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# Evaluating the Effect of a Supplemental Home-Delivered Meal Program on Physical Health and Nutrition Status of Community-Dwelling Vulnerable Older Adults: A Pilot Study

*Crandall, Sullivan, Schafer, and Johnson*

**Abstract**

The population of older adults suffering from food insecurity is growing exponentially, yet there are limited resources available to serve them. To address this problem, the Weekend Accessible and Ready Meals (WARM) Program was created in one midwestern town to supplement the Meals on Wheels Program. The purpose of this pilot investigation was to determine if supplementing the MOW program was beneficial for improving aspects of physical health and nutrition. The results revealed no statistically significant impact on specific aspects of physical health and nutrition. Although not statistically significant, our results may help guide future WARM program planning.

## Introduction

Food insecurity is defined as not having the economic, social, and physical resources to shop, cook, and eat in order to ensure a sufficient supply of safe and nutritionally appropriate food (O'Leary et al., 2020). The population of older adults suffering from food insecurity is growing exponentially, yet there are limited resources available to serve them. Meals on Wheels (MOW) is a nationally disseminated nutrition program (MOW, 2021) with the purpose of delivering up to five nutritious meals, Monday through Friday, to low-income older adults who are impaired in some way that makes them unable to cook for themselves and unable to attend a senior community center (SCC) to eat a meal (Charlton et al., 2019). However, because the MOW meals are only delivered Monday through Friday and not on holidays, older adults may not have access to nutritious meals every day of the week.

To address this problem, the Weekend Accessible and Ready Meals (WARM) program was created to *supplement* the MOW program by providing up to two additional weekly meals, up to a total of seven weekly meals, for older adults to prepare on holidays and weekends. Staff from a midwestern senior community center (SCC) pick up food donated by the local hospital's food service provider. They then prepare and freeze each meal. The local MOW staff delivered the two frozen meals one day during the week while delivering regular MOW meals to qualified WARM participants.

The purpose of this 26-week pilot investigation was to determine the effects of supplementing the existing MOW program with two additional frozen meals each week. We hypothesized supplementing the MOW program with two additional weekly meals (WARM program) would positively affect the participants by improving specific aspects of physical health and nutrition status.

## Literature Review

This literature review will explore the literature on what effects MOW programs have on the mental and physical health of older adults.

### Physical Health

Low-income older adults are significantly more likely to fall than other older adults. Choi et al. (2019) found that older adults who receive home-delivered meals have a fall rate of 40%, considerably higher than other older adults in the United States (US). They also found that this population has a higher rate of chronic illness than other older adults, contributing to the higher fall rate.

There is scant literature regarding the efficacy of US MOW programs on a person's physical health, suggesting more in-depth research needs to be done. Shan et al. (2019) measured the number of hospital visits, emergency department visits, and utilization of nursing homes before and after receiving MOW for six months. There was a reduction in hospital and emergency department visits, as well as a reduction in the utilization of nursing homes six months after the beginning of the study. A similar study found that the length of hospital stays decreased after an individual received meals (Cho et al., 2018).

Luscombe-Marsh et al. (2014) found that MOW may not prevent older people who are nutritionally vulnerable from declining health due to age-related issues. However, the authors concede

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that there is a potential reduction in hospital admissions for this population and that more research needs to be done. Conversely, Sharkey (2003) found that home-delivered meals might not be meeting the needs of homebound older women. The study also found that the meals provided were low in crucial nutrients and that the women who did not receive meals on the weekends reported significantly lower intakes of all nutrients.

### Mental Health

There is more literature about the positive effect that MOW programs have on this population's mental health. It is not uncommon for older adults to face social isolation. The National Academies of Sciences, Engineering, and Medicine (2020) found that nearly one-fourth of adults ages 65 and older are considered to be socially isolated. Studies have shown that older adults with fewer social ties are at an increased risk of mortality from all causes, accidents, and suicide (Eng et al., 2002). However, MOW has the potential to reduce social isolation for its recipients through the delivery drivers. Thomas et al. (2020) conducted a qualitative study to measure the benefits of interactions between meal recipients and the delivery driver. Participants of the study reported a feeling of comradery and a reduction in their own social isolation due to frequent and scheduled visits from the drivers. Additionally, adults who receive meals daily report lower levels of loneliness than those who only receive a meal once a week (Thomas et al., 2016).

There is evidence to show older adults who receive MOW have better outcomes than those who do not. For example, Thomas et al. (2016) found that 31% of older adults on the waitlist for MOW were depressed. The researchers compared this with the national statistic of older adults living with depression, which is 12%. Additionally, 28% of those on the waiting list showed signs and symptoms of anxiety. Again, the researchers compared this to the national statistic of older adults who exhibit signs of anxiety, which is 10%. In addition, a 2013 study found that 92% of its participants reported that the meals delivered through the MOW program allowed them to continue living in their own homes (Thomas & Mor, 2013).

## Methods

### Participants

To qualify for the MOW program, staff from the local Area Development District (ADD) administer the DETERMINE (disease, eating poorly, tooth problems, economic issues, reduced social contact, multiple medicines, involuntary weight loss or gain, needs assistance, and elderly above age 80) nutrition screener, a 10-item (range 0-21) tool to assess the risk of poor nutritional status (0-2 = good; 3-5 = moderate nutritional risk; ≥6 = high nutritional risk). Along with financial need, lack of caregiver/family assistance, and lack of physical mobility, older adults scoring ≥3 on the DETERMINE screener may qualify for MOW. For this investigation, all current MOW recipients were recruited by ADD staff using flyers and word-of-mouth. All current MOW participants were informed that non-participation in the study would not affect their existing MOW deliveries. An SCC staff person obtained informed consent from each participant during their regular MOW delivery. Potential participants not able to provide informed consent due to cognitive impairment were excluded from this investigation. Each participant received $20.00 for completing the study.

### Materials and Design

Prior to study initiation, approval was obtained from the Institutional Review Board of the investigators, and all participants were treated in accordance with the ethical principles and code of conduct of the American Psychological Association. The study used a 2 (Pre- vs. Postintervention) x 2 (Group: WARM vs. No-WARM condition) design. A total of seventy-two (72) participants volunteered for the study. Nineteen (19) declined to participate before baseline data collection due to death/health issues or moving out of the geographic area. To ensure all participants had access to extra meals if needed, each participant was allowed to choose their condition. WARM participants received two frozen meals in addition to their weekly MOW meals, while the no-WARM group continued to receive their regular MOW meals during the week. Fifty-three (53) participants completed baseline testing (WARM $n$ = 21; No-WARM $n$ = 32). Seven (7) participants (WARM $n$ = 4; No-WARM $n$ = 3) dropped out prior to posttesting. Nineteen (19) WARM

participants and twenty-five (25) no-WARM participants who completed the study are included in our analyses.

**Outcomes**

To evaluate the effectiveness of the WARM program, we assessed aspects of physical health (grip strength and body mass index [BMI]) and nutrition (Mini-Nutritional Assessment-SF (MNA®; Cereda, 2012). A trained agency staff member and university student visited each participants' home at baseline and at the end of the 26-week study. Each of the following outcomes were assessed.

**Grip Strength.**

Participants' grip strength was assessed at baseline and at the end of the study using a research-grade handgrip dynamometer (Jamar). Briefly, a calibrated Jamar dynamometer (Performance Health, Warrenville, IL), with its handle in the second position, was used. Participants were instructed to squeeze the dynamometer as hard as they could while seated in an upright posture, with arms by their sides, elbows flexed to 90°, and forearms in a neutral position. Participant's highest grip strength score using their dominant hand was used for statistical analysis.

**Body Mass Index.**

Participants' body weight and height were assessed in their homes using a research-grade portable body weight scale. Height was estimated by measuring the length of the ulna of participants unable to stand (Barbosa et al., 2012). Body mass index was then calculated (height in meters/body weight in kilograms$^2$).

**Nutrition Status.**

Prior to the beginning of the current investigation, the DETERMINE nutrition screener was administered by ADD staff, who were not a part of our research team. In addition to the DETERMINE nutrition screener, our team administered, the Mini-Nutritional Assessment-SF (MNA®), a validated nutrition screening tool that can identify geriatric patients aged 65 and above who are malnourished or at risk of malnutrition. Scores range from 0-14 (0-7 = malnourished; 8-11 = at risk of malnutrition; 12-14 = normal nutritional risk).

**Statistical Analysis**

A 2 (Pre- vs. Postintervention) x 2 (Group: WARM vs. No-WARM program) mixed design repeated measure ANOVA, with significance set to $p < .05$, was used to detect any significant pre- to postintervention changes in grip strength and body mass index. Kendall's tau-b was used to detect pre and post changes in DETERMINE and MNA® nutrition status. Effect sizes are reported as partial eta squared values. Chi square tests were used to detect any significant sex differences

**Table 1.**

*Demographic Data*

Note: Data are represented as mean ± standard deviation, [a] one-way ANOVA, [b] Chi-square; $p < .05$.

| Variable | Experimental Group (WARM $n = 19$) | Control Group (No WARM; $n = 25$) | $p$ value |
|---|---|---|---|
| **Age (years)[a]** | 75.21 ± 10.17 | 75.36 ± 9.13 | 0.96 |
| **Sex (n)[b]** | | | 0.57 |
| Male | 6 (31.5%) | 10 (40%) | |
| Female | 13 (68.5%) | 15 (60%) | |

between conditions. A one-way ANOVA was used to compare baseline age between conditions. The Statistical Package for the Social Sciences (SPSS 28) was used for analyses. There were no significant differences between conditions in age or sex. See Table 1 for results.

## Results

There were no statistically significant differences in grip strength, BMI, or DETERMINE risk status between the WARM and no-WARM conditions. Results from the repeated measures ANOVA and Kendall's tau-b analyses are presented in Table 2.

## Discussion

The purpose of this pilot investigation was to determine if supplementing the MOW program with two additional frozen meals each week was beneficial for improving aspects of physical health and nutrition. The results revealed no statistically significant impact of the WARM program on specific aspects of physical health and nutrition. Although not statistically significant, our results may help guide future WARM program planning.

Body mass index in both conditions was lower at the end of the investigation, yet the differences within and between conditions were not statistically significant. Body mass index is a useful measure of disease risk. The higher the BMI, especially above 30, the greater risk of heart disease, type II diabetes, and some cancers. The mean BMI for both conditions, before and after this study, was greater than 30. This suggests participants in both conditions were receiving sufficient weekly calories to maintain their current, although unhealthy, body mass index. Poor nutritional quality of the participants' overall diet and a lack of physical activity likely contributed to unhealthy BMI. The regular MOW meals delivered Monday through Friday are planned by a registered dietician, ensuring nutritional quality and portion control. The supplemental meals for the WARM program are created from food donated by the local hospital's food service provider, therefore, there is little control over the nutritional composition and quantity of these meals. If possible, future attempts to create more nutritionally balanced meals may help improve indicators of physical health like BMI.

There is abundant evidence suggesting grip strength is associated with concurrent overall strength, upper limb function, bone mineral density, fractures, falls, cognitive impairment, depression, sleep problems, diabetes, multimorbidity, and quality of life (Bohannon, 2019). Males with a grip strength <27 kg and females with grip strength <16 kg are more likely to be diagnosed with sarcopenia, a muscle disease involving deficits in strength, lean muscle mass, and physical function (Schlicht et al., 2021). For this study, mean baseline grip strength measures for males and females in both conditions were below these minimums, suggesting they may be at increased risk for sarcopenia (Wang et al., 2018). Grip strength in both conditions declined over the course of the study, but the declines were not statistically significant within or between the conditions. Increasing physical activity was not the focus of the WARM program; therefore, we did not expect to see significant improvements in grip strength.

After administering the baseline MNA® and DETERMINE nutrition screening assessments of nutrition status, we expected participants to be similarly classified regardless of which screener was used. Surprisingly, using the DETERMINE screener, forty-three (43) participants were classified as "high risk" for malnutrition, while just one was classified as normal risk. In contrast, only 20 participants were initially classified at risk for malnutrition or malnourished based on the MNA® nutrition screener, while 24 were classified as normal risk.

Posttesting results were also contradictory between the two nutrition screeners. Although not statistically significant, four (4) WARM participants and five (5) no-WARM participants improved their nutrition status as measured by the DETERMINE nutrition screener. Also, a total of twelve (12) participants, six (6) from each group, reported no decreases in food intake compared to the beginning of the study. These findings should be interpreted with caution but do suggest the nutritional status of the no-WARM group improved more than the WARM group.

When using the MNA® nutrition screener, there were statistically significant differences in postnutritional status between the conditions at the end of the investigation. One WARM group participant, classified as "normal" risk at baseline, was classified as "malnourished" at the end of the study. Comparatively, two no-WARM group

**Table 2.**
*Intervention Effects*

Note: Data are represented as mean ± standard deviation, [a] mixed design repeated measures ANOVA, [b] Kendall's tau-b; *$p < .05$.

| Outcome | WARM | | No-WARM | | | | |
|---|---|---|---|---|---|---|---|
| | Baseline | Post-intervention | Baseline | Post-intervention | *F* | *p* | $\eta_p^2$ |
| **Body Mass Index (BMI)** [a] | 34.49 ± 10.19 | 33.69 ± 9.70 | 34.16 ± 11.20 | 32.81 ± 9.32 | 0.233 | 0.632 | 0.006 |
| **Grip Strength (kgs)** [a] | 16.68 ± 8.37 | 15.84 ± 8.72 | 20.72 ± 7.91 | 18.88 ± 8.23 | 0.317 | 0.576 | 0.007 |
| Male | 21.50 ± 8.36 | 20.83 ± 10.11 | 27.60 ± 6.79 | 24.60 ± 6.93 | | | |
| Female | 14.46 ± 7.69 | 13.54 ± 7.30 | 16.13 ± 4.61 | 15.07 ± 6.80 | | | |
| **MNA® Risk Status (*n*)** [b] | | | | | | 0.019 * | |
| Normal | 9 | 8 | 15 | 19 | | | |
| At risk | 9 | 9 | 7 | 5 | | | |
| Malnourished | 1 | 2 | 3 | 1 | | | |
| **Determine Risk Status (*n*)** [b] | | | | | | 0.816 | |
| Moderate (3-5) | 0 | 4 | 1 | 6 | | | |
| High (+6) | 19 | 15 | 24 | 19 | | | |

participants moved from "at risk" to "normal" risk and two moved from "malnourished" to "normal" risk.

## Limitations

There were limitations to this study that may have affected the results. First, because participants were allowed to choose their group, WARM or no-WARM, there is a possibility of selection bias. Second, it was not feasible to measure the macronutrient composition of the MOW or WARM meals, making it difficult to compare the weekly macronutrient composition and density.

## Conclusions

An important question to consider when evaluating the success of any health promoting program is whether the benefits to the participants outweigh the costs. The financial costs for the WARM program are minimal because the food is donated, and the extra WARM meals are delivered along with the participant's normal MOW meals. There are agency staff costs to pick up the donated food from the hospital and materials, e.g., disposable plates, to make and freeze each of the WARM meals, but these are minimal and can often be covered by other funding sources or volunteer staff.

Most importantly, the results of this investigation suggest there were no *identified* benefits to the participants after adding two additional weekly meals to the existing MOW program. Because our team was able to provide a better picture of the older adults who participate in the MOW and WARM programs, we found, on average, participants could be described as obese with poor grip strength compared to normative references. Also, most of the participants were not at risk of malnutrition, although this finding is questionable considering many were classified as malnourished based on the DETERMINE screener.

The high BMI and low grip strength of the participants also suggest many participants may suffer from sarcopenic obesity (SO), which is the concurrent presence of sarcopenia and obesity (Koliaki et al., 2019). Providing two extra meals each week may be contributing to the already existing problem of SO among the MOW participants. This problem is likely exacerbated by the fact that macronutrient composition and total calories are not well controlled when constructing the WARM meals.

The primary goal of the WARM program was to ensure nutritionally at-risk older adults receive at least two extra meals to eat on weekends and holidays. Based on our findings, the following actions are recommended.

1. It is clear from the results of this study that the screening process for determining who receives WARM meals should be reviewed to ensure only those most at risk receive the additional meals.
2. A physical activity education and/or intervention should be added to both the MOW and WARM programs to help address the unhealthy BMI and low muscle strength described in both study conditions.
3. Although the SCC staff have no control over the types of foods that are donated, it may be helpful to recruit a registered dietician to help ensure the WARM meals are nutritionally comparable to the regular MOW meals.
4. Although not formally assessed in this study, participants in both conditions reported social benefits of the weekly visits by the SCC staff and university student. These visits were not a part of the daily MOW meal delivery, therefore, outside of the typical WARM program. However, dedicating additional financial resources to allow specific visits could help address the previous recommendations. For example, a physical activity intervention could be implemented during the visits.

Of course, there are likely benefits to the WARM program that were not assessed in this study, as well as benefits that are difficult to quantify. For example, the psychological benefits of eating at least one warm meal each day are apparent, but difficult to quantify. Therefore, more research is needed to further examine the impact of the MOW and WARM programs on vulnerable older adults' physical, social, and psychological health.

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