

Contribution of Physical Activity to the Life's Simple 7 Metric in Older Rural Adults

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Abstract Purpose: The aim of this study was to examine specifically the contribution of physical activity (PA) to the American Heart Association's (AHA) Life's Simple 7 (LS7) metric and its relationship to health-related quality of life (HRQOL). **Methods:** Data for this study came from a large national survey conducted in 2015. A total of N=46,498 adults 50+ years of age and residing in a rural U.S. county were included. A modified LS7 metric was assessed to include: 1) not smoking within past year, 2) BMI less than 25, 3) consumption of 5+ fruits and vegetables per day, 4) obtaining 150+ minutes of moderate PA per week, and not being diagnosed with 5) high cholesterol, 6) hypertension, or 7) diabetes. One set of analyses were performed with those meeting the PA metric excluded and one set with those meeting the PA metric included. Multiple logistic regression was used to compute odds ratios (ORs) and 95% confidence intervals (CIs) while adjusting for age, sex, race, and income. **Results:** Prevalence of good HRQOL increased linearly (59.0%, 68.9%, 75.1%, 80.4%, 84.2%, 89.6%, & 90.0%, $p<.001$) across adult groups meeting 0 to 6 LS7 metrics, respectively. Adjusted models with those meeting PA excluded showed increased odds of reporting good HRQOL in adults meeting 1 (OR=2.16; 95% CI: 1.74-2.67), 2 (2.40; 2.01-2.88), 3 (2.61; 2.13-3.21), 4 (3.08; 2.32-4.08), and 5+ (4.56; 2.67-7.78) LS7 metrics. Adjusted models with those meeting PA included showed mostly greater odds of reporting good HRQOL in adults meeting 1 (1.71; 1.55-1.87), 2 (3.78; 3.03-4.73), 3 (4.69; 3.72-5.93), 4 (6.66; 5.01-8.86), and 5+ (6.76; 5.22-8.74) LS7 metrics. **Conclusions:** Results from this study show that the LS7 metric is a stronger predictor of HRQOL when PA is met in older rural U.S. adults. Health promotion programs should emphasize the importance of PA to the LS7 metric.

Keywords: *physical activity, life's simple 7, epidemiology, health-related quality of life*

Cite This Article: Peter D. Hart, "Contribution of Physical Activity to the Life's Simple 7 Metric in Older Rural Adults." *American Journal of Cardiovascular Disease Research*, vol. 5, no. 1 (2017): 1-4. doi: 10.12691/ajcdr-5-1-1.

1. Introduction

The American Heart Association (AHA) has developed a new metric representing ideal cardiovascular health [1]. The Life's Simple 7 (LS7) consists of four health behavior and three health factor metrics: 1) smoking, 2) body mass index (BMI), 3) healthy diet, 4) physical activity (PA), 5) cholesterol, 6) blood pressure, and 7) diabetes mellitus. The LS7 metric has been shown to be related to many major health outcomes. Among stroke survivors, those who met at least four LS7 metrics were significantly less likely to experience mortality than counterparts meeting less than two metrics [2]. In a series of studies using multi-ethnic participants, adults with higher LS7 scores had lower rates of both incident heart failure [3] as well as non-cardiovascular disease events [4]. Finally, among general population adults participating in the Australian Health Survey, those meeting five to seven LS7 metrics had 60% less risk of cardiovascular disease and those meeting three to four metrics had over 30% less risk of cardiovascular disease [5].

There is much evidence suggesting disparities in health among older and rural U.S. adults. A recent study from the National Center for Injury Prevention and Control, CDC, showed that rural status was associated with higher rates of passenger-vehicle-occupant deaths as well as lower rates of seat belt use [6]. A large population-based survey of U.S. adults indicated that rural regions had higher levels of obesity, physical inactivity, and poor diet, as compared to urban U.S. regions [7]. Another population-based study that researched quality of life in older U.S. adults showed that rural adults had lower social functioning, as compared to their urban counterparts [8]. This current knowledge regarding health inequities among older rural adults merits concern regarding their assessment on the LS7 metric as well as any associated health outcomes related to LS7 status.

Currently, the AHA promotes meeting all seven components of the LS7 metric, considering each component equal in terms of its impact on health outcomes [9]. Therefore, the aim of this study was to examine specifically the contribution of PA to the LS7 metric in terms of its relationship to health-related quality of life (HRQOL) in older rural adults.

2. Methods

2.1. Participants and Design

Data for this study came from a large national cross-sectional survey conducted in 2015 [10]. The Behavioral Risk Factor Surveillance System (BRFSS) is a state-based annual survey of U.S. non-institutionalized adults 18 years of age and older. The BRFSS uses a multi-stage complex probability sampling scheme and so provides estimates that are representative of all U.S. adults. The BRFSS is designed to assess health risk behaviors associated with the nation's leading causes of disease as well as the prevalence of chronic conditions. The 2015 BRFSS included survey questions regarding fifteen core sections: health status, health-related quality of life, health care access, hypertension, cholesterol, chronic health, demographics, tobacco use, alcohol consumption, fruit and vegetable consumption, physical activity, arthritis, seatbelt use, immunization, and HIV/AIDS [11]. This study used participant responses primarily from the demographics, HRQOL, hypertension, cholesterol, chronic health, fruit and vegetable consumption, tobacco use, physical activity cores. A total of N=46,498 adults 50+ years of age, who answered all relevant survey questions, and resided in a rural U.S. county were included [12].

2.2. Measures

HRQOL was the outcome variable for all analyses. HRQOL was assessed using the CDC Healthy Days Index and dichotomized to represent good or poor health. [13]. Independent variables consisted of the number of LS7 metrics both including and excluding PA as a metric. PA was assessed based on responses to a series of questions regarding PA in the past 30 days. Participants reporting 150+ minutes of moderate-intensity PA per week were considered to have met the PA guidelines [14]. A modified LS7 metric was assessed to include: 1) not smoking within past year, 2) BMI less than 25, 3) consumption of 5+ fruits and vegetables per day, 4) obtaining 150+ minutes of moderate PA per week, and not being diagnosed with 5) high cholesterol, 6) hypertension, or 7) diabetes.

2.3. Statistical Analysis

One set of analyses was performed with those meeting the PA metric excluded and one set with those meeting the PA metric included. Multiple logistic regression was used to compute odds ratios (ORs) and 95% confidence intervals (CIs) while adjusting for age, sex, race, and income [15]. All analyses were performed using SAS [16].

3. Results

Table 1 shows that prevalence of good HRQOL increased linearly (59.0%, 68.9%, 75.1%, 80.4%, 84.2%, 89.6%, & 90.0%) across adult groups meeting 0 to 6 LS7 metrics, respectively. Figure 1 displays the positive trend line ($p<.001$) between prevalence of good HRQOL and the number of LS7 metrics. Table 2 displays both unadjusted

and adjusted models of incremental increasing number of LS7 metrics predicting good HRQOL, both with and without the PA metric. Unadjusted models with those meeting PA excluded showed increased odds of reporting good HRQOL in adults meeting 1 (OR=2.05; 95% CI: 1.71-2.45), 2 (2.46; 2.12-2.85), 3 (2.92; 2.47-3.45), 4 (3.51; 2.80-4.40), and 5+ (5.30; 3.44-8.15) LS7 metrics. Unadjusted models with those meeting PA included showed mostly greater odds of reporting good HRQOL in adults meeting 1 (2.05; 1.89-2.23), 2 (4.71; 3.91-5.66), 3 (5.43; 4.49-6.57), 4 (8.17; 6.47-10.32), and 5+ (8.23; 6.68-10.14) LS7 metrics.

Adjusted models with those meeting PA excluded showed increased odds of reporting good HRQOL in adults meeting 1 (OR=2.16; 1.74-2.67), 2 (2.40; 2.01-2.88), 3 (2.61; 2.13-3.21), 4 (3.08; 2.32-4.08), and 5+ (4.56; 2.67-7.78) LS7 metrics. Adjusted models with those meeting PA included showed mostly greater odds of reporting good HRQOL in adults meeting 1 (1.71; 1.55-1.87), 2 (3.78; 3.03-4.73), 3 (4.69; 3.72-5.93), 4 (6.66; 5.01-8.86), and 5+ (6.76; 5.22-8.74) LS7 metrics. Table 3 displays both unadjusted and adjusted models of incremental increasing number of LS7 behavioral construct metrics predicting good HRQOL, both with and without the PA metric. Similar patterns were seen in these models as shown above.

Table 1. Weighted Percent of Good HRQOL by Number of LS7 Metrics

No. of LS7 Metrics	%	95% CI
0	59.0	57.1-60.8
1	68.9	65.8-71.9
2	75.1	73.3-76.8
3	80.4	78.8-81.9
4	84.2	82.4-85.9
5	89.6	87.7-91.2
6	90.0	86.3-92.8
7	-	-

Note. N=46,498. 74.6% (95% CI: 73.8-75.4) reported good HRQOL. Significant linear trend was seen, $p<.001$.

Table 2. Odds of Good HRQOL for Adults with Varying LS7 Metrics

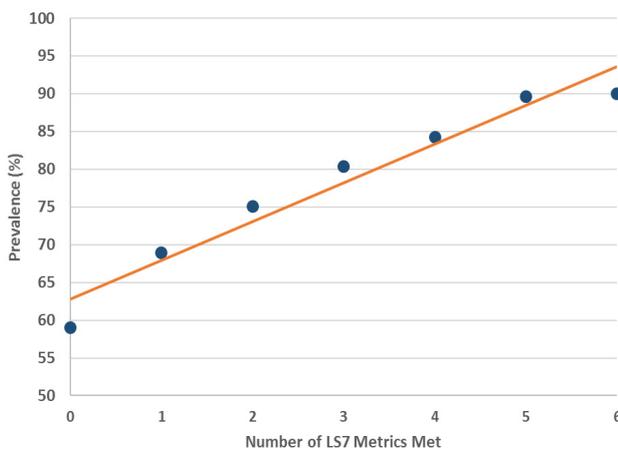
LS7 Metrics	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
1 LS7 Metric	2.05	1.71-2.45	2.16	1.74-2.67
PA Metric	2.05	1.89-2.23	1.71	1.55-1.87
2 LS7 Metrics	2.46	2.12-2.85	2.40	2.01-2.88
PA + 1 LS7 Metric	4.71	3.91-5.66	3.78	3.03-4.73
3 LS7 Metrics	2.92	2.47-3.45	2.61	2.13-3.21
PA + 2 LS7 Metrics	5.43	4.49-6.57	4.69	3.72-5.93
4 LS7 Metrics	3.51	2.80-4.40	3.08	2.32-4.08
PA + 3 LS7 Metrics	8.17	6.47-10.32	6.66	5.01-8.86
5+ LS7 Metrics	5.30	3.44-8.15	4.56	2.67-7.78
PA + 4+ LS7 Metrics	8.23	6.68-10.14	6.76	5.22-8.74
6+ LS7 Metrics	-	-	-	-
PA + 5+ LS7 Metrics	8.45	5.80-12.31	8.18	5.36-12.48

Note. LS7 metric rows exclude those meeting PA guidelines. PA metric rows includes those meeting PA guidelines.

Table 3. Odds of Good HRQOL for Adults with Varying LS7 Behavior Construct Metrics

Behavioral Construct	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
1 LS7 Metric	2.30	2.04-2.60	2.03	1.75-2.34
PA Metric	2.05	1.89-2.23	1.71	1.55-1.87
2 LS7 Metrics	2.90	2.45-3.43	2.42	1.99-2.95
PA + 1 LS7 Metric	4.11	3.56-4.75	3.19	2.70-3.77
3 LS7 Metrics	2.79	2.01-3.89	2.20	1.48-3.27
PA + 2 LS7 Metrics	5.61	4.71-6.67	4.22	3.43-5.20
All 4 LS7 Metrics	6.23	4.84-8.17	5.29	3.90-7.16

Note. The behavioral metric consists only of smoking, BMI, healthy diet, and PA metrics. LS7 metric rows exclude those meeting PA guidelines. PA metric rows includes those meeting PA guidelines.

**Figure 1.** Prevalence of Good HRQOL Across Number of LS7 Metrics

4. Discussion

The purpose of this study was to examine specifically the contribution of PA to the LS7 metric in terms of its relationship to HRQOL in older rural adults. The evidence from this research indicates that a strong relationship does indeed exist between the LS7 metric and HRQOL. Specifically, as the number of metrics met increased, in this population, so did the prevalence of good HRQOL. Whereas, among those meeting 6+ LS7 metrics, 90% reported good HRQOL. More importantly, however, this research showed that older rural adults who met the PA metric had greater odds of reporting good HRQOL when other (2 total or more) LS7 metrics were also met, as compared to their same LS7 counterparts who did not meet the PA metric. Furthermore, this increased HRQOL contribution by the PA metric remained after adjusting the models for confounders. A beneficial feature of the LS7 metric is that it can be evaluated in its entirety (all 7 metrics) or in terms of the behavioral metrics alone (behavioral construct). In this part of the study, similar findings were seen. That is, an increased odds of reporting good HRQOL was seen by those who met the PA metric along with other LS7 metrics, in comparison to counterparts not meeting the PA metric.

The strengths concerning this study should be mentioned. That is, this study analyzed data that are representative of

all U.S. rural adults 50+ years of age. Many similar studies lack this high quality external validity component regarding their generalizations. Another strength was the ability to completely assess the entire LS7 metric from survey data. The BRFSS is a rich survey in that it assesses several different health-related risk behaviors and health conditions [11]. Therefore, this study had the ability to use all LS7 metrics as well as its more specific behavioral construct.

This study also has limitations worth mentioning. One limitation, is that this study needed to use a modified LS7 metric as opposed to the original metric defined by the AHA [9]. Specifically, the metrics most modified here were the diet and health factor metrics. The AHA diet metric includes five different diet variables including the consumption of 1) fruit and vegetables, 2) fish, 3) fiber, 4) sodium, and 4) sugar beverages. This study was limited to assessing fruit and vegetable consumption only. Additionally, the AHA health factor metrics (i.e., cholesterol, blood pressure, and glucose) include clinically determined values with specific AHA-determined cutoff value criteria. This study was limited to participants indicating whether a healthcare professional had ever told them they had high cholesterol, hypertension, or diabetes. These limitations warrant caution when interpreting the findings from this study.

5. Conclusions

Results from this study show that the LS7 metric is a very strong predictor of HRQOL among older rural adults. Furthermore, the LS7 metric is an even stronger predictor of HRQOL when PA is met in older rural U.S. adults. Health promotion programs should emphasize the importance of PA to the LS7 metric.

Acknowledgements

No financial assistance was used to assist with this project.

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