



Original article

A nutritionally focused program for community-living older adults resulted in improved health and well-being



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SUMMARY

Objectives: Among older adults, malnutrition is common and is associated with increased risk for impaired health and functionality, conditions further associated with poorer quality of life. In this study of community-living older adults, our objective was to quantify outcome changes following identification and treatment of malnutrition or its risk.

Design: Our intervention was a nutritional quality improvement program (QIP). The nutritional QIP included: (i) education of participants about the importance of complete and balanced macro- and micronutrient intake plus physical exercise, (ii) nutritional intervention with dietary counseling; and (iii) provision of oral nutritional supplements (ONS) for daily intake over 60 days. Follow-up measurements took place 30 days after ONS treatment ended, i.e., 90 days after start of intervention.

Setting and participants: We recruited 618 transitional-care, chronically ill, older adults (>60 years) with malnutrition/risk (per Mini Nutrition Assessment-Short Form, MNA-SF) from the outpatient clinic of Hospital Universitario San Ignacio, in Bogotá, Colombia.

Methods: For pre-post comparisons, we examined cognition (Mini-Mental State Exam, MMSE), physical abilities (Barthel Activities of Daily Living, ADL; Short Physical Performance Battery, SPPB), affective disorder status (Global Depression Scale, GDS), and quality of life (QoL; EuroQoL-5D-3L, EQ-5D-3L; EuroQoL-Visual Analog Scale, EQ-VAS).

Results: Participants were mean age 74.1 ± 8.7 y, female majority (69.4%), and had an average of 2.6 comorbidities with cardiovascular and respiratory diseases predominant (28.5%). QIP-based nutritional intervention led to significant improvements in cognitive (MMSE) and physical functions (ADL and SPPB), affective disorder status (GDS), and health-related quality of life (EQ-VAS); all differences ($P < 0.001$). Self-reported QoL (EQ-5D-3L) also improved.

Conclusions and implications: Over 90 days, the nutritional QIP led to improvements in all measured outcomes, thus highlighting the importance of addressing malnutrition or its risk among community-living older adults. From a patient's perspective, maintaining mental and physical function are important and further linked with quality of life.

Brief summary: For older, community-living adults, nutrition care can improve health and well-being outcomes. Care includes screening for malnutrition risk, dietary and exercise counseling, and daily nutritional supplements when needed.

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1. Introduction

Worldwide, the number of people older than 60 years is expected to increase from 1 billion in 2019 to 1.4 billion before 2030 [1]. By 2050, the global population of older people is estimated to more than double to 2.1 billion [1]. As such, older people and their families, communities, and governments need to develop strategies and systems that can promote aging well. When older people were asked what it meant to age well, they highlighted maintaining physical health, preserving good mental health, and having a sense of well-being [2]. Such factors are particularly important to older people who want to continue living independently in their communities [3,4].

Good nutritional status is an important determinant of health in aging; adequate nutrition is foundational for proper function of all body systems [5]. In South America and around the world, older adults are vulnerable to malnutrition, especially undernutrition, when they have chronic disease or are recovering from an acute illness, surgery, or injury [6–11]. Malnutrition is defined as inadequate intake or uptake of nutrition, conditions that predispose to altered body composition and body cell mass, in turn leading to diminished physical and mental function and impaired clinical outcomes from disease [12]. Evidence shows that poor nutritional status is associated with lower physical function [13], poorer quality of life (QoL) [14], and shorter survival [15,16].

Recognizing risk for malnutrition in community-living older adults is thus an important public health goal, yet this goal often remains unmet in Latin America and elsewhere in the world [17]. Based on an extensive review of Latin American studies (66 studies, 12 countries), results revealed that malnutrition or its risk was highly prevalent among patients admitted to hospital from the community, i.e., in the range of 40%–60% [18]. Global studies have shown benefits of identifying and treating malnutrition risk among community-living, older adults [7,19,20], but our recent research report presented results for the only study of this kind in a Latin American country—Colombia [21]. For that study, we applied a nutritionally focused Quality Improvement Program (QIP) over a 90 day interval; post-QIP results showed more favorable measures for nutrition-related parameters in older people, i.e., greater Mini Nutrition Assessment-Short Form (MNA-SF) scores, calf circumference (CC) increases, and better body mass index (BMI) values [21]. Similar use of nutritionally focused QIPs for care of hospitalized patients in the United States (US) led to improved health outcomes and lower costs of care [22,23].

In the present report, we extended our prior observations from a nutritional QIP in Colombia [21] by analyzing additional outcomes for the community-living, older adults who were enrolled from an outpatient clinic in Bogotá. The current analysis quantified overall indicators of health and well-being (physical capabilities, cognitive function, affective disorder status, and QoL). We measured scores in each subfactor category before and after enrollees took part in a comprehensive, nutritionally focused QIP.

2. Methods

2.1. Study participants and ethical approval

We recruited older adults (>60 years) with malnutrition or its risk using a validated Spanish version of the Mini Nutrition Assessment-Short Form (MNA-SF, score 0–7 *malnourished*, 8–11 *at risk for malnutrition*) at the outpatient clinical setting of the Hospital Universitario San Ignacio, in Bogotá, Colombia [24,25]. We excluded candidates with advanced dementia (Reisberg Global Deterioration Score \geq 6) [26]; delirium; intolerance or allergy to oral nutritional supplements (ONS); or life expectancy less than 90

days. Our study population included many individuals considered to be in ‘transitional care,’ a critical period for people living with long-term conditions recovering from acute disease or hospital stays but not yet healthy enough to be fully independent in the community and may require additional homecare or assistance from caregivers. In this population, nutritional status becomes an important risk factor for hospital readmissions, greater use of healthcare resources, disease relapses, longer recovery times or incomplete recovery, and even death.

Each participant (or his or her caregiver) signed an informed consent form. Our study protocol was approved by the Ethics and Research Committee of the Hospital Universitario San Ignacio and was registered in ClinicalTrials.gov under Identifier: NCT04042987.

2.2. Intervention

As described previously, we used a multi-dimensional and comprehensive nutrition-focused QIP with a nutritional intervention for participants who were malnourished or at risk [27]. The QIP included: (i) education of people living with long-term conditions about the health importance of nutrition and physical exercise; and (ii) nutritional intervention with dietary counseling and information about the importance of physical exercise, and (iii) provision of ONS for daily intake over 60 days. Parameters were measured at baseline, with follow-up measurement 30 days after ONS treatment ended, i.e., 90 days after the intervention began. The study took place September 2019–July 2020. COVID-19 lockdown was implemented in Colombia on March 19, 2020.

2.3. Outcome characteristics and measures

To examine the relationship between nutrition and aging, we evaluated a combination of factors that reflect the extent to which better nutritional care can support or restore health and well-being in older adults. Specifically, we utilized tools to measure physical capabilities, cognitive function, affective disorder status, and QoL (Fig. 1).

2.3.1. Cognition

We used the 30-point Mini-Mental State Exam (MMSE) to assess cognitive function; MMSE is reported to be practical, reliable, and valid [28,29]. When the MMSE score was greater in a follow-up visit than in the initial visit, it was considered ‘improved.’ This indicator yields scores between 0 and 30.

2.3.2. Locomotor/physical activity

To assess physical capabilities, we used Barthel's Index to score the ability of study participants to perform usual activities of daily living (ADL) such as feeding, bathing, grooming, dressing, and toileting [30]. The Barthel Index was selected as one of four most valid and reliable psychometric instruments for assessing ADL in older community-dwelling populations [31]. When the Barthel Index score was greater in a follow-up visit than in the initial visit, it was considered ‘improved.’ This indicator takes values from 0 to 100 (responses have values of 0, 5, 10, or 15 points); improvement is indicated by an increase of at least 5 points in the index score. The physical performance was measured by the Short Physical Performance Battery (SPPB) consisting of three components—the balance test, 4-m gait speed, and 5-times chair stand test [32]. SPPB scores range from 0 to 10, and a score lower than 10 indicates mobility limitation.

2.3.3. Affective disorder status

We assessed affective disorder status by measurement of depression using the 15-item instrument, Geriatric Depression Screening Scale (GDS); the 15 items were chosen because of their

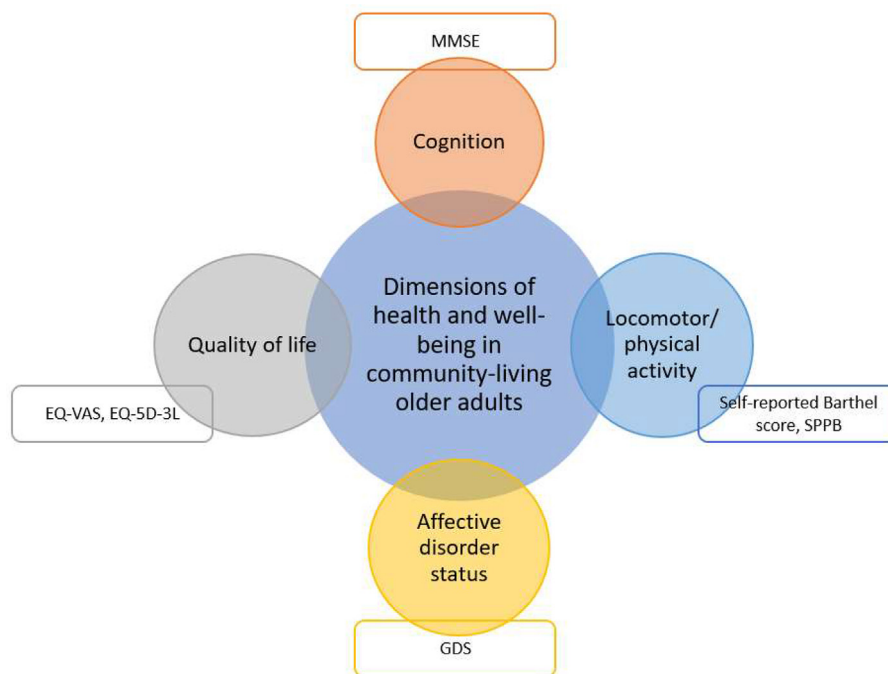


Fig. 1. Model for exploring the effects of nutrition on dimensions of health and well-being in our study of community-living older adults. These major factors were evaluated by measuring characteristics in subfactor categories—cognitive, locomotor/physical activity, affective disorder status, and quality of life. Measured characteristics are listed in unfilled rectangles. Abbreviations: MMSE, mini-mental state exam; GDS, geriatric depression score; EQ-VAS, EuroQoL visual analog scale; EQ-5D-3L, EuroQoL system for health-related quality of life states in adults, consisting of five dimensions (mobility, self-care, usual activities, pain & discomfort, anxiety & depression); SPPB, short physical performance battery.

high correlation with depressive symptoms in validation studies [33]. In the GDS, improvement was identified when the total score was lower in the last measure with respect to the value reported in the initial visit. This indicator takes values between 0 and 15.

2.3.4. Quality of life (QoL)

We used EuroQoL, a 2-part measure, to evaluate QoL in community-living older adults—self-reported QoL (EuroQoL-5D-3L, EQ-5D-3L) and self-perceived health-related QoL on the EuroQoL Visual Analog Scale (EQ-VAS) [34]. These measures are applicable to a wide range of health conditions and treatments.

In the EQ-5D-3L index, the results of the five dimensions of QoL were scored and summed. Each of the 5 dimensions (mobility, self-care, habitual activities, pain/discomfort, and anxiety/depression) were rated as values of 1, 2, or 3 where 1 indicates no limitation, 2 indicates some limitation, and 3 is the greatest limitation. The sum of the five dimensions of the EQ-5D-3L gives a total score between 5 and 15. Improvement was evidenced by a score decrease of at least 1 point.

In the EQ-VAS indicator, a self-assessment of health-related QoL is reported on a vertical visual analogue scale from 0 to 100, on which patients provide a global assessment of their health. Improvement was identified when the value was higher in the last measure with respect to the value in the initial visit. Improvement was indicated by at least a 1-point score increase.

2.4. Statistical analyses

Descriptive analyses (means and standard deviations or counts and percentages) were performed to assess the characteristics of the overall patient population. Chi-Squared tests were used for pre/post QIP comparison for all outcomes of interest. Adjusted multivariate logistic regression analyses were performed to assess the impact of nutrition status and other key patient socio-demographic parameters on the factors of cognition, locomotor/physical

function, and affective disorder status. In factors with more than one subfactor measured, pre-post comparisons were also made. To summarize outcome changes via logistic regression analysis, all results were dichotomized by assigning values of 1 or 0. A value of 1 was used if the final category was superior to baseline category, while 0 was used if the status remained the same or declined. Participants with missing data in variables of interest were excluded from the analysis. The significance level was defined as a significant confidence interval, and all analyses were performed using STATA 14[®] (College Station, TX: StataCorp LP).

3. Results

3.1. Recruitment and enrollment of participants

Of the 707 participants recruited to the study, 30 participants withdrew or were excluded before the baseline visit because of updated enrollment criteria, leaving 677 participants. Of these, 618 participants completed the QIP.

3.2. Demographic characteristics of enrollees at baseline

As reported previously, the mean age of study participants was 74.1 ± 8.7 years, and 69.4% of the sample was female [27]. The overall mean number of comorbidities was $2.6 (\pm 1.5)$ [21]. Cardiovascular and respiratory diseases were the most frequent diagnoses in the overall population (28.5%), followed by cancer (10.5%) and thromboembolic, hematological and endocrinological diseases (8.4%).

3.3. Improvements in nutritional status with QIP

After QIP intervention, 324 participants (52.4%) had improvement in nutritional outcomes, as reported earlier [21]. Nutritional

outcomes were measured by MNA-SF scores and calf circumference (a proxy for leg muscle mass) measures along with nutrition-related anthropometric determinations of body weight and body mass index (BMI).

Improvements in locomotor or physical activities measures (SPPB, Barthel), in affective disorder status (GDS), in cognition (MMSE) and in health-related QoL (EQ-VAS).

Following intervention, study participants had significant improvements in measures of physical, affective disorder status, and cognitive function, along with improvement in QoL (Table 1). For overall SPPB scores, 48% of participants showed significant improvement. The SPPB component measures of balance, gait speed, and five-times chair stand were improved for 56%, 53%, and 58% of participants, respectively (Table 1). Among participants with the greatest ADL impairment (Barthel score < than 80 points), 71% showed improvement post-intervention; 44% of minimally impaired participants (Barthel score < 95 points) also showed evidence of improvement. In addition, we observed marked and significant improvements in measures of affective disorder status, cognition, and self-perceived health-related QoL.

3.4. Overall quality of life

In the full population of participants (n = 618), most scores related to components of the self-reported overall QoL measures (EQ-5D-3L) improved after the nutritional QIP. These included relative increases in the percentage of participants having no problems with mobility (+4.1%), no problems with self-care (+1.4%), no pain or discomfort (+14.2%), and a relative increase of participants reporting that they were not anxious or depressed (+9.7%), as summarized in Table 2. We found a decrease in the percentage of participants reporting ‘no problems with performing usual activities.’ On the other hand, an increased proportion of

participants reporting ‘some problems with performing usual activities’ was likely a result of COVID-19 lockdowns limiting usual activities (Appendix Table 1 on usual activities before and after COVID-19 lockdown).

When assessing the impact of different nutritional and baseline participant characteristics on outcomes of interest for the total study population via regression analyses, we found that improved nutrition status led to a higher probability of observing improvements in physical function (OR = 1.56, P = 0.039) and affective disorder status (OR = 1.8, P = 0.001). No significant effects were observed for cognitive function and health-related QoL (Table 3).

Being of female sex and older than 75 years was associated with higher odds of experiencing improved physical function (OR = 2.35, P = 0.001 and OR = 1.59, P = 0.028, respectively), while being older than 75 years was associated with reduced probability of improved affective disorder status (Table 3). Higher probability of improved affective status and QoL was observed among participants with more than 3 comorbidities. Finally, having a low calf circumference (<30 cm) was associated with higher probability of reduced improvement in affective status (Table 3).

4. Discussion

Results of our QIP study in Bogotá, Colombia provide evidence in support of nutritional interventions (nutritional education plus use of ONS) to improve outcome measures of locomotor/physical activities, cognition, affective disorder status, and QoL for older, community-living adults with malnutrition or its risk receiving outpatient care. The QIP stimulates collaborative efforts of health-care professionals and patients through (i) education of older adults living with long-term conditions about the health importance of complete and balanced macro- and micronutrient intake plus physical exercise; and (ii) implementation of nutritional

Table 1
Proportion of participants with malnutrition or risk who had post-QIP measurable improvement in locomotor or physical activities measures (SPPB, Barthel), in affective disorder status (GDS), in cognition (MMSE) and in health-related QoL (EQ-VAS).

| | N | Percent | Total |
|--|--------|---------|-------|
| Locomotor/physical activities | | | |
| SPPB | | | |
| Improved-participants with baseline less than 9 points | 197 | 48% | 407 |
| P value | <0.001 | | |
| Components of SPPB | | | |
| Improved balance-participants with baseline less than 4 points | 68 | 56% | 122 |
| Improved gait speed-participants with baseline less than 4 points | 211 | 53% | 398 |
| Improved 5-times chair stand-participants with baseline less than 4 points | 231 | 58% | 396 |
| P value | 0.001 | | |
| Barthel index-ADL | | | |
| Improved-participants with baseline less than 95 points | 121 | 44% | 272 |
| Improved-participants with baseline less than 80 points | 20 | 71% | 28 |
| P value | <0.001 | | |
| Affective disorder status | | | |
| Geriatric depression scale-GDS | | | |
| Improved-participants with baseline more than 6 points | 158 | 84% | 187 |
| P value | <0.001 | | |
| Cognition | | | |
| Mini-mental state exam-MMSE | | | |
| Improved-participants with baseline less than 26 points | 108 | 75% | 144 |
| Improved-participants with baseline less than 24 points | 48 | 72% | 67 |
| P value | <0.001 | | |
| Health-related quality of life | | | |
| Health-related QoL-EQ-VAS | | | |
| Improved-participants with baseline less than 60 points | 120 | 76% | 157 |
| Improved-participants with baseline between 60 and 80 points | 88 | 65% | 136 |
| Improved-participants with baseline more than 80 points | 73 | 22% | 325 |
| Improved-total | 281 | 45% | 618 |
| P value | <0.001 | | |

Abbreviations: ADL, activities of daily living; MMSE, mini-mental state exam; GDS, geriatric depression score; EQ-VAS, EuroQoL visual analog scale; SPPB, short physical performance battery.

Table 2
Self-reported QoL by EQ-5D-3L at baseline and after nutritional QIP.

| Dimension/level | Baseline (n = 618) | | Final (n = 618) | | P value |
|---|--------------------|---------|-----------------|---------|---------|
| | N | (%) | N | (%) | |
| Mobility | | | | | |
| No problems in walking about | 560 | (90.6%) | 583 | (94.3%) | <0.001 |
| Some problems in walking about | 57 | (9.2%) | 35 | (5.7%) | |
| Confined to bed | 1 | (0.2%) | 0 | (0%) | |
| Self-care | | | | | |
| No problems with self-care | 598 | (96.8%) | 607 | (98.2%) | <0.001 |
| Some problems washing or dressing myself | 16 | (2.6%) | 10 | (1.6%) | |
| Unable to wash/dress | 4 | (0.6%) | 1 | (0.2%) | |
| Usual activities | | | | | |
| No problems with performing my usual activities | 319 | (51.6%) | 282 | (45.6%) | <0.001 |
| Some problems with performing my usual activities | 281 | (45.5%) | 328 | (53.1%) | |
| Unable to perform my usual activities | 18 | (2.9%) | 8 | (1.3%) | |
| Pain | | | | | |
| No pain or discomfort | 261 | (42.2%) | 298 | (48.2%) | <0.001 |
| Some pain or discomfort | 337 | (54.5%) | 316 | (51.1%) | |
| Extreme pain or discomfort | 20 | (3.2%) | 4 | (0.6%) | |
| Anxiety | | | | | |
| Not anxious or depressed | 307 | (49.7%) | 337 | (54.5%) | 0.043 |
| Moderately anxious or depressed | 275 | (44.5%) | 278 | (45%) | |
| Extremely anxious or depressed | 36 | (5.8%) | 3 | (0.5%) | |

Table 3
Odds of experiencing improved physical activities, cognitive function, and health-related QoL based on improved nutritional status, female gender, age >75 years, >3 comorbidities, and low calf circumference (<30 cm).

| Model | Improved physical function | | | Improved cognitive function | | | Improved health related-QoL | | | Improved affective disorder status | | |
|---|----------------------------|--------------|-------------|-----------------------------|--------------|-------------|-----------------------------|--------------|-------------|------------------------------------|--------------|-------------|
| | Odds ratio | P-value | CI 95% | Odds ratio | P-value | CI 95% | Odds ratio | P-value | CI 95% | Odds ratio | P-value | CI 95% |
| Independent variables | | | | | | | | | | | | |
| Improved nutritional status | 1.56 | 0.039 | [1.02–2.38] | 0.85 | 0.361 | [0.61–1.20] | 1.29 | 0.126 | [0.93–1.80] | 1.8 | 0.001 | [1.29–2.52] |
| Female sex | 2.35 | 0.001 | [1.42–3.91] | 1.04 | 0.835 | [0.72–1.50] | 0.75 | 0.113 | [0.53–1.12] | 1.03 | 0.855 | [0.72–1.47] |
| >75 years | 1.59 | 0.028 | [1.05–2.40] | 1.07 | 0.72 | [0.75–1.50] | 0.81 | 0.211 | [0.58–1.12] | 0.67 | 0.022 | [0.48–0.94] |
| >3 Comorbidities | 1.18 | 0.442 | [0.78–1.79] | 0.64 | 0.011 | [0.45–0.90] | 1.43 | 0.035 | [1.02–1.98] | 1.58 | 0.008 | [1.12–2.2] |
| Low calf circumference (<30 cm) | 1.49 | 0.062 | [0.98–2.25] | 1.09 | 0.607 | [0.78–1.54] | 1.07 | 0.67 | [0.77–1.49] | 0.64 | 0.008 | [0.45–0.89] |
| n | 618 | | | 517 | | | 618 | | | 618 | | |

Bold values have a significant p-value of <0.05.

intervention with dietary counseling, and (iii) provision of ONS for daily intake over 60 days, then conducting follow-up after an additional 30 days.

Individuals who participated in the nutritionally focused QIP had statistically significant improvements in scores for Barthel's ADL Index, Mini-Mental State Exam, Global Depression Scale, and EQ-5D-3L and EQ-VAS for patient-rated QoL. Taken together, these findings are consistent with and extend our prior report on improvements in nutritional status in this Colombian outpatient study group [21]. In that analysis, we found that the QIP-based intervention led to better nutritional status at the 90-day follow-up, as evidenced by significant improvements in MNA-SF scores and calf circumferences, as well as nutrition-related anthropometric measures (body weight and BMI) [21].

4.1. Perspectives and clinical implications of our study findings

Prompt identification and treatment of nutritional problems can improve health outcomes and enhance QoL—differences that are important to older adults who want to continue independent living in their communities [36]. We and others thus advise that older,

community-living adults should be screened routinely for nutritional issues [37]. Such nutritional screening is now used when older adults are diagnosed with chronic or acute health conditions [38,39] or when they are admitted to hospitals or care homes [40,41]. However, routine screening is not yet common for older people receiving care at outpatient clinics or in primary care practices. For these outpatients, we urge nutritional screening and periodic rescreening at intervals determined by individual clinical status.

Previously, an interplay has been reported between nutritional health and cognitive, affective, and physical functionality [42–46]. About 10%–15% of older adults have clinically-relevant symptoms of depression [42], which is a risk factor for dementia, functional loss, poor QoL, and morbidity and mortality [43]. We thus recognize that treatments to improve nutritional status could help to improve and prevent cognitive decline and depressive symptoms in old age, thereby promoting better functionality, QoL, and overall health.

4.2. The World Health Organization and healthy aging

To address population changes, the World Health Organization (WHO) has led the way by conducting research and by building

policies and strategies to facilitate healthy aging [1,47,48]. According to the WHO, healthy aging depends on functional (physical and mental) abilities that enable well-being in older age [48,49]. Functional abilities allow people to be and to carry out what they value, i.e., perceived QoL. Healthy aging happens when a person develops functional abilities across a lifetime and sufficiently maintains them in older age [1]. Functional abilities represent the intrinsic capacity of the individual, characteristics of the environment where he or she lives, along with the interactions between person and environment [49,50]. Intrinsic capacity is a combination of an individual's physical and mental capacities, while environmental characteristics are home, community, and societal factors that affect an individual's life (health and social policies, residence, personal relationships, and attitudes and values) [49,50].

According to the WHO, intrinsic capacity is determined by status in the subfactor categories of locomotor, cognitive, affective, vitality, and sensory. Although we did not measure sensory aspects (sight and hearing), there is notable overlap between outcomes used in our current study report and the WHO definition of intrinsic capacity and its component factors. In our current study, we measured self-perceived QoL, which is consistent with the WHO concept of environmental and social factors that affect well-being.

4.3. Other studies showing benefits from nutritional care

In our first-reported analysis of nutritional health in older, community-living adults in Colombia, post-QIP results showed improvements in measures of nutrition-related parameters, i.e., significantly greater MNA-SF scores, calf circumference increases, and better BMI values [21]. Such nutrition-related findings reflect WHO components underlying the subfactor 'vitality.' [49,50].

It is widely agreed that early recognition of malnutrition or its risk offers greater opportunities to intervene and prevent worsening of associated adverse outcomes. While many early studies recognized disease-related malnutrition in hospitalized patients, [51–53] practices for prompt recognition and treatment of malnutrition or its risk have only recently been applied to older adults living in the community [17,27,54].

4.4. Strengths and limitations of our study

This study is one of a limited number of studies to recognize and address risk of malnutrition in community-living older adults. The study used real-world QIP methods with systematic implementation of changes to nutrition-related processes. Notably, the QIP strategy included a component for educating patient participants on the importance of good nutrition and exercise in daily lifestyle. Accordingly, participants were highly compliant with the ONS nutritional intervention. We underscore that our study was conducted in Colombia, a Latin American country known for its high WHO ranking for providing low-cost but high-quality healthcare [55].

This study has several limitations. First, the study was not designed as a randomized, controlled trial, so we report associations rather than cause–effect relationships. Secondly, participants were aware of being enrolled in the study and may have altered their behavior leading to a Hawthorne effect. Thirdly, we relied on participants' self-reported data to confirm compliance with ONS and to assess outcomes of interest. Fourthly, it is always important to question whether the findings from a clinic in Colombia can be generalized to older people receiving care at outpatient clinics of other countries. Finally, in terms of data interpretation, we used dementia as an exclusion criterion in this study due to possible

ethical considerations in regard to informed consent. Therefore, only 11% of our QIP participants had MMSE scores indicative of cognitive impairment; this population may have limited our chances of measuring whether nutrition can prevent or treat cognitive deterioration. It has in fact been shown that poor nutritional status is associated with worsened cognition [56,57].

5. Conclusions and implications

For community-living, older adults receiving care in an outpatient clinic in Bogotá, Colombia, we found that QIP-based identification of those with malnutrition or its risk, dietary and exercise education, and 60-day ONS use led to better nutritional status at day 90 follow-up. We also observed significant improvements in health outcomes that are important to older people living in the community – maintaining or restoring physical function and cognition, lessening likelihood of depression symptoms, and preventing or delaying age-related declines in QoL.

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Statement of authorship

All authors have approved the manuscript and met criteria for authorship. CC, LV, FB, and EC were involved in patient enrollment and data collection. DG and JDM were responsible for the data analysis and interpretation of data. SS, CB, GG drafted the manuscript, and all authors contributing to critical revision of the manuscript. CC was responsible for obtaining funding. The corresponding author had full access to all data used and shared final responsibility for the accuracy of the analyzed data.

Conflict of interest

Drs. Gomez and Sulo and Mr. Misas, Brunton and Ms. Gracia are employees and stockholders of Abbott. Dr Cano has received speaker honoraria from Abbott outside of present work. Other authors have no conflicts of interest to report.

Related publications

The paper is not under consideration elsewhere. Portions of this study were presented at the 2021 American Society of Parenteral and Enteral Nutrition (ASPEN) Virtual Meeting, 2021 European Society for Clinical Nutrition and Metabolism (ESPEN) Virtual Congress, 2021 European Geriatric Medicine Society Virtual Congress, 2021 International Conference on Frailty & Sarcopenia Research, and 2021 Gerontological Society of America Virtual Conference. If this paper is accepted, it will not be published elsewhere in the same form without the written consent of the copyright holder.

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Appendix

Table 1
Changes in percentage of people who were able to perform usual activities before and during lockdown.

| Before lockdown | Initial | | Final | |
|---|---------|---------|-------|---------|
| | Freq. | Percent | Freq. | Percent |
| No problems with performing my usual activities | 186 | 52% | 188 | 53% |
| Some problems with performing my usual activities | 155 | 44% | 161 | 45% |
| Unable to perform my usual activities | 14 | 4% | 6 | 2% |
| P-value | <0.001 | | | |
| Total | 355 | 100% | 355 | 100% |
| During lockdown | Initial | | Final | |
| | Freq. | Percent | Freq. | Percent |
| No problems with performing my usual activities | 133 | 51% | 94 | 36% |
| Some problems with performing my usual activities | 126 | 48% | 167 | 63% |
| Unable to perform my usual activities | 4 | 2% | 2 | 1% |
| P-value | <0.001 | | | |
| Total | 263 | 100% | 263 | 100% |

References

- [1] WHO global strategy on ageing and health. Decade of healthy ageing 2020–2030 proposal. 2020.
- [2] Halaweh H, Dahlin-Ivanoff S, Svantesson U, et al. Perspectives of older adults on aging well: a focus group study. *J Aging Res* 2018;2018:9858252.
- [3] van Leeuwen KM, van Loon MS, van Nes FA, et al. What does quality of life mean to older adults? A thematic synthesis. *PLoS One* 2019;14(3):e0213263.
- [4] The WHOQOL Group, DotWracs. Development of the WHOQOL: rationale and current status. *Int J Ment Health* 1994;23:24–56.
- [5] Ahmed T, Haboubi N. Assessment and management of nutrition in older people and its importance to health. *Clin Interv Aging* 2010;5:207–16.
- [6] Correia MI, Hegazi RA, Diaz-Pizarro Graf JI, et al. Addressing disease-related malnutrition in healthcare: a Latin American perspective. *J Parenter Enteral Nutr* 2016;40(3):319–25.
- [7] McKeever L, Farrar I, Sulo S, et al. Nutritional adequacy and oral nutritional supplementation in older community-dwelling adults. *J Aging Res Clin Pract* 2019;8:7–14.
- [8] Sheean P, Farrar IC, Sulo S, et al. Nutrition risk among an ethnically diverse sample of community-dwelling older adults. *Public Health Nutr* 2019;22(5):894–902.
- [9] Wolters M, Volkert D, Streicher M, et al. Prevalence of malnutrition using harmonized definitions in older adults from different settings – a MaNuEL study. *Clin Nutr* 2019;38(5):2389–98.
- [10] Kaiser MJ, Bauer JM, Ramsch C, et al. Frequency of malnutrition in older adults: a multinational perspective using the mini nutritional assessment. *J Am Geriatr Soc* 2010;58(9):1734–8.
- [11] Wei JM, Li S, Claytor L, et al. Prevalence and predictors of malnutrition in elderly Chinese adults: results from the China Health and Retirement Longitudinal Study. *Public Health Nutr* 2018;21(17):3129–34.
- [12] Cederholm T, Barazzoni R, Austin P, et al. ESPEN guidelines on definitions and terminology of clinical nutrition. *Clin Nutr* 2017;36(1):49–64.
- [13] Villafane JH, Pirali C, Dughi S, et al. Association between malnutrition and Barthel Index in a cohort of hospitalized older adults. *J Phys Ther Sci* 2016;28(2):607–12.
- [14] Marshall S, Bauer J, Isenring E. The consequences of malnutrition following discharge from rehabilitation to the community: a systematic review of current evidence in older adults. *J Hum Nutr Diet* 2014;27(2):133–41.
- [15] Prado CM, Purcell SA, Alish C, et al. Implications of low muscle mass across the continuum of care: a narrative review. *Ann Med* 2018;50(8):675–93.
- [16] Rodríguez MG, Sichaca EG. Mortality due to malnutrition in older adults, Colombia, 2014–2016. *Biomedica* 2019;39(4):663–72.
- [17] Wadas-Enright M, King A. Early recognition of malnutrition in the older adult: a quality improvement project using a standardized nutritional tool. *J Community Health Nurs* 2015;32(1):1–11.
- [18] Correia MITD, Perman MI, Waitzberg DL. Hospital malnutrition in Latin America: a systematic review. *Clin Nutr* 2017;36(4):958–67.
- [19] Sulo S, Schiffer L, Sheean P, et al. Community-dwelling adults at nutrition risk: characteristics in relation to the consumption of oral nutritional supplements. *J Prim Care Community Health* 2020;11:2150132720922716.
- [20] Smith TR, Cawood AL, Walters ER, et al. Ready-made oral nutritional supplements improve nutritional outcomes and reduce health care use—a randomised trial in older malnourished people in primary care. *Nutrients* 2020;12(2).
- [21] Chavarro-Carvajal D, Ayala A, Venegas-Sanabria L, et al. Use of a nutrition-focused quality improvement program for community-living older adults at malnutrition risk is associated with better nutritional outcomes. *Clin Nutr ESPEN* 2022;48:291–7. <https://doi.org/10.1016/j.clnesp.2022.01.032>.
- [22] Hong K, Sulo S, Wang W, et al. Nutrition care for poorly nourished outpatients reduces resource use and lowers costs. *J Prim Care Community Health* 2021;12:21501327211017014.
- [23] Sriram K, Sulo S, VanDerBosch G, et al. Nutrition-focused quality improvement program results in significant readmission and length of stay reductions for malnourished surgical patients. *J Parenter Enteral Nutr* 2018;42(6):1093–8.
- [24] Kaiser MJ, Bauer JM, Uter W, et al. Prospective validation of the modified mini nutritional assessment short-forms in the community, nursing home, and rehabilitation setting. *J Am Geriatr Soc* 2011;59(11):2124–8.
- [25] Salvà Casanovas A. El mini-nutricional assessment: veinte años de desarrollo ayudando a la valoración nutricional. *Rev Esp Geriatr* 2012;47(6):245–6.
- [26] Reisberg B, Ferris SH, de Leon MJ, et al. The global deterioration scale for assessment of primary degenerative dementia. *Am J Psychiatry* 1982;139(9):1136–9.
- [27] Riley K, Sulo S, Dabbous F, et al. Reducing hospitalizations and costs: a home health nutrition-focused Quality Improvement Program. *J Parenter Enteral Nutr* 2020;44(1):58–68.
- [28] Folstein MF, Folstein SE, McHugh PR. “Mini-mental state”. A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975;12(3):189–98.
- [29] Tombaugh TN, McIntyre NJ. The mini-mental state examination: a comprehensive review. *J Am Geriatr Soc* 1992;40(9):922–35.
- [30] Wade DT, Collin C. The Barthel ADL Index: a standard measure of physical disability? *Int Disabil Stud* 1988;10(2):64–7.
- [31] Hopman-Rock M, van Hirtum H, de Vreede P, et al. Activities of daily living in older community-dwelling persons: a systematic review of psychometric properties of instruments. *Aging Clin Exp Res* 2019;31(7):917–25.
- [32] Guralnik JM, Simonsick EM, Ferrucci L, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol* 1994;49(2):M85–94.
- [33] Yesavage J, Sheikh J. Geriatric depression scale (GDS): recent evidence and development of a shorter version. *Clin Gerontol* 1986;5(1–2):165–73.
- [34] Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. *Ann Med* 2001;33(5):337–43.
- [35] Agarwal E, Miller M, Xaxley A, et al. Malnutrition in the elderly: a narrative review. *Maturitas* 2013;76(4):296–302.
- [36] Hamirudin AH, Charlton K, Walton K. Outcomes related to nutrition screening in community living older adults: a systematic literature review. *Arch Gerontol Geriatr* 2016;62:9–25.
- [37] Garcia RS, Tavares LR, Pastore CA. Nutritional screening in surgical patients of a teaching hospital from Southern Brazil: the impact of nutritional risk in clinical outcomes. *Einstein* 2013;11(2):147–52.
- [38] Prado CM, Purcell SA, Laviano A. Nutrition interventions to treat low muscle mass in cancer. *J Cachexia Sarcopenia Muscle* 2020;11(2):366–80.
- [39] Graham J, Fan L, Meadows ES, et al. Addressing malnutrition across the continuum of care: which patients are likely to receive oral nutritional supplements. *J Aging Res Health* 2017;1(3):18–27.

- [41] Holyday M, Daniells S, Bare M, et al. Malnutrition screening and early nutrition intervention in hospitalised patients in acute aged care: a randomised controlled trial. *J Nutr Health Aging* 2012;16(6):562–8.
- [42] Kok RM, Reynolds 3rd CF. Management of depression in older adults: a review. *JAMA* 2017;317(20):2114–22.
- [43] Rodda J, Walker Z, Carter. J. Depression in older adults. *BMJ* 2011;343:d5219.
- [44] Gale SA, Acar D, Daffner KR. Dementia. *Am J Med* 2018;131(10):1161–9.
- [45] Maresova P, Mohelska H, Dolejs J, et al. Socio-economic aspects of Alzheimer's disease. *Curr Alzheimer Res* 2015;12(9):903–11.
- [46] Livingston G, Huntley J, Sommerlad A, et al. Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. *Lancet* 2020;396(10248):413–46.
- [47] WHO. Integrated care for older people (ICOPE): guidelines on community-level interventions to manage declines in intrinsic capacity. 2017. https://www.who.int/ageing/WHO-ALC-ICOPE_brochure.pdf?ua=1. [Accessed 18 June 2021].
- [48] WHO. World report on ageing and health. Geneva. 2015.
- [49] de Carvalho I, Martin F, Cesari M, et al. Operationalising the concept of intrinsic capacity in clinical settings. Geneva, Switzerland: WHO Clinical Consortium on Healthy Ageing; 2017.
- [50] Beard JR, Si Y, Liu Z, et al. Intrinsic capacity: validation of a new WHO concept for healthy ageing in a longitudinal Chinese study. *J Gerontol A Biol Sci Med Sci* 2021;77(1):94–100. <https://doi.org/10.1093/gerona/rlab226>.
- [51] Correia MI, Hegazi RA, Higashiguchi T, et al. Evidence-based recommendations for addressing malnutrition in health care: an updated strategy from the feedM.E. Global Study Group. *J Am Med Dir Assoc* 2014;15(8):544–50.
- [52] Guest JF, Panca M, Baeyens JP, et al. Health economic impact of managing patients following a community-based diagnosis of malnutrition in the UK. *Clin Nutr* 2011;30(4):422–9.
- [53] Pirlich M, Schutz T, Kemps M, et al. Prevalence of malnutrition in hospitalized medical patients: impact of underlying disease. *Dig Dis* 2003;21(3):245–51.
- [54] Chew STH, Tan NC, Cheong M, et al. Impact of specialized oral nutritional supplement on clinical, nutritional, and functional outcomes: a randomized, placebo-controlled trial in community-dwelling older adults at risk of malnutrition. *Clin Nutr* 2021;40(4):1879–92.
- [55] The World Health Organization's ranking of the world's health systems, by rank 2021. <https://photius.com/rankings/healthranks.html>. [Accessed 21 May 2021].
- [56] Yu W, Yu W, Liu X, et al. Associations between malnutrition and cognitive impairment in an elderly Chinese population: an analysis based on a 7-year database. *Psychogeriatrics* 2021;21(1):80–8.
- [57] Sanders C, Behrens S, Schwartz S, et al. Nutritional status is associated with faster cognitive decline and worse functional impairment in the progression of dementia: the Cache County Dementia Progression Study. *J Alzheimers Dis* 2016;52(1):33–42.