Original Article

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Meeting Recommended Levels of Physical Activity and Health-Related Quality of Life in Rural Adults

Peter D. Hart[1,2,*]

[1]Health Promotion, Montana State University - Northern, [2]Research and Statistical Consultant, Health Demographics, Havre, MT, USA

Background: Little is known about physical activity (PA) and health-related quality of life (HRQOL) among rural adults. The purpose of this study was to investigate the relationship between meeting recommended levels of PA and HRQOL in a rural adult population.

Methods: This study analyzed data from 6,103 rural adults 18 years of age and older participating in a 2013 survey. Respondents reporting at least 150 minutes a week of moderate-intensity (or moderate-vigorous combination) PA during the past month were categorized as meeting PA guidelines. Five health variables were used to assess HRQOL. A continuous HRQOL ability score was also created using item response theory (IRT).

Results: Rural adults who met recommended levels of PA were significantly more likely to report good HRQOL in adjusted models of physical health (OR: 1.99; 95% CI: 1.54-2.56), mental health (OR: 1.96; 95% CI: 1.46-2.64), inactivity health (OR: 2.14; 95% CI: 1.54-2.97), general health (OR: 1.69; 95% CI: 1.35-2.13), and healthy days (OR: 1.98; 95% CI: 1.58-2.47), compared to those who did not meet recommended levels. Furthermore, rural adults meeting recommended levels of PA also had a significantly greater HRQOL ability score (51.7 ± 0.23, Mean ± SE), compared to those not meeting recommended levels (48.4 ± 0.33, $p < .001$).

Conclusion: This study found that meeting recommended levels of PA increases the likelihood of reporting good HRQOL in rural adults. These results should be used to promote the current PA guidelines for improved HRQOL in rural populations.

Key Words: Physical activity, Health-related quality of life (HRQOL), Rural health, Item-response theory (IRT)

INTRODUCTION

The body of evidence has clearly shown great health disparity between rural versus non-rural residing adults in the U.S. Examining life expectancy alone shows an almost 2.5 year imbalance in years lived, with those residing in metropolitan areas having a life expectancy of 79.1 years as compared to 76.7 years among those residing in rural areas [1]. Chronic disease is a likely factor increasing risk of premature death in rural adults. Prevalence of both heart disease and type II diabetes has been shown to be significantly greater among those residing in rural areas as compared to those in urban areas [2]. Obesity, a major risk factor for many of the chronic diseases, has also been shown to disproportionately affect rural adults as compared to their non-rural residing counterparts [3]. Many behaviors which

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*Corresponding author: Peter D. Hart
Health Promotion, College of Education, Arts & Sciences and Nursing, Montana State University - Northern, P.O. Box 7751, Havre, MT 59501-7751, USA
Tel: 1-406-265-3719, Fax: 1-406-265-4129
E-mail: peter.hart@msun.edu

lead to chronic diseases are also seen at greater prevalence in rural areas. Adults residing in rural areas are more likely to smoke cigarettes, use smokeless tobacco, and be subject to second-hand smoke than non-rural residing adults [4].

Health-related quality of life (HRQOL) is an outcome variable of growing interest in public health research and is considered a broad measure of perceived health [5]. HRQOL can also be assessed more specifically to include dimensions such as physical health, mental health, social health, emotional well-being, pain severity, as well as many others [6]. The interest in this latent construct has prompted the U.S. Department of Health and Human Services to include HRQOL as a new topic area in Healthy People 2020 [7]. In this report, the stated objectives are to increase the percentage of self-reported good (or better) physical (and mental) health by year 2020. Disparity in HRQOL also exists between rural and non-rural residing adults, with rural adults reporting lower levels of both physical and mental health [8].

Physical activity (PA) is associated with an increased longevity [9], a decreased risk of heart disease, stroke, cancer, and type II diabetes [10], as well as an increased risk of being obese [11]. Due to such evidence, current guidelines for PA recommend adults meet 150 minutes of moderate-intensity PA each week, or 75 minutes of vigorous-intensity activity each week, or an equal combination of moderate and vigorous activity each week [12]. Physical activity, in proper quantities, is known to also increase HRQOL [13]. Evidence is limited, however, as to whether meeting recommended levels of PA can improve HRQOL in rural adults. Therefore, the purpose of this study was to investigate the relationship between meeting recommended levels of PA and HRQOL in a rural adult population.

MATERIALS AND METHODS

1. Sample

Data for this study came from the 2013 Montana Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is an annual state-based cross-sectional survey of non-institutionalized U.S. adults 18 years of age and older [14]. The survey is telephone administered and collects responses to questions concerning health-related risk behaviors, health status, as well as participant use of preventive services. A total of 6,103 adults who indicated residing in a rural county were used in the analysis [15].

2. Measures

PA status was assessed by a series of steps from self-reported data regarding participant PA during the previous 30 days [16]. The first step is to estimate maximal oxygen consumption ($VO2_{max}$) using the respondent's age and $VO2_{max}$ formulas for men ($VO2_{max}$ = (60 − 0.55 * age in years) and women ($VO2_{max}$ = (48 − 0.37 * age in years). Dividing the estimated $VO2_{max}$ values by 3.5 allows for the conversion of $VO2_{max}$ to metabolic equivalents (METs). The second step is to determine the MET cutoff for moderate and vigorous intensity classification. The maximal MET estimated from step 1 is multiplied by 0.60 to determine a vigorous intensity cutoff for each respondent (i.e., $MET_{max} \times 0.60$). Any activity greater than or equal to 3 METs is considered moderate in intensity. The third step requires each reported activity to be intensity classified as either vigorous, moderate, or neither. This is accomplished using the 2011 Compendium of Physical Activities. Once these activities are intensity coded (moderate and vigorous), they are then combined with the reported frequency (number of days) and duration (minutes that each activity lasted) for each activity to form a combined value of minutes of moderate PA. The final step is to classify each respondent into an appropriate PA category. Those reporting 150+ minutes of moderate PA (or moderate-vigorous equivalent) per week were considered having met guidelines.

Six different HRQOL measures were used in this study. The CDC's Healthy Days core was used for the first four measures of HRQOL (general health, physical health, mental health, and inactivity health) [5]. The general health measure was assessed by a single item asking adults to rate their perceived general health. Response options included "excellent", "very good", "good", "fair", and "poor". Those reporting either "excellent", "very good", or "good" were considered to have "good" HRQOL. Those reporting "fair" or "poor" were considered to have "poor" HRQOL. The second and third measures were also single items specifically addressing physical health and mental health, respectively. These questions asked respondents to report the number of

days (out of the previous 30 days) that their physical (or mental) health was not good. Those reporting 13 days or less were considered to exhibit "good" physical (or mental) health [17].

The fourth measure, a single question, specifically asked for the number of days (out of the previous 30 days) that poor physical or mental health kept them from their usual activities (self-care, work, or recreation). Those reporting 13 days or less were considered to be active due to health and therefore exhibit "good" HRQOL. A fifth measure, the Healthy Days index, was computed to represent the number of healthy days out of the previous 30. These five measures were dichotomized to indicate good HRQOL. Finally, the sixth HRQOL measure was formed from a well-fit IRT measurement model [18]. The IRT HRQOL ability scores were used in this study as a continuous variable.

3. Statistical analysis

Prevalence estimates, standard errors (SEs), and Rao-Scott chi-square tests of independence were used to describe both PA as well as HRQOL across demographic characteristics. Multiple logistic regression models were used to calculate the adjusted odds ratios (ORs) and 95% confidence intervals (CI) of reporting good HRQOL among adults who met PA guidelines, while adjusting for age, race, gender, and income. The general linear model was finally used to form analysis of variance (ANOVA) models and test for the linear trend in mean HRQOL scores across PA categories. Continuous HRQOL scores were first T-score transformed ($M = 50$, $SD = 10$) where larger scores represent better HRQOL. All analyses were performed using the complex samples module of SPSS version 16. All p-values are reported as 2-sided and statistical significance was set at 0.05.

RESULTS

A total of 5,660 rural adults had complete PA data to be included in the analysis (Table 1). Overall, 57.7% of rural adults reported meeting current PA guidelines of at least 150 minutes of moderate intensity (or moderate-vigorous combination) PA each week. Although some demographic categories showed modest difference in PA prevalence, only income showed significant ($p < .001$) difference across categories. Table 2 shows prevalence estimates for HRQOL (general health). Overall, 82.3% of rural adults reported good HRQOL. With the exception of gender, all demographic characteristics had significant difference in prevalence across groups.

Table 3 displays results of the logistic regression analyses. Each analysis modeled the probability of good HRQOL (as compared to poor HRQOL) using PA as its main independent variable, coded for meeting PA guideline (as compared to not meeting the guideline). Each unadjusted model was significant, with greatest odds of good HRQOL (OR = 2.16, 95% CI: 1.73, 2.71) seen using the physical health measure. As well, all adjusted models were sig-

Table 1. Prevalence of meeting and not meeting recommended levels of PA by demographic category, rural adults 2013

	N	Met PA Guidelines				p
		Yes		No		
		%	*SE*	%	*SE*	
Overall	5660	57.7	1.0	42.3	1.0	<.001
Gender	5660					.291
Male	2290	44.4	1.3	46.5	1.5	
Female	3370	55.6	1.3	53.5	1.5	
Age Group (yr)	5660					.456
18-24	131	5.6	0.9	4.5	0.8	
25-34	362	8.0	0.8	8.3	0.9	
35-44	514	12.3	1.0	12.4	1.0	
45-54	847	16.3	1.0	19.2	1.3	
55-64	1455	24.4	1.1	24.8	1.2	
65+	2351	33.4	1.2	30.9	1.3	
Race/Ethnicity	5618					.088
White	4851	89.1	0.8	86.8	0.9	
American Indian	576	7.3	0.6	9.5	0.7	
Hispanic	73	2.0	0.4	1.3	0.3	
Multiracial	88	1.2	0.2	1.6	0.4	
Other	30	0.4	0.2	0.8	0.3	
Income (US $)	5092					<.001
<10,000	318	5.1	0.8	6.6	0.7	
10-14,999	375	5.9	0.7	7.8	0.8	
15-19,999	427	6.2	0.6	9.3	0.9	
20-24,999	616	11.1	0.9	12.0	0.9	
25-34,999	663	10.9	0.8	13.9	1.1	
35-49,999	883	18.3	1.1	18.2	1.2	
50-74,999	836	18.8	1.1	15.2	1.2	
75,000+	974	23.8	1.2	17.0	1.2	

Note. p-values are for the Rao-Scott chi-square statistic. 150 minutes of moderate intensity PA (or vigorous equivalent) was guideline used for meeting PA. % represents column percentages.

Table 2. Prevalence of good and poor HRQOL by demographic category, rural adults 2013

	N	General Health				p
		Good		Poor		
		%	*SE*	%	*SE*	
Overall	5650	82.3	0.7	17.7	0.7	<.001
Gender	5650					.414
Male	2288	45.1	1.1	46.4	2.3	
Female	3362	54.9	1.1	53.6	2.3	
Age Group (yr)	5650					<.001
18-24	131	6.1	0.7	0.5	0.3	
25-34	362	8.9	0.6	4.5	1.3	
35-44	514	13.5	0.8	7.0	1.2	
45-54	846	16.8	0.8	21.2	1.9	
55-64	1452	24.2	0.9	26.7	2.1	
65+	2345	30.6	0.9	40.1	2.2	
Race/Ethnicity	5608					.002
White	4843	89.0	0.6	84.1	1.6	
American Indian	575	7.3	0.5	12.6	1.4	
Hispanic	72	1.8	0.3	1.0	0.4	
Multiracial	88	1.4	0.2	1.3	0.5	
Other	30	0.5	0.2	1.0	0.6	
Income (US $)	5083					<.001
<10,000	318	4.8	0.6	10.3	1.4	
10-14,999	372	4.6	0.5	16.0	1.8	
15-19,999	426	6.6	0.6	11.8	1.5	
20-24,999	614	10.3	0.7	16.8	1.9	
25-34,999	662	12.2	0.7	12.0	1.6	
35-49,999	882	18.7	0.9	16.1	1.9	
50-74,999	835	19.1	0.9	9.0	1.3	
75,000+	974	23.6	1.0	8.0	1.3	

Note. p-values are for the Rao-Scott chi-square statistic. HRQOL in this table is self-reported general health. % represents column percentages.

Table 3. Odds of good HRQOL among adults who met recommended levels of PA

Good HRQOL	Meets PA Guidelines			
	Unadjusted		Adjusted	
	OR	*95% CI*	*OR*	*95% CI*
Physical health	2.16	1.73, 2.71	1.99	1.54, 2.56
Mental health	2.14	1.63, 2.82	1.96	1.46, 2.64
Inactivity health	2.11	1.57, 2.85	2.14	1.54, 2.97
General health	1.89	1.54, 2.32	1.69	1.35, 2.13
Healthy days	2.15	1.76, 2.64	1.98	1.58, 2.45

Note. Comparison group are those who did not meet recommended levels of PA. Adjusted logistic regression models are controlling for age, sex, race, and income.

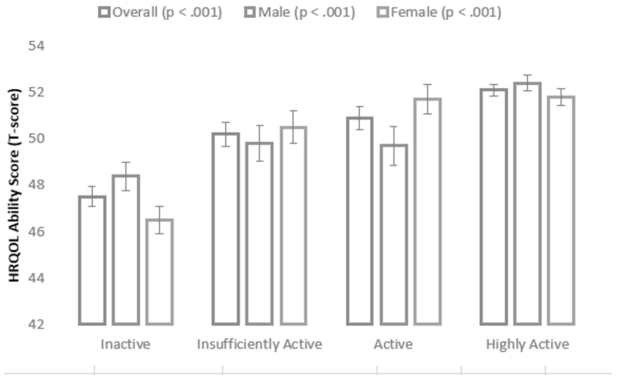

Fig. 1. Dose-response relationship between PA and HRQOL. Note. p-values represent tests of linear trend across group means. Error bars represent SEs. HRQOL ability scores are T-score transformed (M = 50, SD = 10) where larger scores represent better HRQOL.

nificant, with greatest odds of good HRQOL (OR = 2.14, 95% CI: 1.54, 2.97) seen using the inactivity health measure.

Rural adults meeting recommended levels of PA also had a significantly greater HRQOL ability score (51.7 ± 0.23, Mean ± SE), compared to those not meeting recommended levels (48.4 ± 0.33, $p < .001$). This relationship was similar in both males (51.7 ± 0.33 vs. 48.8 ± 0.48, $p < .001$) and females (51.7 ± 0.33 vs. 48.0 ± 0.46, $p < .001$). Fig. 1 shows the dose-response relationship between amounts of PA and HRQOL ability score. A significant linear trend was present in the overall, male, as well as female models (p's < .001), showing that more PA was associated with greater levels of HRQOL.

DISCUSSION

The primary purpose of this study was to investigate the relationship between meeting recommended levels of PA and HRQOL in a rural adult population. This relationship was clearly established by evidence from the logistic regression analyses. Those rural adults who reported meeting current PA guidelines (≥150 minutes of moderate-intensity PA per week) were in fact more likely (approximately twice as likely) to report good HRQOL. This finding was consistent across all five models, each using different measures of HRQOL. Furthermore, this relationship between PA and HRQOL was maintained even after controlling for the potential confounding effects of age, sex, race, and income.

The continuous measure of HRQOL resulting from a well-fit IRT measurement model, also showed greater HRQOL among those meeting PA guidelines, as compared to those not meeting guidelines. The collective findings from the analysis of all six HRQOL measures are evidence that this PA and HRQOL relationship is a robust one.

A secondary purpose of this study was to examine the extent to which different doses of PA associated with different levels of HRQOL. Results from these analyses showed that PA and HRQOL were in fact directly related. Specifically, as rural adults moved from categories of "inactive" to "insufficiently active" to "active" to "highly active", mean scores of HRQOL also significantly increased. This dose-response relationship was maintained in both male and female analyses.

One limitation of this study is its cross-sectional nature which limits these findings to correlation-type inferences as opposed to cause-and-effect generalizations. However, the test of linear trend in this study, which also tests for the dose-response effects of PA and HRQOL, is a statistical tool that can strengthen cross-sectional generalizations to provide more cause-and-effect like evidence. Another limitation of this study is that its data are collected via telephone. It is commonly understood that certain segments of the population, such as the poor, may not have access to a telephone. These subpopulations may also be less likely to be physically active and more likely to exhibit poor HRQOL. However, including more respondents from such segments may only increase the strength of our reported relationship. A final limitation of this study is the use of the self-reported assessment of PA. It may be a case that some respondents perceive certain modes of PA at intensities different than our assessment methodology. This type of inconsistency may allow for some error in PA classification.

This study has many strengths worth mentioning. First, data for this study are from a representative sample of rural adults 18 years of age and older residing in the state of Montana. The complex multi-stage sampling utilized in this survey ensures representation from all subgroups commonly left out of non-probability samples. Hence, these data allow for much stronger generalizations concerning rural adults and their health status. A second strength of this study is its use of the BRFSS PA rotating core (PARC). The PARC allows for an estimate of $VO2_{max}$ from each respondent and thereby allowing a relative assessment of vigorous activity. This methodology strengthens the study's PA classification scheme by permitting a more accurate assessment of total minutes of PA, both minutes of moderate- and vigorous-intensity. A final strength worth mentioning is the use of multiple logistic regression models to assess the relationship between PA and HRQOL. These models included commonly known confounding variables that otherwise could distort a study's generalizations.

In conclusion, this study found that meeting recommended levels of PA increases the likelihood of reporting good HRQOL in rural adults. It was also shown that increasing PA to each successive category provides additional benefit, in terms of HRQOL. These results should be used to promote the current PA guidelines for improved HRQOL in rural populations.

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