Muscle Strengthening Activity and Perceived General Health in West Virginia Adults

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Abstract **Background:** Muscle strengthening activity (MSA) is encouraged for all adults due to its positive associations with health outcomes, including bone strength, muscular fitness, and health-related quality of life. MSA is also associated with improved functional health and is recommended as part of a multicomponent physical activity program. West Virginia (WV) is currently the lowest-ranking U.S. state in the percentage of adults meeting MSA guidelines. Moreover, the extent to which health status influences MSA in this population is not understood. This study examined the associations between perceived general health and MSA in WV adults. **Methods:** Data for this study came from the CDC's Behavioral Risk Factor Surveillance System (BRFSS). A total of 5,301 adult participants 18+ years of age residing in WV were extracted from the national dataset. The primary outcome variable was meeting MSA guidelines status, where respondents reporting 2+ days per week of MSA were considered to have met guidelines. The primary predictor variable was perceived general health, where participants rated their general health as "excellent," "very good," "good," "fair," or "poor." General health was also dichotomized, with those responding as good or better categorized as good and all others as poor. Control variables included smoking, alcohol consumption, obese status, age, sex, race/ethnicity, and income. Analyses involved percentage estimates (%) of meeting MSA guidelines and multiple logistic regression modeling. **Results:** Overall, 26.1% (95% CI: 24.5% – 27.7%) of WV adults met MSA guidelines. Across subgroups, male, younger, other races, and more income populations met MSA guidelines at a higher rates than their counterparts. The percentage of meeting MSA guidelines was also higher among those with good as compared to those with poor general health (28.9% versus 18.2%, $p < .001$) and followed a linear trend from poor to excellent health (p trend $< .001$). Additionally, adults with good general health saw an 83% increase in odds (OR = 1.83, 95% CI: 1.49 – 2.23) of having met MSA guidelines compared to those with poor health. After controlling for all covariates, these odds were reduced to an increase of 36% (OR = 1.36, 95% CI: 1.07 – 1.72). Finally, the general health and meeting MSA guidelines relationship was stronger (general health × sex p = .004) in males (OR = 1.43, 95% CI: 1.23 – 1.64, p trend < .001) than in females (OR = 1.21, 95% CI: 1.07 – 1.38, p trend = .004) moving from poor to excellent health. **Conclusion:** These findings indicate that perceived general health is predictive of and may influence MSA behavior in WV adults.

Keywords: Physical activity (PA), Muscle strengthening activity (MSA), BRFSS, General health

Cite This Article: Peter D. Hart, "Muscle Strengthening Activity and Perceived General Health in West Virginia Adults." *American Journal of Public Health Research*, vol. 11, no. 6 (2023): 1-5. doi: 10.12691/ajphr-11-6-5.

1. Introduction

Physical activity (PA) is promoted to all adult populations due to health benefits such as decreasing risk for disease, increasing longevity, and improving health-related quality of life [1,2]. Current PA guidelines recommend all adults engage in 150+ minutes per week of moderate-intensity PA or 75+ minutes per week of vigorous-intensity PA or an equivalent combination of moderate-to-vigorous-intensity PA [3]. Muscle strengthening activity (MSA) is a specific type of PA promoted to adults as a preventive health behavior [4].

Healthy People 2030 has an objective related to MSA to increase the percentage of adults who perform muscle-strengthening activities on 2+ days per week [5]. MSA is a separate recommendation because of its positive associations with bone strength, muscular fitness, and health-related quality of life [6,7]. MSA is also associated with improved functional health and is recommended as part of a multicomponent physical activity program [8,9].

Despite these benefits and regardless of the national-level recommendations, many U.S. adults neglect this form of exercise. Recent estimates (2017) indicate that approximately 70% of U.S. adults do not meet current MSA recommendations [10]. Adults with lower income have been cited as less likely to meet MSA guidelines,

which may contribute to their reduced health status [11]. West Virginia (WV) is currently the lowest-ranking U.S. state regarding the percentage of adults meeting MSA guidelines [12,13]. Moreover, the extent to which health status influences this population's MSA is unknown. This study examined the associations between perceived general health and MSA in WV adults.

2. Materials & Methods

Study Procedures

Cross-sectional data from the 2019 Behavioral Risk Factor Surveillance System (BRFSS) were used for this study. Details regarding the BRFSS are explained elsewhere [14]. Briefly, the BRFSS is a state-based annual telephone survey of noninstitutionalized U.S. adults 18+ years of age designed to collect data on health-risk behaviors, health conditions, and preventive care. This study used data from the WV state portion of the larger 2019 dataset. This resulted in 5,301 records for this 2019 WV BRFSS analysis.

Muscle Strengthening Activity

To assess MSA behavior, respondents were asked how many times per week (or per month) they participated in physical activities or exercises to strengthen their muscles (such as calisthenics, yoga, sit-ups, push-ups, weight machines, free weights, and elastic bands). Respondents were asked not to include aerobic activities like walking, running, or bicycling. Answers to this question were then used to categorize participants into one of two MSA groups: 1) those meeting MSA guidelines (participating in MSA 2+ days per week) or 2) those not meeting MSA guidelines (participating in MSA < 2 days per week).

General Health

General health was assessed using a single question asking participants to rate their general health with the following response options: "excellent", "very good", "good", "fair" or "poor". Responses to this question were then numerically recoded from 1 to 5, with higher scores representing better general health. General health was also dichotomized, with those responding as good or better categorized as good and all others as poor.

Covariates

A smoking status variable was used and considered an "ever smoked" indicator variable. Participants were considered to have ever smoked if they reported smoking 100 or more cigarettes in their entire life. An alcohol consumption variable was used and considered a "moderate drinker" indicator variable. Participants were considered moderate drinkers if they reported having had at least one drink of alcohol in the past 30 days but did not binge drink and were not considered heavy drinkers. Finally, an "obese" status variable was used where respondents were categorized as obese if their reported height and weight resulted in a body mass index (BMI) of 30.0 (kg/m^2) or greater. Demographic covariates included age, sex, race/ethnicity, and income.

Statistical Analysis

Statistical analysis for this study included descriptive statistics in the form of weighted percentages with 95% confidence intervals (CI). The Rao-Scott Chi-Square test of independence was used to test for dependence between bivariate categorical variables. The relationship between general health and MSA was examined using three different sets of logistic regression models: a) bivariate unadjusted models, b) demographics adjusted models adjusted for age, sex, race, and income, and c) fully adjusted models adjusted for demographics as well as smoking, alcohol, and obese status. Finally, to test the moderating effect of sex on the general health and MSA relationship, a general health-by-sex interaction term was tested in the fully adjusted model with linear contrasts added for a trend test across the general health categories. Significance was set to p < .05 and SAS version 9.4 was used for all analyses [15,16].

3. Results

Table 1 contains the weighted percentages of adults meeting MSA in 2019 across different demographic characteristics. Overall, 26.1% (95% CI: 24.5% – 27.7%) met MSA guidelines, with greater percentages seen among males (28.3%, p = .011), younger adults 18-24 years of age (39.5%, p < .001), and other race/ethnicity groups (41.2%, p < .019). Additionally, age group (p for trend < .001) showed an indirect linear and income (p for trend < .001) a direct linear trend in the percentage of adults meeting MSA guidelines. Table 2 contains the weighted percentages of adults meeting MSA in 2019 across different health characteristics. Overall, 26.6% (95% CI: 25.1% – 28.1%) perceived their general health as poor, with only 18.2% (95% CI: 15.6% – 20.8%) of those adults meeting MSA guidelines. Additionally, lower percentages of meeting MSA guidelines were seen among those who have ever smoked (24.3%, p = .032), those who were not moderate drinkers (24.6%, p < .002), and those considered obese (20.1%, p < .001). Furthermore, general health saw a direct linear trend (p for trend < .001) in the percentage of adults meeting MSA guidelines.

Table 3 contains the logistic regression analyses examining the association between both forms of general health and MSA. Each of the three sets of models (unadjusted, demographics adjusted, and fully adjusted) indicated similar trends. The fully adjusted model using general health in binary form showed a 36% increased odds (OR = 1.36, 95% CI: 1.07 – 1.72) of meeting MSA guidelines for adults with good general health. The fully adjusted model using general health in ordinal form showed a 22% increased odds (OR = 1.22, 95% CI: 1.11 – 1.35) of meeting MSA guidelines for each increase in general health. Figure 1 displays the moderating effect (general health×sex: *p* = .004) of sex on the general health and MSA relationship. Specifically, males (OR = 1.43, 95% CI: 1.23 – 1.64, *p* trend < .001) had greater odds of meeting MSA guidelines than females (OR = 1.21, 95% CI: 1.07 – 1.38, *p* trend = .004) moving from poor to excellent health.

Note. Regression model is adjusted for age, race, income, smoking status, alcohol status, and obese status.

Figure 1. Weighted percent (%) of adults meeting MSA guidelines by general health, WV BRFSS 2019

Table 1. Demographics characteristics overall and by MSA status, WV BRFSS 2019

	Overall				Met MSA Guidelines				
Variable	*n*	*%*	*LL*	*UL*	*n*	*%*	*LL*	*UL*	*p*
Overall	5301				1251	26.1	24.5	27.7	<.001
Sex									
Male	2324	49.1	47.3	50.9	580	28.3	25.8	30.7	.011
Female	2977	50.9	49.1	52.7	671	24.0	21.9	26.2	
Age (yr)									
18-24	200	11.3	9.8	12.9	79	39.5	31.8	47.1	<.001
25-34	384	14.5	13.1	16.0	133	34.5	29.2	39.9	
35-44	576	14.8	13.5	16.1	167	30.5	26.1	35.0	
45-54	816	15.8	14.6	17.0	183	22.1	18.8	25.5	
55-64	1180	17.8	16.7	19.0	212	16.8	14.2	19.4	
65+	2145	25.7	24.5	27.0	477	21.8	19.7	24.0	
linear trend									<.001
Race/Ethnicity									
White	4881	92.7	91.6	93.8	1132	25.4	23.7	27.1	.019
Black	95	3.1	2.3	3.9	30	35.3	22.4	48.3	
Hispanic	45	1.4	0.9	1.9	13	26.8	11.7	41.8	
Other	143	2.8	2.1	3.4	47	41.2	28.7	53.7	
Income ($)									
<15,000	577	12.8	11.5	14.1	116	21.5	16.6	26.4	.062
15,000-24,999	825	18.7	17.2	20.2	192	25.2	21.1	29.2	
25,000-34,999	655	14.6	13.3	15.9	147	25.1	20.6	29.6	
35,000-49,999	703	15.0	13.7	16.4	175	28.7	24.0	33.4	
50,000+	1765	38.9	37.1	40.8	486	29.3	26.4	32.2	
linear trend									<.001

Note. *N* = 5,301. *p*-value is associated with the Rao-Scott Chi-Square test of independence. Respondents reporting 2+ days per week of MSA were considered having met MSA guidelines.

Table 2. Health characteristics overall and by MSA status, WV BRFSS 2019

Variable	Overall				Met MSA Guidelines				
	n	*%*	*LL*	*UL*	*n*	*%*	*LL*	*UL*	*p*
General Health									
Poor	1530	26.6	25.1	28.1	268	18.2	15.6	20.8	<.001
Good	3753	73.4	71.9	74.9	977	28.9	26.9	30.9	
General Health									
Poor	517	8.6	7.7	9.6	88	17.6	13.0	22.1	<.001
Fair	1013	18.0	16.7	19.3	180	18.5	15.3	21.7	
Good	1788	35.0	33.3	36.7	396	24.3	21.6	27.0	
Very good	1442	28.0	26.4	29.7	392	30.0	26.7	33.3	
Excellent	523	10.4	9.3	11.5	189	41.1	35.2	46.9	
linear trend									<.001
Ever Smoked									
No	2654	49.9	48.1	51.7	664	27.9	25.5	30.3	.032
Yes	2539	50.1	48.3	51.9	584	24.3	22.1	26.5	
Moderate Drinker									
No	3945	76.5	74.9	78.0	904	24.6	22.7	26.4	.002
Yes	1183	23.5	22.0	25.1	326	30.7	27.1	34.4	
Obese									
No	2986	60.3	58.5	62.1	825	31.0	28.7	33.3	<.001
Yes	2002	39.7	37.9	41.5	377	20.1	17.8	22.5	

Note. *p*-value is associated with the Rao-Scott Chi-Square test of independence. General health was assessed by asking participants to rate their own general health. Participants rating their general health as good or better were categorized "good" and otherwise "poor". Ever smoked was defined as those who reported smoking 100+ cigarettes in their entire life. Moderate drinker was defined as those reporting having had at least one drink of alcohol in the past 30 days but did not binge drink and were not considered heavy drinkers. Obese was defined as having a body mass index (BMI) of 30.0 (kg/m^2) or greater. Respondents reporting 2+ days per week of MSA were considered having met MSA guidelines.

Table 3. Logistic regression models examining the association between general health and MSA status, WV BRFSS 2019

Variable	Unadjusted			Demographics Adjusted			Fully Adjusted		
	OR	*LL*	*UL*	*OR*	*LL*	*UL*	*OR*	*LL*	*UL*
General Health									
Poor	1.00	-	-	1.00	-	-	1.00	-	-
Good	1.83	1.49	2.23	1.54	1.22	1.93	1.36	1.07	1.72
General Health									
Poor-to-Excellent	1.37	1.26	1.49	1.32	1.20	1.45	1.22	1.11	1.35

Note. Unadjusted models include the single general health predictor variable. Demographics adjusted models are adjusted for age, sex, race, and income. Fully adjusted models are additionally adjusted for smoking status, alcohol status, and obese status.

4. Discussion

This study examined the associations between perceived general health and MSA in WV adults. The results clearly indicate a strong positive relationship between general health and MSA in this population. Specifically, adults who rate their health better saw greater odds of meeting MSA guidelines (of 2+ days per week) than their counterparts rating their health poorer. Moreover, this relationship remained robust after controlling for demographic and health behavior variables. Research supporting these findings has been shown in both clinical and population-based studies involving older adults [17,18]. However, further research may be needed in larger general populations to thoroughly verify this current study's findings.

Another result of this study was finding sex as a moderator of the general health and MSA relationship. The association between general health and meeting MSA guidelines was substantially stronger for males than females. Data supporting this MSA and general health sex difference are sparse. However, the evidence does support the moderating effect of sex on the physical activity and health-related quality of life relationship [19,20]. Thus, more research is needed to corroborate the present study's findings.

This study has a few strengths worth mentioning. First, the data for this study is a strength because they are considered a representative sample of noninstitutionalized adults residing in the state of WV. This is the first known population-based study of all WV adults regarding a health status variable and MSA. Second, using BRFSS survey questions for the assessment of MSA and general health is a strength. The BRFSS specifically designs its

questionnaires to target the leading causes of premature death and disability in the U.S. Additionally, BRFSS questions have adequate measurement properties for assessing these variables.

There are limitations worth mentioning. Firstly, the BRFSS collects responses randomly via phone numbers. This becomes a limitation if specific segments of the WV population are less likely to have access to a phone. Moreover, these subpopulations may be less likely to meet MSA guidelines and more likely to report poor general health. Secondly, BRFSS data are cross-sectional. Cross-sectional research is limited to correlational and not cause-and-effect inferences. Therefore, findings from this study should not be misconstrued as poor general health status causing insufficient MSA in adults. Thirdly, all variables in this study were assessed via a self-report mechanism. Therefore, participant MSA and health status misclassification cannot be ruled out due to measurement and reporting bias. Given these limitations, findings from this study should be interpreted with caution.

5. Conclusions

These findings indicate that perceived general health is predictive of and may influence MSA behavior in WV adults. Health promotion specialists and public health officials should prioritize efforts to explain and address the low MSA in WV. This study is the first to examine the population-level link between perceived health status and MSA in WV adults.

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