<sup>[13]</sup> This site uses web-enabled tools that connect individuals with similar concerns; enable health data sharing; support interactions among users, clinicians, and academics; and allow users to assess and manage health-related concerns. A comprehensive web-enabled innovation must be adapted for rural communities. Given the lower rate of technology uptake among the lower income and less-educated subgroups in this rural community, the design features of the technology must consider the personal characteristics of this demographic, including literacy skills.<sup>[18]</sup> Technologists must also involve this subgroup of prospective users, and relevant stakeholders like healthcare providers, in designing and developing health promotive tools to assure a tailored intervention and ease of use.

A small sample size, and the fact that the sample represented a convenience group of rural women who were employed in the healthcare industry, presents a limitation because the results might not generalize to all working rural women. Notwithstanding the limitations, this pilot analysis of sociodemographic predictors of preventive care behaviors and technology use by working rural women suggests that there can be value in deploying digital healthcare management tools to promote health and wellness among women residing in rural communities.

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### Conflicts of interest

There are no conflicts of interest.

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