



Journal of Public Health Research



eISSN 2279-9036

<https://www.jphres.org/>

Publisher's Disclaimer. E-publishing ahead of print is increasingly important for the rapid dissemination of science. The **Journal of Public Health Research** is, therefore, E-publishing PDF files of an early version of manuscripts that undergone a regular peer review and have been accepted for publication, but have not been through the copyediting, typesetting, pagination and proofreading processes, which may lead to differences between this version and the final one.

The final version of the manuscript will then appear on a regular issue of the journal. E-publishing of this PDF file has been approved by the authors.

J Public Health Res 2021 [Online ahead of print]

To cite this Article:

Hageman PA, Eisenhauer C, Mroz JE, Johnson Beller R. **A web-based intervention is feasible for supporting weight loss and increased activity in rural women with arthritis.** J Public Health Res doi: 10.4081/jphr.2021.2164



© the Author(s), 2021

Licensee [PAGEPress](https://www.pagepress.org/), Italy

A web-based intervention is feasible for supporting weight loss and increased activity in rural women with arthritis

Patricia A. Hageman,¹ Christine Eisenhauer,² Joseph E. Mroz,³ Rebecca Johnson Beller²

¹Department of Health and Rehabilitation Science, College of Allied Health Professions, University of Nebraska Medical Center, Omaha, NE

²College of Nursing-Northern Division, University of Nebraska Medical Center, Norfolk, NE

³Culturebie LLC, Ann Arbor, MI, USA

Corresponding Author: Patricia A. Hageman, PhD, PT, Physical Therapy Education, Department of Health and Rehabilitation Science, College of Allied Health Professions, 984420 Nebraska Medical Center, University of Nebraska Medical Center, Omaha, NE 68198-4420, USA
Email: phageman@unmc.edu

Phone: +1 (402) 559-1967

Fax: +1 (402) 559-8626

Key words: Underserved population, internet, health behavior, health disparities, physical activity

Author Contributions: PAH, CE, JM conceived the study. PAH and CE oversaw implementation of the study. JM & RJB provided leadership in data analysis and interpretation of data. PAH lead in writing draft of paper. All authors provided input to and approval of the final manuscript.

Conflict of Interest: Patricia A. Hageman declares a patent copyright on the DVD Banding Together for Strength used in the intervention component of the clinical trial. All other authors declare no conflicts of interest.

Ethical Approval: This study was approved by the Institutional Review Board of the University of Nebraska Medical Center (approval number 23710-FB) and was conducted according to the principles expressed in the Declaration of Helsinki. All women provided written informed consent prior to enrollment in the study.

Availability of Data and Material: All relevant data are within the paper and its supporting information files. The data source file, available in SPSS v25, used to support findings of this study is available from the corresponding author upon reasonable request

Funding: This study was funded by a National Institute of Nursing Research, National Institutes of Health Grant (Grant no. R01 NR010589), with supplemental funding from a Research Support Fund Grant (no number) from the Nebraska Medical Center and the University of Nebraska Medical Center, and from the Hygenic Corporation Thera-Band Academy (no number).

Significance for Public Health

Addressing increasing prevalence of obesity and sedentary lifestyle among rural women with arthritis is a public health issue. This study demonstrates the feasibility of using web-based interventions to reach and promote sustained engagement in rural women to achieve weight loss and increase activity. Web-based weight loss interventions may have potential to reduce rural health disparities by improving access to and acceptability of preventive public health interventions to achieve sustained, effective program engagement.

Abstract

Rural women have well documented health disparities, with higher prevalence of obesity and chronic conditions, including arthritis. Change in weight and actigraph-recorded data were examined in a subset of 63 of 82 women with physician-diagnosed arthritis who completed a 30-month web-based clinical trial. Repeated measures analyses showed women lost weight from baseline to six months, slowly regained at 18 and 30 months, ending with a lower weight than baseline $F(1,62)=40.89$, $p < .001$, $\eta^2_p=.40$. Of 53 women with complete data, activity increased at six months, decreased at 18 months, and increased at 30 months $F(1,52)=4.14$, $p=.04$, $\eta^2_p=.07$. Women showed improved change in weight and activity from baseline at six, 18 and 30 months. This study adds support that web-based programs may promote weight loss and activity in a hard-to-reach, underserved population of midlife and older rural women with arthritis.

INTRODUCTION

Women living in rural communities are at greater risk of obesity and obesity-related behaviors that contribute a high prevalence of chronic conditions such as arthritis, compared with their urban counterparts.^{1,2} Physician-diagnosed arthritis affects nearly one in three adults in rural areas, with approximately half of these adults reporting arthritis-attributable activity limitations.^{3,4} The high prevalence of arthritis among rural women is attributed to recognized risk factors of age (45 years or older), lower socioeconomic status, lower levels of activity, and/or higher body

mass index (BMI).³ Attaining modest body weight losses of $\geq 2\text{-}5\%$ is related to a reduction in pain and abnormal joint loading,⁵⁻⁷ and is correlated with health-related quality of life.⁸ Maintaining an active lifestyle is important in reducing arthritis-attributable activity limitations and maintaining physical function.⁶ Yet, rural women with arthritis are less likely to receive weight loss counseling from their primary care provider than their urban counterparts,² potentiating the rural access disparity to health promotion resources.²

Purely distance-delivery interventions, via web-based, eHealth, or other formats have shown promise as an effective method to address behavior change for weight loss and weight maintenance in hard-to-reach populations, including rural women, though eHealth studies related to weight management in individuals with arthritis are limited.⁹⁻¹¹ This exploratory study examined whether rural women with obesity and arthritis completing a 30-month web-based intervention would experience change in weight and activity and to assess patterns of change, if found.

METHODS

This is a secondary analysis of change in weight and activity data over time from a subset of women who self-reported physician-diagnosed arthritis at baseline, and who completed the 30-month Women Weigh-in for Wellness randomized controlled trial (ClinicalTrials.gov Identifier: NCT01307644). All women enrolled in the parent trial provided informed consent, consistent with ethical approval requirements received through the Institutional Review Board of the University of Nebraska Medical Center (approval number 23710-FB). The study was conducted between June 2011 and December 2014. The parent trial randomly assigned 301 eligible women from underserved, rural communities to compare the effectiveness of three interventions: web-based only or web-based supplemented by either peer-led discussion or professional email counseling, on achieving weight loss and weight maintenance. Unique to this trial was the use of a three-phased intervention approach to influence initial weight loss and transition to weight maintenance over a 30-month period. The rationale, design and results of this trial have been presented elsewhere.⁹

As the parent-trial data analyses revealed no intervention group differences in the primary outcome of weight,⁹ for this study we combined data for analysis from women across all three intervention groups who self-reported physician-diagnosed arthritis at baseline.¹² Women were excluded if they reported a diagnosis of type 1 diabetes or type 2 diabetes requiring insulin, lost 10% or more bodyweight in the past 6 months, participated in another weight loss

program, or if they were on medications that affected weight loss or weight gain as verified by research personnel.

All women received the same messaging on the basic intervention website about behavior change strategies for adopting lifestyle healthy eating and activity, following accepted national dietary and activity recommendations at the time of intervention.¹³⁻¹⁵ Regardless of group assignment, all women had access to the basic intervention website, whereas women in two groups received augmented features of either participation in a peer-led discussion group or professional email counseling. All women were encouraged to self-monitor using the online web logging feature for weight, daily kilocalorie intake, activity step counts, and goal setting. The intervention was founded on the constructs of Pender's Health Promotion Model, with delivery of messaging purposely addressing motivational messages about benefits and barriers to action, self-efficacy, and interpersonal influences of family and friends for action of behaviors necessary to achieve weight loss and weight maintenance.¹⁶

All assessments were completed by trained research nurses at baseline, 6 months, 18 months, and 30 months, at an office on a community college campus, which was centrally located in the geographic region of the women's residences. Women completed surveys about their general demographic information and health history. Height (m), weight (kg), and body mass index (BMI) were measured via the Tanita scale [TBI-2015, Tanita Corporation of America, Inc.].

An actigraph accelerometer (Model GT3X, Pensacola FL), a device shown to have high reliability and validity, was used to assess weekly minutes of moderate and/or vigorous physical activity (MVPA), using established cut-points.^{17,18} At the assessment time points, women were asked to wear the device placed on an adjustable waist band over their dominant hip. Women were asked to wear the device 24 hours a day, except during activities such as showering, over seven days.

All statistical analyses were completed using SPSS v 25. Repeated measures ANOVAs were conducted to examine women's change in weight and actigraph-recorded physical activity. Using the four available time points (baseline, 6 months, 18 months, and 30 months), we tested for patterns of change (eg. linear, quadratic, cubic) over time, if any. Prior to conducting analyses, all variables were assessed and verified to meet adequate standards for normality. Our analysis was limited to 63 women with complete weight data at all four assessment time points.

RESULTS

Sixty-three of 82 women (77% retention) completed the 30-month trial. At baseline, the mean age of the completers was 57.6 ± 6.7 years with an average BMI of 35.0 ± 4.2 kg/m². Women were non-Hispanic white (n=63, 100%). All women graduated from high school, with 56 (89%) completed some college or greater and 29 reported a baccalaureate degree or higher (46%). Fifty-one women (81%) were employed outside of the home full- or part-time and 52 women (85%) reported an annual household income of \$40,000 or greater.

Repeated measures analysis of weight change showed that women lost an average of 5.7 ± 6.4 kg initially between baseline to six months, then slowly regained at 18 and 30 months, and ended the 30 month study with an average of 2.8 ± 6.8 kg lower weight than at baseline, consistent with a quadratic pattern of weight change, $F(1, 62) = 40.89$, $p < .001$, $\eta^2_p = .40$. See Table 1 and Figure 1. Mean weight at six months, 18 months, and 30 months was lower than baseline bodyweight. Of the 63 women with complete weight data over time, nearly half lost a minimum of 5% percent of body weight at six months (n=31, 49.2%). Over a third lost 5% or more at 18 months (n=24, 38.1%) and 30 months (n=24, 38.1%). The average mean bodyweight loss from baseline was 5.7 ± 6.4 , 3.8 ± 6.8 , and 2.7 ± 6.8 kilograms at the respective follow-up assessments.

Among 53 women with complete actigraph data, women averaged 213.3 ± 122.3 weekly minutes of MVPA at baseline. At six months, the time associated the greatest weight loss, women substantially increased their activity, averaging 251.7 ± 166.7 weekly minutes of MVPA. Overall the pattern of change in physical activity was cubic as noted in Table 1 and graphed in Figure 2, suggesting an initial increase in activity at six months, decrease at 18 months, and another increase at 30 months, $F(1, 52) = 4.14$, $p = .04$, $\eta^2_p = .07$.

Women with complete actigraph data were active, exceeding national activity recommendations of ≥ 150 minutes MVPA across all 4 assessment time-points, noting 30 month completers averaged 232.8 ± 146.3 weekly minutes of MVPA, which was higher than baseline activity. Over half of women averaged at least 150 minutes or more of MVPA per week throughout the study (baseline, n=43, 68%; 6 months, n=46, 73%; 18 months; n=41, 65%; and 30 months, n=36, 57%).

DISCUSSION

This analysis adds to the current evidence that a web-based intervention for change in weight and activity was feasible in reaching and retaining an at-risk population of rural women with physician-diagnosed arthritis. Women achieved and maintained a modest weight loss over time, consistent with other weight loss programs using eHealth delivery.¹¹ Such modest weight losses

have resulted in clinical meaningful reduction in joint loads, osteoarthritis symptoms, and improved functional mobility during daily activities in other studies, although these health outcomes were not assessed in this study.⁵⁻⁷

The rural women who participated in the actigraph-activity monitoring were active, exceeding national recommendations for ≥ 150 weekly minutes of MVPA across all time points. This level of activity may have influenced their success in maintaining a lower weight than baseline at 18 and 30 months, as activity is associated with weight loss maintenance.¹⁹ This active cohort showed the capacity to substantially increase activity between baseline and six months.

There are limitations in this exploratory analysis. The physician-diagnosed arthritis as self-reported by the women was not verified by a health care provider, yet this method is validated for public health surveillance.¹² Demographics of this cohort, all non-Hispanic white women of higher socio-economic status, may have influenced the results, an issue common in many eHealth interventions.^{11,20} Women most likely to be active were potentially more motivated to participate in the actigraph-activity monitoring, and as such may not be reflective of the sample.

Additional research is needed to assess the confounding influences (eg. comorbidities, pain, psychosocial factors, *etc.*) affecting women's change in weight and activity, and potential health outcomes associated with change in these measures. With growing popularity of such distance-delivery interventions, there is a need to involve public health communities in the development of eHealth interventions to advance the acceptability, scalability, and long-term outcomes of the communities they serve.²⁰

CONCLUSION

Findings support the feasibility of reaching and retaining rural women with arthritis to achieve weight reduction and increased activity across 30 months using a web-based intervention. This study broadens the research evidence base with which to inform future public health programming targeting health promotion of rural midlife and older women.

References

1. Hootman JM, Helmick CG, Barbour KE, et al. Updated projected prevalence of self-reported doctor-diagnosed arthritis and arthritis-attributable activity limitation among US adults, 2015–2040. *Arthritis Rheum* 2016;68:1582–7.
2. Greaney ML, Cohen SA, Ward-Ritacco C, Riebe D. Rural-urban variation in weight loss recommendations among US older adults with arthritis and obesity. *Inter J Environ Res Public Health* 2019;16:946.
3. Boring MA, Hootman JM, Liu Y, et al. Prevalence of arthritis and arthritis-attributable activity limitation by urban-rural county classification - United States, 2015. *MMWR Morb Mortal Wkly Rep* 2017;66:527-32.
4. Barbour KE, Helmick CG, Boring M, et al. Obesity trends among US adults with doctor diagnosed arthritis 2009-2014. *Arthritis Care Res* 2017;69:376-83.
5. Christensen R, Bartels EM, Astrup A, Bliddal H. Effect of weight reduction in obese patients diagnosed with knee osteoarthritis: A systematic review and meta-analysis. *Ann Rheum Dis* 2007;66:433-9.
6. Guglielmo D, Hootman J, Murphy LB, et al. Health care provider counseling for weight loss among adults with arthritis and overweight and obesity- United States, 2002-2014. *MMWR Morb Mortal Wkly Rep* 2018;67:246-53.
7. Hughes SL, Tussing-Humphreys L, Smith-Ray R, et al. Fit & strong! plus trial outcomes for obese older adults with osteoarthritis. *Gerontologist* 2020;60:558-70.
8. Hageman PA, Mroz JE, Yoerger MA, Pullen CH. 2019. Weight loss is associated with improved quality of life among rural women completers of a web-based lifestyle intervention. *PLoS One* 2019;14:e0225446.
9. Hageman PA, Pullen CH, Hertzog M, et al. Web-based interventions alone or supplemented with peer-led support or professional email counseling for weight loss and weight maintenance in women from rural communities: Results of a clinical trial. *J Obes* 2017;4:1–21.
10. Maurits MP, Yuminaga H, Huizinga TWJ, Knevel R. Mobile health applications in rheumatology: Could they improve our care and research? *Int J Clin Rheumatol* 2019;14:44-9.
11. Sorgente A, Pietrabissa G, Manzoni GM, et al. Web-based interventions for weight loss or weight loss maintenance in overweight or obese people: a systematic review of systematic reviews. *J Med Internet Res* 2017;19:e299.
12. Sacks JJ, Harrold LR, Helmick CG, et al. Validation of a surveillance case definition for arthritis. *J Rheumatol* 2005;32:340–7.
13. United States Department of Agriculture and United States Department of Health and Human Services. 2010 Dietary Guidelines for Americans, 2010. 7th Ed. Accessed: January 2, 2021. Available from: <https://health.gov/dietaryguidelines/dga2010/dietaryguidelines2010.pdf>
14. United States Department of Health. Healthy people 2010: Understanding and improving health. 2010. Accessed: January 2, 2021. Available from: http://health-equity.lib.umd.edu/640/1/Healthy_People_2010-Under_and_Improv_Health.pdf

15. United States Department of Health and Human Services. Physical Activity Guidelines for Americans. Accessed: January 2, 2021. Available from: <https://health.gov/paguidelines/pdf/paguide.pdf>
16. Pender NJ, Murdaugh CL, Parsons MA. Health promotion in nursing practice, 5th ed. Upper Saddle River: Pearson Prentice-Hall; 2006.
17. Troiano RP, Berrigan D, Dodd KW, et al. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exer* 2008;40:181-8.
18. Freedson PS, Melanson E, Sirard J. Calibration of the Computer Science and Applications, Inc. accelerometer. *Med Sci Sports Exer* 1998;30:777-81.
19. Jensen MD, Ryan DH, Apovian CM, et al. 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. *Circulation* 2014;139:S1022-38.
20. Armaou M, Araviaki E, Musikanski L. ehealth and mhealth interventions for ethnic minority and historically underserved populations in developed countries: an umbrella review. *Int J Commun Well-being* 2020;3:193-221.

Table 1. Weight and physical activity of rural women with arthritis (n = 63). Analyses using Repeated Measures ANOVAs.

Outcome	Baseline	6 Months	18 Months	30 Months	<i>F</i>	η^2_p
	M (SD)	M (SD)	M (SD)	M (SD)		
Weight (kg)	93.53 (12.96)	87.81 (13.68)	89.72 (14.92)	90.78 (14.59)	40.89**	.40
Physical activity ^a	213.28 (122.47)	251.67 (166.68)	217.45 (126.56)	232.84 (146.29)	4.14*	.07

^aNumber of weekly minutes of moderate or vigorous intensity activity over 7 days as measured by actigraph. * $p < .05$. ** $p < .001$.

Figure 1. Average weight (kg) of rural women with arthritis at assessment visits (n=63).

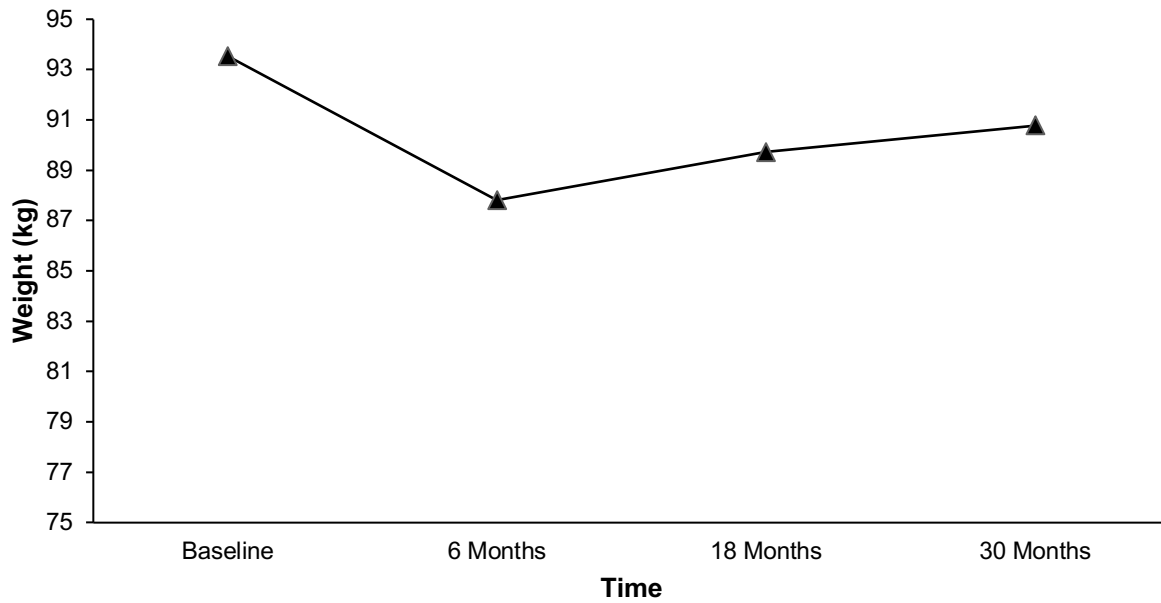


Figure 2. Average weekly minutes of moderate or vigorous intensity physical activity (MVPA) of rural women with arthritis at assessment visits (n=63).

