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Economic Evaluation

Nutrition-Focused Care for Community-Living Adults: Healthcare Utilization and Economic Benefits



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ABSTRACT

Objectives: We assessed the impact of a recently reported nutritional quality improvement program (QIP) on healthcare resource utilization and costs for older, community-living adults in Bogotá, Colombia.

Methods: The study included 618 community-dwelling, older adults (> 60 years) who were at risk or malnourished and receiving outpatient clinical care. The intervention was a QIP that emphasized nutritional screening, dietary education, lifestyle counseling, 60-day consumption of oral nutritional supplements, and 90-day follow-up. For economic modeling, we performed 90-day budget impact and cost-effectiveness analyses from a Colombian third-party payer perspective. The base-case analysis quantified mean healthcare resource use in the QIP study population. Analysis was based on mean input values (deterministic) and distributions of input parameters (probabilistic). As the deterministic analysis provided a simple point estimate, the cost-effectiveness analysis focused on the probabilistic results informed by 1000 iterations of a Monte-Carlo simulation.

Results: Results showed that the total use of healthcare resources over 90 days was significantly reduced by > 40% (hospitalizations were reduced by approximately 80%, emergency department visits by > 60%, and outpatient clinical visits by nearly 40%; $P < .001$). Based on economic modeling, total cost savings of \$129 740 or per-patient cost savings of \$210 over 90 days could be attributed to the use of nutritional QIP strategies. Total cost savings equated to nearly twice the initial investment for QIP intervention; that is, the per-dollar return on investment was \$1.82.

Conclusions: For older adults living in the community in Colombia, the use of our nutritional QIP improved health outcomes while lowering costs of healthcare and was thus cost-effective.

Keywords: community-living adults, health economics, nutrition, oral nutritional supplement, quality improvement program.

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Introduction

Among older adults living in communities worldwide, poor nutritional status is distressingly common, and malnutrition risk is increasingly recognized for its high toll on the health and well-being of older people.^{1–4} In the older population, the prevalence of malnutrition or its risk varies widely by location, age, and chronic health conditions—a range reported as 1.3% to 47.8%.⁵ Overall, up to 1 in 3 community-dwelling older people may have poor nutritional status, such as dietary protein-energy shortfall or nutrient deficiencies.^{1,6–10} Malnutrition risk leads to loss of muscle and bone mass; accordingly, poorly nourished older people are at increased risk of falls and fractures, have mobility limitations, and experience disabilities that lower their capacity for independent living and even threaten survival.^{11–13}

Among seniors with poor nutritional status, growing evidence also shows high use of healthcare resources (eg, outpatient clinic

care, hospitalizations, and emergency department [ED] visits) and correspondingly high costs for such care.^{1,14,15} Numerous studies have shown health and cost benefits of nutritional care for poorly nourished patients who were hospitalized,^{16–22} but relatively few have tested nutritional care strategies for older people living in the community.^{23–25} If health and cost benefits of nutrition care are confirmed and extended, healthcare providers have an enormous opportunity to lessen the burden of care for older community-living adults.^{12,26,27} Beyond cost, healthy aging with sustained functionality and independence is important to older people.^{28–31}

Despite the negative health concerns and excessive costs of poor nutritional status among older people in the community, public health strategies are not yet widely used to identify and lessen such risk. Today's health systems are designed to provide episodic acute healthcare rather than to meet the more challenging needs of community-living older people with chronic conditions.³² Moving forward, experts suggest that community-

based health professionals can better support healthy aging by increasing the awareness and use of nutrition screening tools, prioritizing high-risk populations for screening, and following screening with specific nutritional diagnoses and appropriate interventions.^{29,33,34} To facilitate nutritional practice changes for improved care, quality improvement programs (QIPs) can be followed.³⁵

Previous study results have shown that QIP-based changes can be effectively applied to nutritional care in US hospitals to show benefits such as reduced length of stay and lower likelihood of 30-day readmissions.³⁶⁻³⁸ For older adults using home health services or attending outpatient clinics in the United States, nutritional QIP use decreased risk of hospitalization, ED visits and outpatient clinic visits, thus yielding corresponding cost savings.^{23,39} In this article, we report health economic impact of using a QIP that guided nutritional care for older adults who were receiving outpatient care in Bogotá, Colombia, and were identified to be malnourished or at risk. This study aimed to assess effects of the QIP on healthcare resource use (hospitalizations, ED visits, and outpatient clinic visits), and we also performed an economic analysis to demonstrate the nutritional QIP's ability to generate economic benefits reflected as cost savings and cost-effectiveness. Although previous QIPs have demonstrated cost savings,³⁷⁻³⁹ no other studies to date have investigated the cost-effectiveness of nutrition-focused QIPs in a population of older, community-dwelling adults.

Methods

Study Population and Design

The current study design was a real-world, observational QIP conducted in Bogotá, Colombia; the population has been described previously.⁴⁰ The full Colombian study was comprehensive, including evaluation of the nutrition-related outcomes,⁴⁰ along with measures of physical and cognitive function, affective disorder status or psychological wellness, and quality of life.⁴¹

This study population included many individuals considered to be “transitional,” that is, people with long-term conditions who are recovering from acute disease or hospital stays; many require additional homecare or assistance from caregivers.⁴¹ 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.

Older patients (> 60 years) with malnutrition or its risk according to the Mini Nutritional Assessment Short Form (MNA-SF) tool (a score of 0-7 indicates malnourished and 8-11 indicates at risk of malnutrition) were recruited at the outpatient clinical setting of the Hospital Universitario San Ignacio, in Bogotá, Colombia, between September 2019 and March 2020. A total of 618 patients completed the nutritional QIP, and full anthropometric outcome data (calf circumference, weight, and body mass index) were available for 565 patients (91.4%). Recruited individuals participated in a 60-day nutrition-focused QIP that included follow-up through 90 days; the study was completed in July 2020. Patients were excluded from participation if they had advanced dementia (Global Deterioration Scale \geq 6), delirium, intolerance or allergy to oral nutritional supplements (ONS), or life expectancy of < 90 days.

Study Ethics and Clinical Trials Registration

The study protocol was approved by the Ethics and Research Committee of the Hospital Universitario San Ignacio, in Bogotá,

Colombia. Each participant (or the caregiver) signed the informed consent form.

This study is registered in [ClinicalTrials.gov](https://clinicaltrials.gov) under identifier NCT04042987.

QIP Intervention

The multidimensional, nutrition-focused QIP consisted of (1) nutritional screening at baseline study visit; (2) education of patients and caregivers about the importance of good nutrition and physical exercise; (3) nutritional intervention, including dietary counseling promoting optimization of food intake and provision of ONS as standard formula (Ensure®, Abbott, USA) or diabetes-specific formula (Glucerna®, Abbott, USA) (1 bottle per day for 60 days) according to patient's dietary needs; and (4) follow-up to reinforce education and compliance with the recommended nutrition regimen throughout the QIP. Patients were followed up to 90 days after QIP enrollment.

Statistical Analyses

We used descriptive analyses for sociodemographic and clinical characteristics at baseline. We determined proportions for categorical variables and calculated means \pm standard deviations for quantitative variables. To assess statistical differences in health outcomes and healthcare resource use comparing results before and after QIP intervention, we used paired-sample *t* tests. Participants with missing data in the variables of interest were excluded from the analysis. The significance level was defined as a *P* value of < .05. Statistical analyses were performed using STATA 14® (StataCorp LLC, College Station, TX, USA).

Economic Analysis: General Modeling Methodology

The economic model was developed to perform a budget impact analysis (BIA) and a cost-effectiveness analysis (CEA) from a Colombian third-party payer perspective. The model was based on healthcare resource use and health outcomes informed by previously reported clinical study findings.⁴⁰ The model enabled simulations for a 90-day base-case time horizon, according to the observation period of the underlying study; therefore, no cost discounting was applied.

The BIA enabled the simulation of the cost consequences of the nutritional QIP intervention (after QIP) compared with baseline (before QIP). The base-case analysis was performed with the mean healthcare resource use observed in the study, and the potential variation of the results was reflected by analysis based on the upper and lower 95% confidence intervals. The CEA enabled the simulation of cost-effectiveness using the health outcomes described below. Analysis was based on the mean input values (deterministic) and input parameter distributions (probabilistic). As the deterministic analysis provided a simple point estimate, the visual presentation of CEA results in this article focuses on the probabilistic results informed by 1000 iterations of a Monte-Carlo simulation. The incremental cost-effectiveness outcomes are presented in the incremental cost-effectiveness plane on a per-patient basis.

Health Outcomes Variables

According to a recently published systematic review of cost-effectiveness studies on nutrition intervention in adults, most studies used quality-adjusted life-years (QALYs) as the central outcome.⁴² Therefore, we used QALYs as the primary cost-effectiveness indicator. Furthermore, the model enabled CEA determinations based on health outcome variables (adverse events avoided as hospitalization, ED visits, and outpatient clinic visits)

Table 1. Healthcare resource utilization before and after QIP.

Variable	30 days*		60 days*		90 days*	
	Pre-QIP Mean (SD)	Post-QIP Mean (SD) RRR	Pre-QIP Mean (SD)	Post-QIP Mean (SD) RRR	Pre-QIP Mean (SD)	Post-QIP Mean (SD) RRR
Overall healthcare resource use	1.39 (1.24)	0.57 (0.84) 59%	2.11 (1.82)	1.26 (1.36) 40.3%	2.6 (2.15)	1.48 (1.55) 43.1%
Hospitalizations	0.07 (0.27)	0.01 (0.15) 85.7%	0.14 (0.39)	0.03 (0.21) 78.6%	0.17 (0.45)	0.03 (0.22) 82.4%
ED visits	0.10 (0.32)	0.03 (0.20) 70%	0.22 (0.52)	0.09 (0.32) 59.1%	0.28 (0.6)	0.1 (0.33) 64.3%
Outpatient visits	1.25 (1.13)	0.56 (0.8) 55.2%	1.73 (1.51)	1.18 (1.25) 31.8%	2.16 (1.85)	1.35 (1.41) 37.5%

ED indicates emergency department; QIP, quality improvement program; SD, standard deviation; RRR, relative risk reduction.

* $P < .001$.

and previously reported clinical changes (body weight, MNA-SF scores, and calf circumference).⁴⁰

Cost Calculations

All costs were calculated from the perspective of a third-party payer, corresponding to costs generated for care in the Colombian health system and reported in year 2019 US dollars. Categories of costs included in the model were QIP implementation costs and healthcare resource utilization costs.

QIP implementation costs (fixed and variables costs) were estimated based on records of professional staff time for completing QIP training and other QIP related tasks including patient nutrition screening/assessment, patient education provision, delivery of ONS, follow-up calls, and follow-up data collection. The cost categories reported are similar to those reported for other QIP studies.³⁷⁻³⁹ Hourly wage rates for staff positions (eg, clinicians and administrative and research staff) were taken from publicly available, Colombian wage statistics.⁴³ Healthcare resource utilization costs were estimated based on the costs incurred from hospitalizations, ED visits, and outpatient visits using multiple data sources outlined in Appendix Table 1 in Supplemental Materials found at <https://doi.org/10.1016/j.vhri.2022.08.005>.

Results

Patients who participated in the real-world study were older (> 60 years), living in Bogotá communities, and attending Hospital

Universitario San Ignacio (Bogotá, Colombia) outpatient clinics for care. Participants were at a particular risk of poor nutrition because of their older age. In addition, many were attending the clinic for follow-up after hospitalization for an acute illness or condition. Study participants were recruited after being identified as malnourished or at risk of malnutrition when they underwent nutritional screening via the MNA-SF. Such patients were enrolled in the nutrition-focused QIP intervention, and a total of 618 completed the 90-day study. As reported previously, the participant population had a mean age of 74.1 ± 8.7 years, an average of 2.6 comorbidities, and a high proportion of females (69.4%) and were of medium socioeconomic status (76%).⁴⁰

Healthcare Resource Use

Overall healthcare resource use was significantly reduced; changes correspond to relative risk reductions of 59%, 40%, and 43%, respectively, at the timepoints of 30, 60, and 90 days (each at $P < .001$) (Table 1). By specific healthcare resource (hospitalizations, ED visits, and outpatient visits), utilization was significantly lowered across the 90-day study interval, that is, hospitalizations by 82%, ED visits by 64%, and outpatient visits by 38% ($P < .001$ for each) (Table 1).

BIA Results

QIP intervention resulted in cost savings for each category of healthcare resource use, and the total savings related to the 618 patients included in the study were higher than the costs of the QIP intervention (pre-QIP healthcare resource costs of \$301 980 vs post-QIP costs of \$100 808). Consequently, the budget impact was

Table 2. Budget impact analysis results: cost savings based on reduced healthcare resource utilization (at 90 days).

Variable	Pre-QIP Amount, USD	Post-QIP Amount, USD
Hospitalization costs	\$222 282	\$55 571
Outpatient visit costs	\$53 359	\$35 844
ED visit costs	\$26 302	\$9394
Total healthcare resource costs	\$301 980	\$100 808
Total QIP intervention cost	\$0	\$71 431
Savings for QIP population (N = 618)	\$129 740	
Savings per patient	\$210	

ED indicates emergency department; QIP, quality improvement program; USD, US dollar.

Table 3. CEA results: mean per-patient QIP CEA outcomes.

CE outcome	Variables	Pre-QIP	Post-QIP	Incremental
Cost per QALY gained	Total costs	\$489	\$279	−\$210
	Total effectiveness	0.1785	0.1865	0.008
	Cost-effectiveness	\$2.739	\$1.496	Dominated
Cost per adverse event avoided	Total costs	\$489	\$279	−\$210
	Total effectiveness	2.6	1.59	1.01
	Cost-effectiveness	\$188	\$175	Dominated
Cost per unit calf circumference (cm) gained	Total costs	\$489	\$279	−\$210
	Total effectiveness	30.29	32.01	1.72
	Cost-effectiveness	\$16	\$9	Dominated
Cost per unit body weight (kg) gained	Total costs	\$489	\$279	−\$210
	Total effectiveness	59.94	60.74	0.8
	Cost-effectiveness	\$8	\$5	Dominated
Cost per point improvement in nutritional status (MNA-SF score)	Total costs	\$489	\$279	−\$210
	Total effectiveness	9.3	11.42	2.12
	Cost-effectiveness	\$53	\$24	Dominated

CEA indicates cost-effectiveness analysis; CE, cost-effectiveness; MNA-SF, Mini Nutritional Assessment Short Form; QALY, quality-adjusted life-year; QIP, quality improvement program.

reflected by total cost savings of \$129 740 or \$210 per patient over the 90-day study period (Table 2). Total cost savings equated to nearly twice the initial investment for QIP intervention; that is, the per-dollar return on investment was \$1.82.

CEA Results

After the 90-day intervention program (Table 3), the scenario post-QIP intervention dominated the scenario pre-QIP intervention, which is shown by cost savings combined with a higher efficacy, for all effectiveness outcomes studied. Based on cost savings in combination with improved health outcomes, the nutritional QIP was notably a cost-effective treatment strategy. The improvements in nutritional health measures, as described in a companion Colombian QIP study report,⁴⁰ are summarized in Appendix Table 2 in Supplemental Materials found at <https://doi.org/10.1016/j.vhri.2022.08.005>. These include significant improvements in MNA-SF score (nutritional status in an older person), calf circumference (a proxy for leg muscle mass), body weight, and body mass index, with postintervention improvements at the level of $P < .001$.

To evaluate variability of results, probabilistic sensitivity analyses were performed and plotted in the incremental cost-effectiveness coordinate plane (Fig. 1). Such scatterplots provide density visualization; that is, darker areas represent a higher concentration of outcomes in this range. Irrespective of the cost-effective outcome, most cost-per-outcome results plotted in the lower-right corner of the incremental cost-effectiveness plane, indicating an incremental effectiveness gain accompanied by cost savings. In case that not all results are located in the lower-right corner, the probability of the QIP intervention being the dominant option could be assessed by the number of results located in the specific area of the coordinate plane. This is the case for the cost-effectiveness outcomes QALYs gained, adverse events avoided, and calf circumference gained, with a related probability of being the dominant option of 92.7%, 87.7% and 96.5%, respectively. In case that all results are located in the lower-right corner, there is a 100% probability that the QIP intervention is the dominant

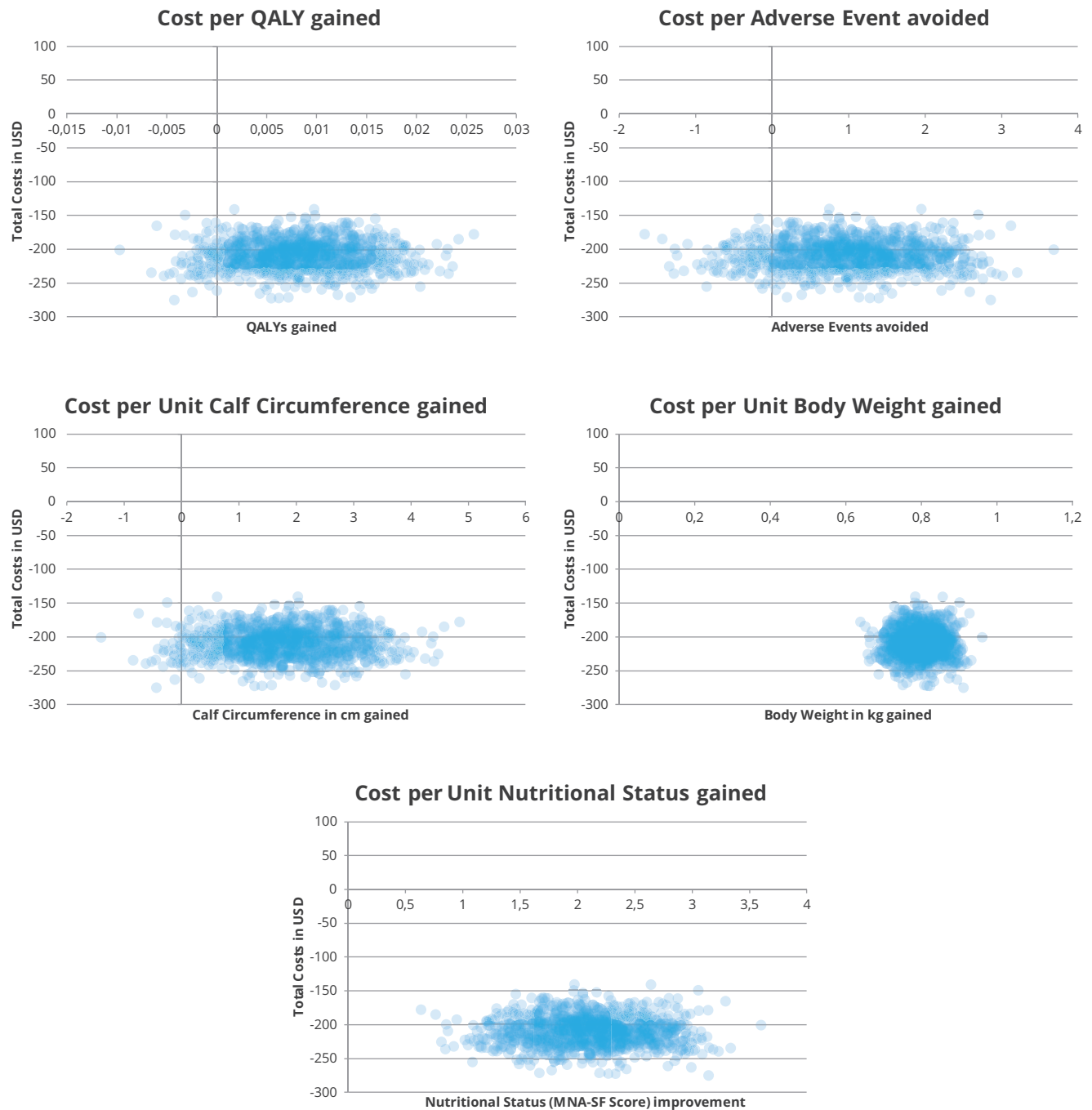
option, as it is seen for the cost-effectiveness body weight gain and nutritional status improvement.

Discussion

Taken together, the findings of our economic model showcased how nutrition-focused care in community healthcare settings in Colombia could yield health improvements at the patient level along with considerable cost savings at the healthcare-system level. Our model accounted for QIP costs incurred to train healthcare professionals for nutrition-focused care for older adults and to sustain such a program. Across the 90-day study timeline, we found that the use of healthcare resources (hospitalizations, ED visits, and outpatient clinic visits) was significantly reduced by > 40%. In particular, hospitalizations were significantly reduced by approximately 80%, ED visits by more than 60%, and outpatient clinical visits by nearly 40%. Our model estimated a per-patient cost savings of \$210 attributable to the nutritional QIP. In terms of cost-effectiveness, we found that irrespective of the cost-effectiveness outcome, the QIP intervention resulted in cost savings accompanied by a higher efficacy. Probabilistic sensitivity analyses have shown that these results are robust for modeling parameter-related uncertainties.

As seen in our current study in Colombia, previous studies have also shown that QIP-based changes can be effectively applied to nutrition care in clinical settings, including outpatient clinics,^{39,40} home health service programs,²³ and hospital inpatients.^{36,38} Notably, such nutrition-focused QIP programs yielded marked cost savings and were consistent with other studies that showed nutrition interventions to be cost-effective.⁴⁴⁻⁴⁶

Evidence supporting economic benefits of improving the quality of nutritional care is abundant and growing based on studies across the continuum of care. A study in 3 US healthcare outpatient clinics found that patients who participated in a nutrition-focused QIP program (N = 600) had lower healthcare resource utilization (hospitalizations, ED visits, and outpatient

Figure 1. CEA results: probabilistic QIP cost-effectiveness outcomes per patient.

CEA indicates cost-effectiveness analysis; MNA-SF, Mini Nutritional Assessment Short Form; QALY, quality-adjusted life-year; QIP, quality improvement program; USD, US dollar.

clinic visits), which was associated with per-patient cost savings of \$485 (compared with non-QIP controls).³⁹ In a nutrition-focused QIP conducted for older patients receiving home-healthcare, hospitalization rates were reduced by approximately 20%, and total cost savings from reduced 90-day healthcare resource utilization were \$1500 per patient treated.²³ In a US multi-hospital study by Sriram et al,³⁸ 30-day readmissions and lengths of hospital stays were significantly lowered for at-risk and malnourished inpatients by the use of medical record-cued nutrition screening, prompt provision of ONS when needed, patient/caregiver

education on the importance of nutrition, and sustained nutrition support; such reductions in the use of hospital resources were associated with savings of almost \$4000 per patient.²¹ In a randomized trial involving older patients in UK nursing homes, the use of ONS for patients with malnutrition or its risk was cost-effective compared with dietary advice alone.⁴⁷ Another study of 168 community-dwelling older adults used a 12-week intensive support program that included consultations with dietitians along with resistance exercise guided by physiotherapists.⁴⁸ Results showed improvements in Short Physical Performance Battery

scores, and the intervention met the criteria for being cost-effective.⁴⁸ Altogether, these findings indicate that nutrition-focused QIPs are feasible across the continuum of care and provide a rationale for merging patient care and financial modeling to make the delivery of value-based medicine possible in malnourished or at-risk patient populations.

Older people who are not well nourished are at increased risk of infections, falls and fractures, mobility limitations, and other physical and mental disabilities that lower their capacity for independent living—in turn increasing the risk of frailty, lowering quality of life, and negatively affecting survival.^{11–13,49–51} Maintaining quality of life with functional independence is important to older adults,³¹ so health policy and decision makers, along with healthcare professionals, are now called upon to harness the potential of maintaining nutritional health and preventing or delaying the onset of archetypal age-related diseases and the frailty condition.²⁹ Such strategies are also a way to achieve affordable healthcare for older people in Colombia. Working together, public health and healthcare professionals can help extend the years people live in good health,⁵² as highlighted in the World Health Organization's Decade of Healthy Aging 2020 to 2030 proposal.⁵³

In terms of health and the overall population, Colombia and other Latin American countries are experiencing growth in the proportion of older people. In Colombia, the proportion of people older than 60 years old is expected to increase from 10% to 20% by 2050. Therefore, it is important for health policy makers in Colombia to build a healthcare system that promotes healthy aging.⁵⁴ A strength of Colombian healthcare is that it covers more than 95% of the population. For 2022, Colombia was 35th of nearly 100 ranked systems around the world.⁵⁵ In perspective, Australia ranked 6th, Germany 17th, Canada 23rd, the United States 30th, Uruguay 39th, and Brazil 63rd.⁵⁵ For such rankings, healthcare quality was determined by many factors—the care process (preventative care, safe care, coordinated care, and patient engagement), access (affordability and timeliness), administrative efficiency, equity, and healthcare outcomes (population health, mortality responsive to healthcare, and disease-specific health outcomes).⁵⁵

Strengths and Limitations of This Study

This is a first-of-its-kind study assessing the impact of a nutrition-focused QIP on cost-effectiveness for at-risk and malnourished patients receiving care in Colombian outpatient clinics. By using a real-world study design, we were able to assess endpoints that supported the development of a BIA and CEA. As such, our study findings provided evidence supporting both health and economic benefits of improving nutritional care via QIP for older adults living in the community.

The study has several limitations. It used an observational QIP methodology, so the study had limitations inherent to trials that are not randomized controlled trial designs. Second, the results of this study may not be generalizable to all outpatient populations in Colombia or other. Third, administrative institution-level and patient survey data were mainly used to confirm healthcare resource utilization, so it is possible that healthcare visits outside of the institution or its network were not fully captured. Finally, we used a time horizon of 90 days. A recent study conducted among community-dwelling adults in Singapore demonstrated that the positive impact of a nutritional intervention could be sustained over 180 days.⁵⁶ It is unclear how long the positive effects of a nutritional QIP could be sustained in our population, so we invite longer-term nutritional QIP investigations on health outcomes and healthcare resource use.

To confirm and extend our findings on health and cost benefits of nutrition-focused care for older, community-living adults in Colombia, we propose the use of prospective randomized study designs among patients who are attending outpatient clinics or are receiving care in home health-assistance programs. With randomized assignment to treatments, such studies could be used to assess designated health and cost benefits of (1) dietary food counseling, (2) physical exercise, and (3) provision of ONS, with study treatments used singly or in combination.

Conclusions

For older, community-living adults, nutritional care—screening for malnutrition risk, provision of nutrition education and intervention when needed, and follow-up—can improve nutritional outcomes while lowering costs of healthcare. Results showed overall use of healthcare resources (hospitalizations, ED visits, and outpatient clinic visits) was significantly reduced by more than 40% equating to a total savings of \$210 per patient over 90-day period. Total cost savings equated to nearly twice the initial investment for QIP intervention; that is, the per-dollar return on investment was \$1.82.

For cost-effectiveness, the post-QIP nutritional intervention was favored over pre-QIP care, with differences expressed as cost savings combined with a higher efficacy. Such findings underscore the opportunities for implementing nutritional care programs to lessen the increasing burden of costs for healthcare in the aging population of Colombia and worldwide.

Supplemental Material

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.vhri.2022.08.005>.

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REFERENCES

- Rodriguez-Sanchez B, Sulo S, Carnicero JA, Rueda R, Rodriguez-Manas L. Malnutrition prevalence and burden on healthcare resource use among Spanish community-living older adults: results of a longitudinal analysis. *Clinicoecon Outcomes Res.* 2020;12:355–367.
- Sharman Moser S, Doyev R, Cohen B, et al. Prevalence and characteristics of malnutrition among community-dwelling older adults in Israel. *Clin Nutr ESPEN.* 2018;28:179–185.
- Ahmed T, Haboubi N. Assessment and management of nutrition in older people and its importance to health. *Clin Interv Aging.* 2010;5:207–216.
- Agarwal E, Miller M, Yaxley A, Isenring E. Malnutrition in the elderly: a narrative review. *Maturitas.* 2013;76(4):296–302.
- Evidence profile: malnutrition. World Health Organization. <https://www.who.int/publications/i/item/WHO-MCA-17.06.06>. Accessed August 4, 2021.
- 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):1734–1738.
- Ramage-Morin PL, Gilmour H, Rotermann M. Nutritional risk, hospitalization and mortality among community-dwelling Canadians aged 65 or older. *Health Rep.* 2017;28(9):17–27.
- 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):2389–2398.
- Sulo S, Schiffer L, Sheean P, Farrar I, Partridge J, Fitzgibbon M. Community-dwelling adults at nutrition risk: characteristics in relation to the consumption of oral nutritional supplements. *J Prim Care Community Health.* 2020;11:2150132720922716.
- Wei JM, Li S, Claytor L, Partridge J, Goates S. Prevalence and predictors of malnutrition in elderly Chinese adults: results from the China Health and Retirement Longitudinal Study. *Public Health Nutr.* 2018;21(17):3129–3134.
- Rodriguez MG, Sichaca EG. Mortality due to malnutrition in older adults, Colombia, 2014–2016. [Mortalidad por desnutrición en el adulto mayor, Colombia, 2014–2016]. *Biomedica.* 2019;39(4):663–672.
- Jyvakorpi SK, Ramel A, Strandberg TE, et al. The sarcopenia and physical frailty in older people: multi-component treatment strategies (SPRINTT) project: description and feasibility of a nutrition intervention in community-dwelling older Europeans. *Eur Geriatr Med.* 2021;12(2):303–312.
- Wanaratna K, Muangpaisan W, Kuptniratsaikul V, Chalerm Sri C, Nuttamonwarakul A. Prevalence and factors associated with frailty and cognitive frailty among community-dwelling elderly with knee osteoarthritis. *J Community Health.* 2019;44(3):587–595.
- 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):422–429.
- Snider JT, Linthicum MT, Wu Y, et al. Economic burden of community-based disease-associated malnutrition in the United States. *JPEN J Parenter Enter Nutr.* 2014;38(2 suppl):77S–85S.
- Schuetz P, Sulo S, Walzer S, et al. Cost savings associated with nutritional support in medical inpatients: an economic model based on data from a systematic review of randomised trials. *BMJ Open.* 2021;11(7):e046402.
- Sriram K, Sulo S, VanDerBosch G. Malnutrition intervention implementation. *J Acad Nutr Diet.* 2018;118(5):813.
- Buitrago G, Vargas J, Sulo S, et al. Targeting malnutrition: nutrition programs yield cost savings for hospitalized patients. *Clin Nutr.* 2020;19(9):2896–2901.
- Elia M, Normand C, Norman K, Laviano A. A systematic review of the cost and cost effectiveness of using standard oral nutritional supplements in the hospital setting. *Clin Nutr.* 2016;35(2):370–380.
- Thornton Snider J, Jena AB, Linthicum MT, et al. Effect of hospital use of oral nutritional supplementation on length of stay, hospital cost, and 30-day readmissions among Medicare patients with COPD. *Chest.* 2015;6:1477–1484.
- Sulo S, Feldstein J, Partridge J, Schwander B, Sriram K, Summerfelt WT. Budget impact of a comprehensive nutrition-focused quality improvement program for malnourished hospitalized patients. *Am Health Drug Benefits.* 2017;10(5):262–270.
- Stratton RJ, Hebuterne X, Elia M. A systematic review and meta-analysis of the impact of oral nutritional supplements on hospital readmissions. *Ageing Res Rev.* 2013;12(4):884–897.
- Riley K, Sulo S, Dabbous F, et al. Reducing hospitalizations and costs: a home health nutrition-focused quality improvement program. *JPEN J Parenter Enter Nutr.* 2020;44(1):58–68.
- Smith TR, Cawood AL, Walters ER, Guildford N, Stratton RJ. 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):517.
- Zhu LY, Chan R, Kwok T, Cheng KC, Ha A, Woo J. Effects of exercise and nutrition supplementation in community-dwelling older Chinese people with sarcopenia: a randomized controlled trial. *Age Ageing.* 2019;48(2):220–228.
- Nikolova S, Heaven A, Hulme C, et al. Social care costs for community-dwelling older people living with frailty. *Health Soc Care Community.* 2022;30(3):e804–e811.
- Sulo S, Lanctin D, Feldstein J, et al. Budget impact analysis of a home-based nutrition program for adults at risk for malnutrition. *Am Health Drug Benefits.* 2020;13(3):95–101.
- Melzer TM, Manosso LM, Yau SY, Gil-Mohapel J, Brocardo PS. In pursuit of healthy aging: effects of nutrition on brain function. *Int J Mol Sci.* 2021;22(9):5026.
- Roberts SB, Silver RE, Das SK, et al. Healthy aging-nutrition matters: start early and screen often [published correction appears in *Adv Nutr.* 2021;12(4):1597–1598]. *Adv Nutr.* 2021;12(4):1438–1448.
- Robinson SM. Improving nutrition to support healthy ageing: what are the opportunities for intervention? *Proc Nutr Soc.* 2018;77(3):257–264.
- Wiles JL, Leibing A, Guberman N, Reeve J, Allen RE. The meaning of “aging in place” to older people. *Gerontologist.* 2012;52(3):357–366.
- Integrated care for older people (ICOPE): guidelines on community-level interventions to manage declines in intrinsic capacity. World Health Organization. <https://www.who.int/publications/i/item/9789241550109>. Accessed June 18, 2021.
- Dwyer JT, Gahche JJ, Weiler M, Arensberg MB. Screening community-living older adults for protein energy malnutrition and frailty: update and next steps. *J Community Health.* 2020;45(3):640–660.
- Roberts HC, Lim SER, Cox NJ, Ibrahim K. The challenge of managing under-nutrition in older people with frailty. *Nutrients.* 2019;11(4):808.
- Planning for quality improvement. Agency for Healthcare Research and Quality. <https://www.ahrq.gov/data/monahrq/myqi/planning.html>. Accessed August 5, 2021.
- Meehan A, Loose C, Bell J, Partridge J, Nelson J, Goates S. Health System Quality improvement: impact of prompt nutrition care on patient outcomes and health care costs. *J Nurs Care Qual.* 2016;31(3):217–223.
- 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. *JPEN J Parenter Enter Nutr.* 2018;42(6):1093–1098.
- Sriram K, Sulo S, VanDerBosch G, et al. A comprehensive nutrition-focused quality improvement program reduces 30-day readmissions and length of stay in hospitalized patients. *JPEN J Parenter Enter Nutr.* 2017;41(3):384–391.
- 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.
- Chavarro-Carvajal DA, Ayala AM, Venegas-Sanabria LC, 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;48:291–297.
- Gomez G, Botero-Rodríguez F, Diego Misas J, et al. A nutritionally focused program for community-living older adults resulted in improved health and well-being. *Clin Nutr.* 2022;41(7):1549–1556.
- Galekop MMJ, Uyl-de Groot CA, Ken Redekop W. A systematic review of cost-effectiveness studies of interventions with a personalized nutrition component in adults. *Value Health.* 2021;24(3):325–335.
- Salario en Colombia 2022. Talent.com. <https://co.talent.com/salary>. Accessed January 11, 2022.
- Zhong Y, Cohen JT, Goates S, Luo M, Nelson J, Neumann PJ. The cost-effectiveness of oral nutrition supplementation for malnourished older hospital patients. *Appl Health Econ Health Policy.* 2017;15(1):75–83.
- Neelemaat F, Bosmans JE, Thijis A, Seidell JC, van Bokhorst-de van der Schueren MA. Oral nutritional support in malnourished elderly decreases functional limitations with no extra costs. *Clin Nutr.* 2012;31(2):183–190.
- Norman K, Pirlich M, Smoliner C, et al. Cost-effectiveness of a 3-month intervention with oral nutritional supplements in disease-related malnutrition: a randomised controlled pilot study. *Eur J Clin Nutr.* 2011;65(6):735–742.
- Elia M, Parsons EL, Cawood AL, Smith TR, Stratton RJ. Cost-effectiveness of oral nutritional supplements in older malnourished care home residents. *Clin Nutr.* 2018;37(2):651–658.
- Dorhout BG, Haveman-Nies A, van Dongen EJJ, et al. Cost-effectiveness of a diet and resistance exercise intervention in community-dwelling older adults: ProMuscle in practice. *J Am Med Dir Assoc.* 2021;22(4):792–802.e2.

49. 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.
50. O’Keeffe M, Kelly M, O’Herlihy E, et al. Potentially modifiable determinants of malnutrition in older adults: a systematic review. *Clin Nutr.* 2019;38(6):2477–2498.
51. Chen CY, Gan P, How CH. Approach to frailty in the elderly in primary care and the community. *Singapore Med J.* 2018;59(5):240–245.
52. World report on ageing and health. WHO. http://apps.who.int/iris/bitstream/handle/10665/186463/9789240694811_eng.pdf. Accessed March 12, 2022.
53. Decade of healthy ageing: baseline report. WHO. <https://www.who.int/publications/i/item/9789240017900>. Accessed March 12, 2022.
54. Robledo LMG, Cano-Gutiérrez C, García EV. Healthcare for older people in Central and South America. *Age Ageing.* 2022;51(5):afac017.
55. Best healthcare in the world 2022. CEOWORLD Health Care Index. <https://worldpopulationreview.com/country-rankings/best-healthcare-in-the-world>. Accessed June 8, 2022.
56. 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):1879–1892.