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Relationship between an IRT-derived HRQOL Score and PA among Adults in Montana

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Abstract **Background**: Much research supports the physical activity (PA) and health-related quality of life (HRQOL) relationship. However, less is known about this association when advanced measurement techniques are used to assess HRQOL. The aim of this study was to use item response theory (IRT) to score HRQOL items and subsequently examine the extent to which PA relates to the new measure. **Methods**: Data from N = 6,245 adults 18+ years of age participating in the 2019 Montana Behavioral Risk Factor Surveillance System (BRFSS) were used. Four different 3-category HRQOL items were created from survey questions regarding general, physical, mental, and activity health. Two PA variables were created from survey questions regarding PA guidelines and PA quantity. A graded response IRT model (GRM) was used to assess the HRQOL scale and output ability scores. Multinomial logistic regression was used to examine the relationship between PA and HRQOL tertile membership while adjusting for sex, age, race, income, education, marital status, BMI, smoking status, and alcohol consumption. **Results**: Factor analysis retained a single HRQOL factor (loadings > .68) with ordinal alpha indicating acceptable internal consistency ($\alpha_{ordinal}$ = .83). The GRM analysis confirmed all HRQOL items fit a unidimensional construct with adequate discrimination (*a*s: 1.17 to 5.13) and difficulty (*b*s: -2.052 to -0.07). Fully adjusted regression models showed increased odds of high HRQOL tertile membership (versus low tertile) for adults meeting aerobic PA (APA) (OR = 1.64, 95% CI: 1.28 – 2.09) and adults meeting both APA and muscle strengthening activity (MSA) (OR = 1.73, 95% CI: 1.34 – 2.23) guidelines, compared to those meeting neither APA nor MSA guidelines. Similarly, there was increased odds of high HRQOL tertile membership (versus low tertile) for adults considered sufficiently active (OR = 1.59, 95% CI: 1.16 – 2.19) and adults considered highly active (OR = 2.03, 95% CI: 1.58 – 2.61), compared to those considered inactive. Adults meeting MSA guidelines only and adults insufficiently active were no more likely to see high HRQOL tertile membership than their less active counterparts. **Conclusion**: The IRT-derived HRQOL score is a novel outcome measure and found to be associated with both PA guidelines and PA quantity among adults in Montana.

Keywords: *physical activity (PA), Health-related Quality of Life (HRQOL), item response theory (IRT), graded response model (GRM), rural health*

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1. Introduction

Health-related quality of life (HRQOL) is a popular outcome measure used in health and medical disciplines and considered a subjective assessment of a person's own health status [1]. HRQOL has become popular in outcomes investigations, in part, because of its strong predictive relationship with mortality [2]. Given this connection, health behaviors that have the ability to change HRQOL can be promoted in susceptible populations, thus increasing longevity. One such health behavior is physical activity (PA). Specifically, evidence supports the direct relationship between PA and HRQOL in both general, rural, and diseased populations [3,4,5]. Even with this information, there is little agreement regarding which assessment or which set of items is best for measuring HRQOL. Item response theory (IRT), however, has the ability to score a scale measuring a unidimensional construct while remaining item invariant [6]. Said differently, regardless of which items are used in a HRQOL assessment, participants will receive the same relative IRT-derived HRQOL score. This attribute of IRT allows for optimal measurement of HRQOL in a given sample and an ideal set of scores in subsequent modeling. Hence, the purpose of this study was to first assess a brief HRQOL scale and second to examine the relationship between PA and the IRT-derived HRQOL scores in a sample of adults from Montana.

2. Materials & Methods

2.1. Study Procedures

Data for this research came from the 2019 Montana Behavioral Risk Factor Surveillance System (BRFSS). Detailed BRFSS methodology can be found elsewhere [7,8]. Briefly, the BRFSS is a state-based annual telephone survey designed to collect prevalence and trends data on health-risk behaviors and health status indicators in United States (U.S.) adults 18+ years of age. In the 2019 survey, the BRFSS assessed health factors ranging from alcohol, tobacco, and e-cigarette use to physical activity, diet, and safety behavior to health care utilization and primary prevention screening. Beginning in 2011, respondents have been recruited randomly using both landline telephones as well as cellular phones. The BRFSS is questionnaire-based and all responses are self-reported. For the current study, Montana participants were extracted from the national dataset.

2.2. Health-related Quality of Life (HRQOL) Variables

Four HRQOL items were created from four different survey questions regarding general, physical, mental, and activity health. The general health item (General_Health) was created from the following question: "Would you say that in general your health is: Excellent, Very good, Good, Fair, Poor." The following General_Health item coding included: "Excellent" or "Very good" = 2, "Good" = 1, and "Fair" or "Poor" = 0. The physical health item (Physical_Health) was created from the following question: "Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?" The following Physical_Health item coding included: "No days" = 2, "1 thru 13 days" = 1, and "14 thru 30 days" = 0. The mental health item (Mental_Health) was created from the following question: "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" The following Mental_Health item coding included: "No days" = 2, "1 thru 13 days" = 1, and "14 thru 30 days" = 0. The activity health item (Activity_Health) was created from the following question: "During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?" The following Activity_Health item coding included: "No days" = 2, "1 thru 13 days" = 1, and "14 thru 30 days" = 0.

2.3. Physical Activity (PA) Variables

Two PA variables were used in this study to include the meeting of certain PA guidelines and PA quantity. The PA guidelines variable included four (4) mutually exclusive groups where participants were categorized as either 1) meeting both aerobic PA (APA) and muscle strengthening activity (MSA) guidelines, 2) meeting APA guidelines only, 3) meeting MSA guidelines only, or 4) meeting neither guideline. Meeting APA guidelines was defined as engaging in 150+ minutes of moderate (or vigorous equivalent) PA per week. Meeting MSA guidelines was defined as engaging in PA or exercise specifically to strengthen muscles on 2+ days per week. The PA quantity variable included four (4) mutually exclusive groups where participants were categorized as either 1) Highly Active, 2) Active, 3) Insufficiently Active, or 4) Inactive. Participants were considered "highly active" if they reported 300+ minutes of moderate (or vigorous equivalent) APA per week. Participants were considered "active" if they reported 150+ minutes of moderate (or vigorous equivalent) APA per week, but less than 300 minutes. Participants were considered "insufficiently active" if they reported being physically active but less than 150 minutes per week. Finally, participants were considered "inactive" if they reported no PA.

2.4. Demographic and Health Variables

In order to control for possible health and demographic confounding, body mass index (BMI), smoking, alcohol consumption, sex, age, race, income, education, and marital status variables were used in this study. BMI was used as a numeric variable and assessed from self-reported height and weight as kg/m^2. For descriptive purposes, weight status groups were also formed using BMI and consisted of 1) Underweight (BMI < 18.5 kg/m^2), 2) Normal weight (18.5 kg/m^2 <= BMI < 25.0 kg/m^2), 3) Overweight (25.0 kg/m^2 <= BMI < 30.0 kg/m^2), and 4) Obese (BMI >= 30.0 kg/m^2). Smoking status was a categorical variable indicating being a current smoker (smokes every day or some days) or not current smoker. Alcohol consumption status was a categorical variable indicating heavy drinker (> 2 drinks per day for men and of > 1 drink per day for women) or not heavy drinker. Sex was a categorical variable indicating male or female. Age was used as a numeric variable and consisted of ages ranging from 18 to 80+ years. Race was used as a categorical variable and comprised the following four groups: 1) Non-Hispanic White, 2) Non-Hispanic Black, 3) Hispanic, and 4) Other (all other race groups). Income was used as a numeric variable, collected as household income, and comprised eight different income brackets ranging from 1 = $0 to $9,999 to 8 = $75,000 and over. Education was used as a categorical variable and comprised the following three categories: 1) Not a high school graduate, 2) High school graduate, and 3) College graduate. Finally, marital status was used as a categorical variable indicating married or not married.

2.5. Statistical Analyses

For the measurement portion of the study, both classical and modern techniques were applied. Classical item statistics (means, standard deviations), item-total correlations, and item category frequencies were computed for initial inspection. Polychoric correlation coefficients were evaluated between all items with an exploratory factor analysis and ordinal internal consistency reliability (alpha, α) performed on the correlation matrix [9]. The graded response model (GRM) was then run on the 4-item HRQOL scale using a logit function and marginal

maximum likelihood estimation. IRT-derived HRQOL person scores (theta, θ) were outputted and converted to a new tertile-based dependent variable. For the modeling portion of the study, both descriptive statistics and regression analyses were performed. Percentages were computed across the IRT-derived HRQOL score tertiles by demographic and health variable categories, with significance tests performed using the Rao-Scott chi-square statistic. Multinomial logistic regression was used to estimate the odds of being in the middle and then the highest HRQOL tertile relative to the lowest HRQOL tertile using the two PA variables as separate predictors. Analyses were weighted to produce generalizations representative of noninstitutionalized adults in Montana. SAS version 9.4 was used for all analyses [10].

3. Results

A total of N = 6,245 Montana participants had complete data for the measurement portion of the study. The modeling portion of the analyses lost 612, 509, 929, 14, 41, 184, and 268 observations due to missing data on the PA guidelines, PA quantity, income, education, marital status, smoking, and alcohol consumption variables, respectively. Table 1 contains results for the HRQOL scale item statistics. Item means indicate the General_Health item targeted a lower (poorer) HRQOL and the Activity_Health targeted a higher (better) HRQOL. Item-total correlations indicate adequate item associations with all unadjusted and adjusted correlations greater than .64 and .38, respectively. Table 2 displays the polychoric correlation matrix used for the exploratory factor analysis and ordinal alpha reliability analyses. Table 3 displays these results with the factor analysis retaining a single HRQOL factor (loadings > .68) and ordinal alpha indicating acceptable internal consistency ($\alpha_{ordinal}$ = .83). Table 4 contains results from the GRM analysis and confirms that all HRQOL items fit a unidimensional construct with adequate discrimination (*a*s: 1.17 to 5.13) and difficulty (*b*s: -2.052 to -0.07). Figure 1 is a visual representation of these results.

Table 5 and Table 6 contain descriptive statistics for IRT-derived HRQOL score tertile by demographic and health variable categories. Most noteworthy is the significantly (all *p*s < .05) higher percentage of lower tertile membership among minorities, those with lower income, those with less education, those who are married, those who are inactive, those who met MSA only, those who are either underweight or overweight, those who are a current smoker, and heavy drinkers.

Table 7 and Table 8 contain results from the multinomial logistic regression analyses. Fully adjusted regression models showed increased odds of high HRQOL tertile membership (versus low tertile) for adults meeting APA (OR = 1.64, 95% CI: 1.28 – 2.09) and meeting both APA and MSA (OR = 1.73, 95% CI: 1.34 – 2.23) guidelines, compared to those meeting neither APA nor MSA guidelines. Similarly, there was increased odds of high HRQOL tertile membership (versus low tertile) for adults considered sufficiently active (OR = 1.59, 95% CI: 1.16 – 2.19) and adults considered highly active (OR = 2.03, 95% CI: 1.58 – 2.61), compared to those considered inactive. Those meeting MSA guidelines only and those insufficiently active were no more likely to see high HRQOL tertile membership than their less-active counterparts.

Table 1. HRQOL scale item statistics

	Statistics		Item-Total Correlations		Category Frequencies		
Item	Mean	SD	Unadjusted	Adjusted	0	1	2
General_Health	1.36	0.75	.730	.482	1011	1956	3278
Physical_Health	1.50	0.73	.809	.619	867	1386	3992
Mental_Health	1.52	0.70	.646	.380	754	1503	3988
Activity_Health	1.67	0.65	.805	.643	606	867	4772

Note. N = 6,245. HRQOL items: 0 = poorer HRQOL and 2 = better HRQOL.

Table 2. HRQOL scale polychoric correlation matrix

Item	1	2	3	4
1. General_Health	1	.600	.313	.554
2. Physical_Health	.600	1	.413	.804
3. Mental_Health	.313	.413	1	.568
4. Activity_Health	.554	.804	.568	1

Note. N = 6,245.

Table 3. HRQOL scale factor analysis and reliability using polychoric correlation matrix

	Factor Analysis		Reliability	
Item	Loadings	Communality	$\alpha_{Deleted}$	$\alpha_{Overall}$
General_Health	.756	.571	.815	.826
Physical_Health	.887	.787	.734	
Mental_Health	.678	.460	.849	
Activity_Health	.916	.839	.704	

Note. N = 6,245. All α values are ordinal-level using the polychoric correlation coefficients [9].

Table 4. Graded response model item parameter estimates for the HRQOL scale

Item	Parameter	Estimate	*SE*	*p*
General_Health	Threshold 1	-1.579	0.050	<.001
	Threshold 2	-0.071	0.025	.002
	Slope	1.331	0.049	<.001
Physical_Health	Threshold 1	-1.265	0.030	<.001
	Threshold 2	-0.414	0.019	<.001
	Slope	2.872	0.128	<.001
Mental_Health	Threshold 1	-2.052	0.069	<.001
	Threshold 2	-0.595	0.032	<.001
	Slope	1.174	0.045	<.001
Activity_Health	Threshold 1	-1.362	0.028	<.001
	Threshold 2	-0.748	0.020	<.001
	Slope	5.127	0.494	<.001

Note. N = 6,245. Graded response model used a logit function and marginal maximum likelihood estimation [10].

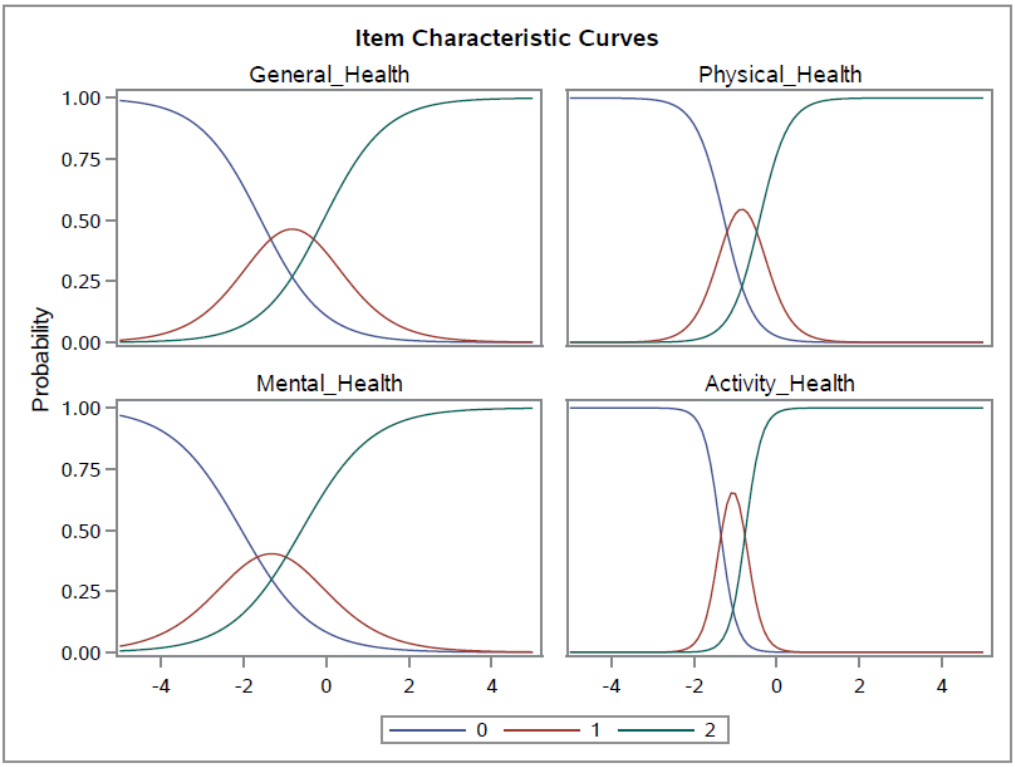

Figure 1. Graded response model item characteristic curves (ICCs) for the HRQOL scale

Table 5. Descriptive statistics for IRT-derived HRQOL score tertile by demographic variables, 2019 Montana BRFSS

	HRQOL Score Tertile						
	1		2		3		χ^2
Variable	%	SE	%	SE	%	SE	*p*
Overall	34.6	0.74	34.8	0.74	30.6	0.70	.001
Sex							<.001
Male	30.4	1.00	35.4	1.03	34.2	1.01	
Female	38.8	1.08	34.2	1.06	27.1	0.96	
Age (yr)							.003
18 to 24	41.4	2.69	34.8	2.58	23.8	2.29	
25 to 34	34.6	2.10	37.4	2.15	28.1	1.96	
35 to 44	34.8	1.93	31.2	1.88	34.0	1.94	
45 to 54	32.6	1.96	35.3	1.97	32.1	1.89	
55 to 64	34.7	1.55	35.6	1.56	29.7	1.47	
65+	32.0	1.16	34.5	1.18	33.5	1.15	
Race/Ethnicity							.001
White	33.4	0.78	34.8	0.78	31.9	0.75	
Black	52.7	14.84	21.5	11.97	25.8	12.17	
Hispanic	44.1	5.12	31.4	4.71	24.5	4.45	
Other	41.6	2.49	36.9	2.45	21.5	1.97	
Household Income ($)							<.001
< 15,000	57.9	3.19	28.9	3.10	13.2	1.99	
15,000 to 24,999	50.7	2.17	32.0	1.99	17.3	1.61	
25,000 to 34,999	38.5	2.46	33.2	2.34	28.3	2.23	
35,000 to 49,999	34.0	2.00	34.8	2.00	31.3	1.90	
50,000+	24.9	1.00	37.2	1.12	37.9	1.12	
Education							<.001
Not High school graduate	42.1	3.55	37.7	3.51	20.2	2.82	
High school graduate	36.2	0.95	34.5	0.94	29.3	0.89	
College graduate	28.7	1.11	34.9	1.18	36.4	1.17	
Marital status							<.001
Married	41.0	1.23	33.0	1.16	26.0	1.08	
Not married	30.1	0.91	36.1	0.96	33.8	0.92	

Note. SE is standard error. Significance tests are Rao-Scott chi-square statistics. HRQOL score tertile ranges from 1 = lowest (poorer) HRQOL to 3 = highest (better) HRQOL. Married marital status includes those self-reporting being in an unmarried relationship.

Table 6. Descriptive statistics for IRT-derived HRQOL score tertile by health variables, 2019 Montana BRFSS

	HRQOL Score Tertile						
	1		2		3		χ^2
Variable	%	SE	%	SE	%	SE	*p*
PA guideline status							<.001
Met APA and MSA	30.2	1.40	33.2	1.46	36.6	1.43	
Met APA only	31.1	1.30	37.4	1.33	31.4	1.24	
Met MSA only	42.0	2.46	32.7	2.33	25.3	2.14	
Met neither APA/MSA	42.5	1.57	33.9	1.49	23.6	1.35	
PA quantity							<.001
Highly active	30.0	1.08	34.3	1.12	35.7	1.10	
Active	32.4	1.94	39.0	1.99	28.6	1.76	
Insufficiently active	38.5	2.02	34.7	1.97	26.8	1.84	
Inactive	45.0	1.71	33.5	1.61	21.5	1.39	
Weight status							<.001
Underweight	44.2	6.70	35.0	6.80	20.8	5.19	
Normal weight	31.4	1.32	34.2	1.33	34.4	1.32	
Overweight	30.0	1.22	34.3	1.26	35.8	1.24	
Obese	44.8	1.46	35.3	1.40	19.9	1.15	
Smoking status							<.001
Current smoker	48.4	2.06	31.3	1.88	20.3	1.67	
Not current smoker	32.1	0.79	35.7	0.81	32.2	0.78	
Alcohol status							.078
Heavy drinker	40.1	2.71	30.0	2.42	30.0	2.49	
Not heavy drinker	34.6	0.79	35.1	0.79	30.3	0.74	

Note. SE is standard error. Significance tests are Rao-Scott chi-square statistics. HRQOL score tertile ranges from 1 = lowest (poorer) HRQOL to 3 = highest (better) HRQOL. APA is aerobic physical activity. MSA is muscle strengthening activity. Weight status assessed using typical CDC BMI criteria. Current smoker smoking status is defined as smoking every day or some days and having smoked at least 100 cigarettes in their lifetime. Heavy drinker alcohol status is defined as > 2 drinks per day (men) of > 1 drink per day (women).

Table 7. Multinomial logistic regression analyses for IRT-derived HRQOL score tertile (middle vs. lowest) and PA status, 2019 Montana BRFSS

	Odds of middle HRQOL tertile vs. lowest HRQOL tertile								
	Model 1			Model 2			Model 3		
Predictor Variable	OR	LL	UL	OR	LL	UL	OR	LL	UL
PA guideline status									
Met APA and MSA	**1.38**	1.12	1.70	**1.32**	1.04	1.66	1.22	0.96	1.55
Met APA only	**1.51**	1.24	1.84	**1.50**	1.21	1.86	**1.40**	1.12	1.74
Met MSA only	0.98	0.75	1.28	1.00	0.75	1.35	0.94	0.69	1.28
Met neither APA/MSA	1.00	reference		1.00	reference		1.00	reference	
PA quantity									
Highly active	**1.54**	1.27	1.88	**1.56**	1.25	1.94	**1.45**	1.16	1.82
Sufficiently active	**1.66**	1.29	2.14	**1.53**	1.15	2.02	**1.50**	1.12	2.00
Insufficiently active	1.23	0.96	1.58	1.29	0.97	1.70	1.26	0.94	1.67
Inactive	1.00	reference		1.00	reference		1.00	reference	

Note. Model 1 is unadjusted. Model 2 adjusts for demographic variables (age, sex, race/ethnicity, income, education, and marital status). Model 3 adjusts for demographic and health variables (BMI, smoking status, and alcohol consumption). OR is odds ratio. ORs in bold are significant ($p < .05$). LL is lower limit of the 95% OR confidence interval. UL is Upper limit of the 95% OR confidence interval. APA is aerobic physical activity. MSA is muscle strengthening activity.

Table 8. Multinomial logistic regression analyses for IRT-derived HRQOL score tertile (highest vs. lowest) and PA status, 2019 Montana BRFSS

	Odds of highest HRQOL tertile vs. lowest HRQOL tertile								
	Model 1			Model 2			Model 3		
Predictor Variable	OR	LL	UL	OR	LL	UL	OR	LL	UL
PA guideline status									
Met APA and MSA	**2.19**	1.76	2.72	**1.94**	1.52	2.47	**1.73**	1.34	2.23
Met APA only	**1.83**	1.48	2.25	**1.74**	1.38	2.20	**1.64**	1.28	2.09
Met MSA only	1.09	0.81	1.45	1.18	0.84	1.64	1.06	0.75	1.50
Met neither APA/MSA	1.00	reference		1.00	reference		1.00	reference	
PA quantity									
Highly active	**2.49**	2.02	3.08	**2.29**	1.79	2.91	**2.03**	1.58	2.61
Sufficiently active	**1.89**	1.44	2.47	**1.70**	1.25	2.31	**1.59**	1.16	2.19
Insufficiently active	**1.44**	1.10	1.90	**1.52**	1.11	2.08	1.38	0.99	1.92
Inactive	1.00	reference		1.00	reference		1.00	reference	

Note. Model 1 is unadjusted. Model 2 adjusts for demographic variables (age, sex, race/ethnicity, income, education, and marital status). Model 3 adjusts for demographic and health variables (BMI, smoking status, and alcohol consumption). OR is odds ratio. ORs in bold are significant ($p < .05$). LL is lower limit of the 95% OR confidence interval. UL is Upper limit of the 95% OR confidence interval. APA is aerobic physical activity. MSA is muscle strengthening activity.

4. Discussion

There are a few noteworthy findings from this study worth discussing. For example, both classical methods and IRT were used to validate a brief 4-item HRQOL scale. Both assessment methodologies successfully confirmed a unidimensional HRQOL trait with well-fitting items contributing to its measurement. These findings are particularly significant because the same 4 items are standard in the CDC's HRQOL-4 *Healthy Days Measure* and administered in the BRFSS, National Health and Nutrition Examination Survey (NHANES) and Health Outcome Survey (HOS) [11]. Additionally, robust findings from the modeling stage of this study indicate PA as a significant predictor of HRQOL. Firstly, increased likelihood of middle HRQOL tertile membership (as compared to the lowest tertile) was seen in the fully adjusted model for those meeting APA guidelines only, compared to those meeting neither APA/MSA. Interestingly, this relationship was not significant among those meeting both APA/MSA nor those meeting MSA only. This suggests that MSA may not necessarily relate to HRQOL variation among those with average to poor HRQOL. Moreover, increased likelihood of middle HRQOL tertile membership (as compared to the lowest tertile) was seen in the fully adjusted model for those considered both "highly active" and those "sufficiently active", compared to those "inactive".

Secondly, increased likelihood of high HRQOL tertile membership (as compared to the lowest tertile) was seen in the fully adjusted model for those meeting APA guidelines only as well as those meeting both APA/MSA, compared to those meeting neither APA/MSA. Also, this relationship was not significant among those meeting MSA only. This suggests that MSA by itself does not necessarily relate to HRQOL. Additionally, increased likelihood of high HRQOL tertile membership (as compared to the lowest tertile) was seen in the fully adjusted model for those considered both "highly active" and those "sufficiently active", compared to those "inactive". In sum, these findings suggest that APA has a strong relationship with HRQOL variation, across all levels of HRQOL. Furthermore, MSA appears to contribute to HRQOL variation only when combined with APA and only among those with better HRQOL.

One strength regarding this current study is its use of a representative sample of noninstitutionalized adults in Montana. Therefore, the aforementioned findings generalize to civilian adults in Montana. To date, only one published study has presented relationship data on HRQOL and PA in Montana adults. Specifically, physical inactivity was shown to be a significant predictor of poor HRQOL in Montana adults, with physically inactive females having greater risk of poor HRQOL than their physically inactive male counterparts [4]. Therefore, the current study corroborates the present body of knowledge regarding the PA and HRQOL relationship among Montana adults. Another strength regarding this current study is its use of modern measurement theory to validate survey items and create psychometrically robust HRQOL scores. To date, only one published study has used IRT to validate a HRQOL survey-based scale and use its factor scores to examine their relationship with PA. Specifically, this study reported that meeting PA guidelines increased the likelihood of reporting good HRQOL in rural adults [3]. Thus, the current study also corroborates the present body of knowledge regarding the use of IRT-derived HRQOL scores in modeling PA in Montana adults.

Despite these strengths, there are some limitations worth declaring. Firstly, these findings come from cross-sectional data and therefore in no way imply a cause-and-effect relationship between PA and HRQOL. Secondly, both outcome scale items and predictor variables were assessed via self-report questionnaires. Therefore, there is a possibility for misclassification error due to item and reporting bias. Thus, findings from this study should be considered with caution.

5. Conclusions

This study found that an IRT-derived HRQOL score is a novel outcome measure that can be assessed using the common CDC HRQOL-4 items. Additionally, the newly developed HRQOL scores were found to be associated with both PA guidelines and PA quantity among adults in Montana. Meeting MSA guidelines only was not a predictor of HRQOL in this population. Health promotion specialists should develop intervention components directed toward meeting both APA and MSA guidelines for improving HRQOL in adults.

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