

The Effectiveness of Self-Management Interventions for Individuals with Low Health Literacy and/or Low Income: A Descriptive Systematic Review

Jamie Schaffler, RN, BSc, MSc(N)¹, Katerina Leung, RN, BSc, MSc(N)¹, Sarah Tremblay, RN, BSc, MSc(N)¹, Laura Merdsoy, RN, BA, MSc(N)¹, Eric Belzile, MSc², Angella Lambrou, MLIS³, and Sylvie D. Lambert, RN, BSc(N), PhD^{1,2}

¹Ingram School of Nursing, McGill University, Quebec, Montreal, Canada; ²St. Mary's Research Centre, Quebec, Montreal, Canada; ³Schulich Library of Science and Engineering, McGill University, Quebec, Montreal, Canada.

BACKGROUND: With the burden of chronic illness increasing globally, self-management is a crucial strategy in reducing healthcare costs and increasing patient quality of life. Low income and low health literacy are both associated with poorer health outcomes and higher rates of chronic disease. Thus, self-management represents an important healthcare strategy for these populations. The purpose of this study is to review self-management interventions in populations with low income or low health literacy and synthesize the efficacy of these interventions.

METHODS: A systematic review of trials evaluating the efficacy of self-management interventions in populations with low income or low health literacy diagnosed with a chronic illness was conducted. Electronic databases were primarily searched to identify eligible studies. Data were extracted and efficacy summarized by self-management skills, outcomes, and content tailoring.

RESULTS: 23 studies were reviewed, with ten reporting an overall positive effect on at least one primary outcome. Effective interventions most often included problem-solving as well as taking action and/or resource utilization. A wide range of health-related outcomes were considered, were efficacious empowerment and disease-specific quality of life were found to be significant. The efficacy of interventions did not seem to vary by duration, format, or mode of delivery or whether these included individuals with low health literacy and/or low income. Tailoring did not seem to impact on efficacy.

DISCUSSION: Findings suggest that self-management interventions in populations with low income or low health literacy are most effective when three to four self-management skills are utilized, particularly when problem-solving is targeted. Healthcare providers and researchers can use these findings to develop education strategies and tools for populations with low income or low health literacy to improve chronic illness self-management.

KEY WORDS: self-management; chronic disease; disease management; vulnerable populations; health literacy.

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BACKGROUND

Currently, 50% of Americans¹ and 60% of Canadians² are diagnosed with a chronic condition, with an increasing number of patients suffering from multi-morbidities.³ The prevalence of chronic disease and the long-term follow-up required in chronic disease management are resulting in a substantial economic burden on the healthcare system.⁴ To assess and improve chronic disease care and control healthcare costs, the Chronic Care Model (CCM) was developed, emphasizing six essential elements in the management of chronic illnesses: healthcare organization, linkages to community resources, delivery system design, clinical decision support, clinical information systems, and self-management support.⁵ Several reviews have found that implementation practices in accordance with the CCM improve the quality of care and health outcomes for patients^{6,7} as well as reduce healthcare-associated costs.^{7,8} Of the six CCM elements, self-management support is the most commonly implemented and has received the most attention.⁷

Self-management refers to the tasks that an individual must undertake to live well with a chronic condition.⁹ It includes five core skills: (1) decision-making, (2) problem-solving, (3) utilizing resources, (4) forming a client-healthcare provider partnership, and (5) taking action.¹⁰ Systematic reviews have shown that self-management interventions have mixed efficacy across chronic illnesses,^{11–15} with positive outcomes particularly noted for symptom management, pain control, and role functioning.^{10,16} This research suggests that both the type of chronic illness and the nature of the self-management skills utilized mediate the efficacy of the interventions.^{17,18} Although most studies have been conducted with populations of females with higher socioeconomic status (SES) and education,^{19,20} in the past 2 decades, there has been increased

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attention given to particular vulnerable subgroups, including those of low income or low health literacy.

Education and income are key factors in determining health.²¹ The United States Census Bureau reports that 46.7 million Americans are affected by poverty.²² This is significant because chronic illnesses and lower life expectancies are more prevalent in low-income populations regardless of age, gender, race, and geographical location.²³ Lifestyle factors including limited access to affordable housing, healthy foods, and recreational facilities, as well as increased stress levels, may contribute to these unfavorable health outcomes.²⁴ Further, low-income populations may struggle with limited access to healthcare.²⁴

Additionally, low levels of education are associated with poorer health, more stress, and lower self-efficacy.²⁵ Individuals with low education tend to have limited socioeconomic mobility, lower incomes, insecure employment, and poorer working conditions, all of which contribute to adverse health outcomes.²⁶ Importantly, low education tends to decrease overall literacy and health literacy levels, which in turn adversely impact on the development self-management skills.²⁶ It is estimated that 36% of adults in the US and 60% in Canada have limited health literacy.^{27,28} This has been associated with decreased medication adherence and use of preventative services, higher rates of hospitalizations and mortality, and overall poorer health outcomes.⁴

Thus, interventions for improving self-management skills among a population of low-income or low health literate patients may have profound effects on health outcomes. To our knowledge, the present review is the first one to describe the current use of self-management interventions in patients with low income and/or low health literacy and synthesize the efficacy of these interventions by self-management skills, health-related outcomes, and extent of content tailoring.

METHODS

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was used²⁹ to conduct this descriptive systematic review of the literature (checklist included in the Electronic Supplementary Material S1).

Criteria for Considering Studies

Types of Studies and Participants. Eligible studies were published peer-reviewed experimental or quasi-experimental trials in which: (1) a group of adults with a chronic physical illness (with or without a comorbid mental illness) of low income and/or low health literacy received a self-management intervention and were compared with a group who did not receive the intervention; and (2) outcomes were measured pre- and post-intervention. Low income and low health literacy were defined as per study authors. Only English

and French full texts were included, and studies dating more than 15 years ago were excluded.

Types of Interventions. Studies included were those that evaluated an intervention aimed at enhancing one or more of the five aforementioned core self-management skills.⁹ Restrictions were not applied to the mode of delivery or to the type of care setting. However, solely pharmacological interventions were excluded. Interventions targeting minority groups were also excluded to decrease potential confounding factors.

Types of Outcomes. The outcomes of interest included physiological, behavioral, and/or psychosocial outcomes. Other outcomes of interest included illness knowledge, financial, and healthcare service utilization. Therefore, studies were included if quantitative data were obtained for at least one relevant outcome and if statistical methods were used to evaluate the differences between control and intervention groups.

Search Methods

Eligible studies were identified through an electronic search of MEDLINE, PsycINFO, CINAHL, and Embase. The search strategy used a combination of keywords and medical subject heading (MeSH) terms related to low income, low health literacy, self-management, and the study design (see Electronic Supplementary Material S2). All titles were downloaded to EndNote. Hand searches were performed on the reference lists of all included manuscripts to identify other eligible studies. At least two authors independently assessed the initial eligibility of the retrieved titles and abstracts. The full-texts of all eligible citations were independently examined by at least three authors to confirm eligibility. Any disagreements were discussed at regular team meetings until a consensus was reached.

Data Collection

A standardized form based on the Cochrane Handbook for Systematic Reviews of Interventions was used to extract data³⁰ from each manuscript (e.g., citation details, study design, inclusion criteria, sample size, population characteristics, self-management skills targeted). Two authors independently extracted the data, and disagreements were discussed and resolved with a third author.

The methodological quality of included studies was assessed by five authors using the following criteria^{30,31}: control group, $n > 25$ per group, sufficient power to detect moderate effect, inclusion criteria specified, assessment of reliability and validity of measures, adequate sequence generation, allocation concealed, blind assessment, intention to treat used, $> 80\%$ of the sample in the final analysis, and reasons for attrition stated.

Each criterion was scored as either a 1 = yes or 0 = no. A high methodological quality was defined as a score of at least 9 moderate methodological quality between 6 and 8, and low quality as scores of ≤ 5 .

Data Synthesis

As there was substantial heterogeneity across studies in study design, demographics, type of interventions, and outcomes, a descriptive synthesis was conducted as opposed to a meta-analysis.³² Data extracted were summarized by one author and verified by at least one other author. Efficacy of the interventions was summarized based on self-management skills, outcomes, and integration of individualized assessment (tailoring).³³ For each outcome, efficacy was based on statistical significance ($p < 0.05$) and a Cohen's effect size (ES) of at least $d = 0.2$ or odds ratio (OR) > 1.44 .³⁴ For studies lacking sufficient data to calculate an ES, only statistical significance was considered. For the analysis by self-management skills and tailoring, an intervention was said to be effective, if the results were significant for at least one primary outcome. For the analysis by outcome, if at least 50% of the analyses were positive, the conclusion was that the interventions were effective for that outcome.

RESULTS

The electronic search identified 2976 titles, whereby 50 manuscripts underwent full-text review. Of these, 27 were subsequently excluded, resulting in 23 studies included in the present review. Figure 1 outlines the systematic review process.

Overview of Studies

Types of Studies and Participants. Table 1 summarizes the characteristics of the 23 studies included. Most studies compared two groups,^{35,37-40,42-47,49,50,52,54,55,57} and all studies were conducted in the US, with sample sizes ranging from 28⁴⁷ to 5457.³⁶ Participants were predominately female aged 40-68 diagnosed with diabetes ($n = 9$) or hypertension ($n = 3$). The majority of the studies examined the efficacy of self-management interventions in a population of low-income participants exclusively ($n = 13$). Seven studies examined the efficacy in participants with low health literacy. Three studies included participants with both low health literacy and low income.

Low income defined. Most studies operationalized low income by stating that participants were recruited from healthcare facilities that were "federally qualified health centers" ($n = 4$),^{36,37,41,44} "safety-net" clinics ($n = 3$),^{35,38,55} or

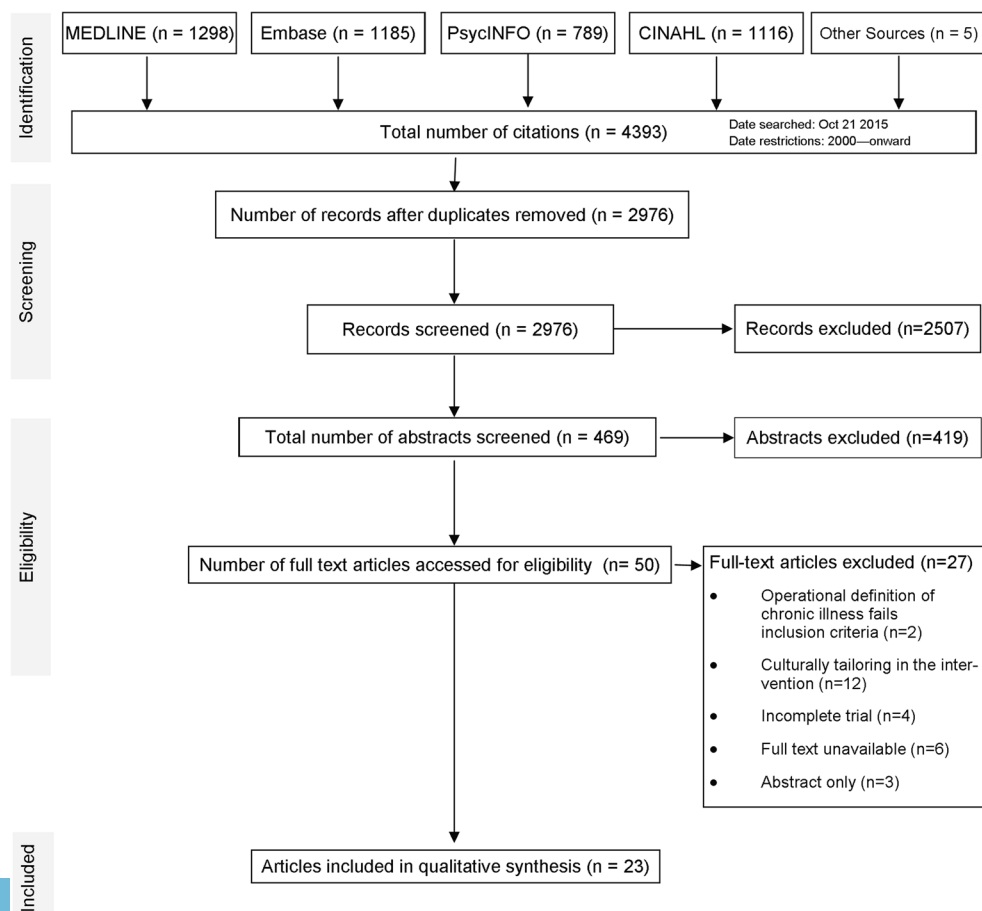


Fig. 1 PRISMA flow diagram. This figure illustrates the methodological flow of our study selection

Table 1 Characteristics of Included Studies (N=23)

Author, Year, Country	Goal	Population	Language	Intervention (I) Control (C)	Outcomes* Primary (P) Secondary (S)	Quality summary score (/11)
Low Income						
<i>Diabetes</i>						
Arora et al. (35) USA	Evaluate a text message-based mobile health intervention (TEXT-MED)	Sample size: 128 Mean Age: C: 51.0, I: 50.5 % Male: C: 31%, I: 40% Ethnicity: C: 89%; I: 86% Latino Income Measure: Safety-net hospital	English or Spanish	I: TEXT-MED text messages to enhance self-care behaviors C: Usual Care Duration of I: 2 text messages/day x 6 month Timing of measurements: Baseline; 6 months	P: No significant decrease in HbA1c levels (data missing for Cohen's d) S: Significant increase medication adherence (Morisky Medication Adherence Scale, d=0.11) No significant increase in self-efficacy (Diabetes Empowerment Scale SF, d=0.12), QoL (Problem Areas in Diabetes Scale, d= -0.39 @ 6 months), diabetes knowledge (Michigan Diabetes knowledge Test, d=0.04), and performance of self-care tasks (Summary of Diabetes Self Care Activities Scale) on subscales of general diet (d=0.09), specific diet (d=0.18), exercise (d=0.04), blood glucose testing (d=0.04) and foot care (d= -0.04). No significant decrease in ED utilization (data missing to calculate Cohen's d)	7
Fischer et al. (36) USA	Evaluate different modes of delivering a patient Report Card (PRC)	Sample size: 5457 Mean Age: C+I: 54.1 % Male: C+I: 40.7 Ethnicity: C+I: 61.5% Latino Income Measure: Federally-qualified community health centers, within an urban safety-net healthcare system	English or Spanish	I: One of the following: (1) Four, quarterly, mailed PRC, (2) Distribution of automatically generated PRC at the point-of-care, or (3) HCP PRC (standard or enhanced) generated from the diabetes registry and distributed to providers as a quarterly email C: Usual care Duration of I: Received PRCs every 3 months x 12 months; met with HCP as needed for 13 months Timing: Baseline, 13 months	Mailed PRC = No significant difference across glycemic control, lipids, and BP (data missing for Cohen's d) Point-of-care PRC = No significant difference lipid target, usual care significantly better glycemic control and BP (data missing for Cohen's d) Enhanced provider PRC = Significant better glycemic control, no significant differences for lipid and BP (data missing for Cohen's d) Point-of-care PRC + Enhanced provider PRC = Significantly worse BP control, no significant outcomes for glycemic control and lipid (data missing for Cohen's d)	7
Fischer et al. (37) USA	Evaluate the effectiveness of a nurse-led telephone care intervention (SM techniques, motivational interviewing) on improving lipid control in adult patients with Type II diabetes	Sample size: 762 Mean Age: C: 58.3, I: 58.5 % Male: C: 42.8%, I: 36.0% Ethnicity: C: 81.1%; I: 81.6% Latino Income Measure: Federally-funded community health centers	English or Spanish	I: Nurse-led telephone outreach program focused on lipid management. Adjustment of LDL medications by nurses based on lab results + on-going medication monitoring + motivational interviewing and facilitated patient SM C: Usual care Duration of I: 20 months Timing of measurements: Baseline, 20 months	P: Significantly fewer patients LDL < 100 mg/dL (data missing for Cohen's d) S: No significant difference in outpatient and ED visits and BP (data missing for Cohen's d) Significant decrease in average cost per patient to the health care system, significantly more patients with CVD with an LDL less than 70 mg/dL (data missing for Cohen's d)	5
Frosch et al. (38) USA	Evaluate the effectiveness of a behavior support intervention (video, workbook, telephone coaching with diabetes specialist nurse) on decreasing HbA1c levels in patients with poorly controlled diabetes	Sample size: 201 Mean Age: C: 54.3, I: 56.7 % Male: C: 57%, I: 46% Ethnicity: C: 71%; I: 72.8% African American or Latino Income measure: 74% incomes of ≤ \$15 000	English or Spanish	I: DVD program + workbook "Living with Diabetes: Making Lifestyle Changes to Last a Lifetime" + maximum of 5 telephone coaching sessions with a bilingual nurse educator. C: Usual care; patients given booklet "4 Steps to Control Your Diabetes for Life" Duration of I: 24 minute video + up to 5 sessions of telephone coaching (1 x 60 min.; 2 x 30 min; and 2 x 15 min) Timing of measurements:	P: No significant reduction in mean HbA1c (d= -0.16) S: Significant improvement self-care behaviors (Summary of Diabetes Self Care Activities Scale) exercise (d=-0.16) No significant changes in LDL (d=0.22), systolic BP (d=0.05), diastolic BP (d=0.07), BMI (d = 0.07), diabetes knowledge (Michigan Diabetes knowledge Test, d=0.05), and self-care behaviors (Summary of Diabetes Self Care Activities Scale) of general diet (d=-0.02), specific diet (d=0.06), blood glucose testing (d=-0.10), foot care	9

Table 1 (continued)

				Baseline, 1 month and 6 months	(d=0.02), taking most of Rx medications (d=-0.19), and taking all of Rx medications (d=-0.34)	
Gregg et al. (39) USA	Enhance coping with diabetes using an acceptance and mindfulness intervention amongst adults with Type II diabetes	Sample size: 81 Mean Age: C: 49.8, I: 51.9 % Male: C: 42.1%, I: 51.2% Ethnicity: C: 26.2%; I: 30.2% Latino Income measure: "Low-income community health center"	English	I: Researcher-led 4-hour education workshop + acceptance and Commitment Therapy (ACT) session C: Education alone attention control including a 7-hour workshop Duration of I: One 4-hour education workshop + ACT sessions (time not specified) Timing of measurements: Baseline; 3 months	P: Significant increase in diabetic control in intervention group compared to control (HbA1c levels <7.0%, data missing to calculate Cohen's d) S: Significant increase in diabetes acceptance (Acceptance and Action Diabetes Questionnaire, d=0.38) and SM behavior (Diabetes Adherence Measure, exercise, diet and glucose monitoring, d=0.2) No significant increase in diabetes knowledge (Diabetes care profile, d= 0.5), or absolute HbA1c levels (d=-0.3)	9
Piette et al. (40) USA	Evaluate the effectiveness of automated telephone disease management (ATDM) intervention to improve diabetes SM and QoL measures in adults with diabetes	Sample size: 248 Mean Age: C: 53.3, I: 55.7 % Male: C: 43.5%, I: 38.7% Ethnicity: C: 51.6%; I: 47.6% Latino Income Measure: C: 56.5%; I: 59.1% <\$10,000 per annum	English or Spanish	I: Standardized, computer-generated, weekly, 5-8 min telephone assessments on glycemic self-monitoring and diabetes self-care + option to receive 30-60 second health tips + option of 3-7 minutes interactive dietary education module + option to receive nurse-led follow up calls as needed. C: Usual care Duration of I: Bi-weekly calls for 12 months Timing of measurements: Baseline; 12 months	Primary and secondary outcomes not specified Significant increase in diabetes self-efficacy (authors developed self-efficacy scale, d=0.27). Significant decrease in depression scores (CES-D, d=-0.29) and days spent in bed because of illness (standard item, d =-0.23) No significant increase in summary score of diabetes-related QoL (DQoL scale, d=0.00), or subscale scores for worry (d = 0.00), burden (d=0.00), and satisfaction (d=-0.09) No significant increase in general QoL (SF-36) in domains of physical functioning (d=0.21), physical role limitations (d=-0.07), social functioning (d=0.24), bodily pain (d=0.12), mental role limitations (d=0.14), and general health perceptions (d=0.20) No decrease in anxiety (Anxiety subscale of the RAND Mental Health Inventory, d=0.09), and days cut down on activity due to illness (standard item, d=0.14)	9
Sequeira et al. (41) USA	Develop and implement continuous glucose monitoring (CGM) in an existing diabetes clinic for low-income Type 1 diabetes patients	Sample size: 39 Mean Age: C+I: 40 % Male: C+I: 52 Ethnicity: C+I: 76% Latino Income measure: clinic for low-income patients	English or Spanish	I: Physician-led continuous glucose monitoring program C: SMBG (cross-over design) Duration of I: monthly visits over 21 weeks Timing of measurements: Baseline; monthly visit	Primary and secondary outcomes not specified No significant difference in HbA1c levels (data missing to calculate Cohen's d) or time in parameters of low or high blood glucose (data missing to calculate Cohen's d)	3
Thom et al. (42) USA	Evaluate the impact of a peer coaching intervention on glucose control on patients with poorly controlled diabetes attending public clinics	Sample size: 299 Mean Age: C: 54.1, I: 56.3 % Male: C: 47%, I: 48.6% Ethnicity: C: 48.7%; I: 44.6% White Hispanic Income Measure: Public health clinic C: 60.4%; I: 60.8% < \$10,000 per annum	English or Spanish	I: Peer coach-led sessions (face-to-face & telephone sessions) for action planning C: Usual care including access to a nutritionist and diabetes educator Duration of I: Two face-to-face contacts & two telephone contacts per month for 6 months Timing of measurements: Baseline, and 6 months	P: Significant decrease in HbA1c level (d= -0.27) S: Significantly more participants had a drop of 1.0% in HbA1c (OR=2.14) No significant decrease in proportion of patients with HbA1c level of less than 7.5% (OR=1.61). No significant decrease in LDL levels (d=-0.08), systolic BP (d=0.2), and BMI (d=0.26)	10
<i>Hypertension</i>						
Bove et al. (43) USA	Evaluate the effectiveness of a telephone and Internet-based system for	Sample size: 241 Mean Age: C: 58.2, I: 61.0 % Male: C: 35%, I: 35%	Not specified (implicit English only)	I: Computer-generated email or telephone reminder to report health data Web form or through the telephone; Nurse-led follow up telephone or internet response for	P: No significant decrease in BP to systolic target of <140 mmHg (data missing to calculate Cohen's D). No significant decrease in absolute systolic BP (d=-0.13), or diastolic BP (d=-0.08)	6

Table 1 (continued)

	delivering a patient-centered self-monitoring program for hypertension management in an underserved, urban community with a high incidence of hypertension and diabetes	Ethnicity: C: 81%; I: 80% African American Income Measure: clinic in underserved area (50% had family incomes at or near the poverty level)		patients with elevated BP C: Usual care + provided data from baseline assessment and advised to contact primary care provider for further care Duration of I: 2 contacts per week for 6 months Timing of measurements: Baseline and 6 months	S: No significant changes in fasting blood glucose (d=-0.08), total cholesterol (d= -0.23), HDL levels (d= 0.03), LDL levels (d=-0.12), triglycerides (d=-0.18), or BMI (d=-0.13) between groups in exploratory analyses	
Martin et al. (44) USA	Determine the effectiveness of a community-based, multimedia intervention on medication adherence among hypertensive adults	Sample size: 434 Mean Age: C: 55.2, I: 56.9 % Male: C: 30.5%, I: 34.4% Ethnicity: C: 94.8%; I: 94.6% African American Income Measure: Federally Qualified Health Center C: 82.2%; I: 81.4% < \$15,000 per annum	Not specified (implicit English only)	I: Delivered via a "Cyber Nurse" and a "Video Doc" with a community health advisor (CHA). The CHA conducted 4 home visits, each visit followed by a phone call C: 4 home visits by CHA to deliver computer-based video education Duration of I: 4 sessions over 6 months Timing of measurements: Baseline, 12 months	P: No significant increase in medication adherence (OR = 0.95) S: No significant change in depression (Center for Epidemiologic Studies Depression scale, insufficient data to calculate Cohen's D)	5
<i>Obesity</i>						
Bennett et al. (45) USA	Evaluate the effectiveness of a behavioral intervention focused on weight loss and adherence to individual HTN medication regimen for primary care patients	Sample size: 365 Mean Age: C: 54.7, I: 54.6 % Male: C: 34.1%, I: 28.9% Ethnicity: C: 70.8%; I: 71.7% African American Income Measure: Urban community health center that served a predominately racial/ethnic minority patient population	English or Spanish	I: Community health-educator led session involving 3 tailored goals to modify health behaviors; self-monitoring via website or telephone; telephone-based follow-up and provision of community resources C: Usual care + self-help booklet Duration of I: 1 initial session and goal revision every 13 weeks; Monthly telephone-based counseling x 12 months followed by bi-monthly counseling x next 12 months Timing of measurements: Baseline, 6-, 12-, 18- and 24-months	P: Significant decrease in body weight (d = -0.09) S: No significant decrease in systolic BP (d = -0.10)	9
<i>Asthma</i>						
Krieger et al. (46) USA	Evaluate the impact of home visits by a Community Health Worker (CHW) on QoL for adults with asthma	Sample size: 366 Mean Age: C: 41.3, I: 41.2 % Male: C: 27%, I: 26.6 Ethnicity: C: 45%; I: 48.6% Latino Income Measure: Household income <250% of 2007 Federal poverty line	English or Spanish	I: CHW led home visits to provide education, support, and service coordination tailored to current knowledge and asthma status + four follow-up contacts C: Usual care + education pamphlets and information about community resources Duration of I: 5 visits (baseline, 0.5, 1.5, 3.5 and 7 months) and follow up phone/email support as needed Timing of measurements: 12 months	P: Significant increase in asthma symptom free-days (d=0.56) and improved asthma QoL (Mini Asthma QoL Questionnaire, d=0.81) No significant difference in urgent care episodes between groups (d = -0.08) S: Significant improvements in night symptoms (d = -0.32), asthma control (d=-0.70), and general physical health status (SF-12, d=1.06) and decreased asthma exacerbation (d = -0.32) and day use of rescue medication (d = 0.42) No significant improvements in pulmonary function (d = 0.00), use of oral steroid burst (d = -0.05), days missed at work and/or school (d = -0.07), or general mental health status (SF-12, d = 0.05)	10
<i>Multiple Chronic Illnesses</i>						
Riley et al. (47) USA	Evaluate the effectiveness of tailored counseling in increasing use of social-environmental resources to support SM of chronic conditions	Sample size: 28 Mean Age: C+I: 58 % Male: C: 8%, I: 27% Ethnicity: C: 67%; I: 47% Caucasian Income Measure: Low income community health center	English	I: Health educator led visit addressing use of social-environmental resources, specific SM goal-planning, barriers, and action-plan; 1 follow up call and 2 newsletters C: Wait-list control Duration of I: 1-hour session, 5 minute follow up call one week later, a generic newsletter delivered after visit, and a tailored	P: Significant increase in use of social-environmental resources (Chronic Illness Resources Survey, sample size too small to calculate Cohen's D) S: Significant increase in medication adherence (Medical Outcomes Study Illness Management scale, sample size too small to calculate Cohen's D) and minutes of physical activity per week (Behavioral Risk Factor Surveillance System, sample size too small to calculate	3

Table 1 (continued)

				newsletter delivered 5 weeks later	Cohen's D)	
				Timing of measurements: Baseline and 1 and 3 months follow-ups	No significant improvements in minutes of walking (Behavioral Risk Factor Surveillance System) and eating patterns (Kristal Fat and Fiber Behavior scale).	
Low Health Literacy						
<i>Arthritis</i>						
Rudd et al. (48) USA	Evaluate the efficacy of plain language information materials and/or individualized sessions to reduce literacy barriers and enhance health outcomes among patients with inflammatory arthritis.	Sample size: 127 Mean age: C: 59.5, I ₁₊₂ : 57.6 % Male: C: 22%, I ₁₊₂ : 19% Ethnicity: C: 94%; I ₁₊₂ : 91% Caucasian Literacy Measure: A-REALM C: 21%; I ₁₊₂ : 16% had high school or less	Not specified implicit English only	I₁ Plain language information materials: educational notebook written at a 5 th -8 th grade reading level I₂ Individualized Care Group: educational notebook + two individual 1-hour meetings with the educator addressing self-care, barriers and communication strategies C: Usual care; Arthritis Foundation pamphlets (11 th -15 th reading level) Duration of I₂: Two 1-hour sessions + additional support as needed Timing of measurements: Baseline, 6 months, and 12 months	P: Significant improvement in self-efficacy (Lorig's self-efficacy scale, d = 0.21). No significant improvements in adherence to treatment (4-item measure based on questionnaire by Levine, d=-0.04), satisfaction with care (Medical Interview Satisfaction Scale, d=-0.23), and appointment keeping (self-efficacy scale, d=-0.17) S: No significant improvements in mental health scores (SF-36, d=0.32) or in health status (Health Assessment Questionnaire, d= 0.08)	6
<i>Cardiovascular Diseases</i>						
DeWalt et al. (49) USA	Compare the efficacy of a single session versus a more intensive multisession education program among patients with heart failure.	Sample size: 605 Mean age: C: 60.3, I: 61.1 % Male: C: 52%, I: 52% Ethnicity: C: 40% Caucasian; 38% African American I: 37% Caucasian; 39% African American Literacy Measure: S-TOFHLA	English or Spanish	I: 1 x 40-minute health educator led session + 10 minutes 5-8 follow up phone calls C: 1 x 40-minute health educator led session + usual care session and self-care sessions Duration of I: 40-minute session + mandatory 4 weeks follow-up telephone calls (10 minutes each) + additional telephone calls every 2 weeks as needed Timing of measurements: All-cause Hosp.: Baseline, 6, and 12 months. HFQOL: Baseline, 1, 6, and 12 months	P: No significant decrease in all-cause hospitalization or death (IRR = 0.96) S: Significant increase in heart failure related QoL (Chronic Illness Care Evaluation Heart Failure Symptom Scale, data missing to calculate Cohen's D). No significant decrease in heart failure related hospitalization (data missing to calculate Cohen's D). or emergency department visits (data missing to calculate Cohen's D)	9
DeWalt et al. (50) USA	Evaluate the efficacy of a heart failure SM program designed for patients with low literacy.	Sample size: 127 Mean age: C: 62, I: 63 % Male: C: 41%, I: 58% Ethnicity: C: 55%; I: 54%, African American Literacy Measure: S-TOFHLA (41% literacy < 4 th grade)	English	I: 1-hour HCP led session on signs and symptoms, daily weight monitoring and diuretic self-adjustment. Patients received an educational booklet written at the 6 th grade reading level. Face-to-face session followed by 10 phone calls x 5-15 minutes each C: Usual care including a general heart failure education pamphlet written at the 7 th grade level. Duration of I: 1-hour educational session + 10 follow up calls x 5-15 minutes each Timing of measurements: Baseline, 6- and 12- months	P: No significant improvements in all-cause hospitalizations, death (IRR = 0.69), and heart failure-related QoL (Minnesota Living with Heart Failure Questionnaire, data missing to calculate Cohen's D) S: Significant improvements in heart failure related knowledge (scale developed by authors, data missing to calculate Cohen's D), self-efficacy (scale developed by authors, data missing to calculate Cohen's D) and self-care behaviors (how often patients weighed themselves, OR = 9.21)	7
Kripalani et al. (51) USA	Evaluate the effect of illustrated medication schedules and refill reminder postcards on medication adherence in adults with coronary heart disease	Sample size: 440 Mean age: C+I _{1,3} : 63.7 % Male: C+I _{1,3} : 44.4 Ethnicity: C+I _{1,3} : 91% African American Literacy Measure: REALM C+I _{1,3} : 45.1% had a literacy level ≤ 6th grade	English	I: Pharmacist-led intervention; patients received: (I ₁) Illustrated medication schedule; (I ₂) Refill reminder post card; or (I ₃) both I ₁ and I ₂ . C: Usual care Duration of I: 5 minute orientation to medication schedule and post-cards every 2 weeks (for those in group 2 and 3 only) Timing of measurements: Baseline, 1 year	P: No significant increase in medication refill adherence (cumulative medication gap, data missing to calculate Cohen's d)	11

Table 1 (continued)

<i>COPD</i>						
Kiser et al. (52) USA	Examine the effect of a literacy-sensitive SM intervention on inhaler technique scores in COPD patients	Sample size: 99 Mean age: C: 63, I: 63 % Male: C: 34%, I: 36% Ethnicity: C: 72%; I: 69% Caucasian Literacy Measure: S-TOFHLA C: 33%; I: 37% low health literacy	English	I: 1 x one-on-one, researcher-led education session with a literacy-sensitive handout and teach-back method for inhaler use C: Usual care Duration of I: 1x 15-30 session Timing of measurements: 2 – 8 weeks (until participant demonstrated teach-back of inhaler use)	P: Significant increase in dose inhaler technique score (data missing to calculate Cohen's D)	6
<i>Cancer</i>						
Wilson et al. (53) USA	Evaluate the differential impact of an audio-visual education program alone versus adding a behavioral contract to the education program among men with prostate cancer	Sample size: 70 Mean age: C+I ₁₊₂ : 67.4 % Male: C+I ₁₊₂ : 100% Ethnicity: C+I ₁₊₂ : 60% African American Literacy Measure: REALM	English	I: Nurse-led intervention in which patient received either (I ₁) an education program or (I ₂) Education plus behavioral contracting after viewing the 1 st video C: Usual Care Duration of I: (1) 1x 15 min video at pre-treatment, treatment, and post-treatment, (2) Same as (1) + weekly one-on-one session to review contract Timing of measurements: Baseline, 3 weeks, 3 months and 6 months	Primary and secondary outcomes not specified. No significant difference in self-care behaviors (Side-Effect Interview and Mood's Self-Care Management Techniques Checklist, data missing to calculate Cohen's D) of men in managing radiation side effects	5
<i>Diabetes</i>						
Cavanaugh et al. (54) USA	Evaluate the impact of addressing both literacy and numeracy as part of an enhanced multidisciplinary diabetes care program	Sample size: 198 Median age: C: 53, I: 52 % Male: C: 35%, I: 37% Ethnicity: C: 44%; I: 42% African American Income measure: C: 45%; I: 52% had < \$20,000/year Literacy Measure: REALM C: 35%; I: 39% literacy < 9 th grade	English	I: Healthcare professional led intervention; patients received the 24 modules of the Diabetes Literacy & Numeracy Education Toolkit (DLNET) which focuses on self-care, nutrition management, and medication administration. C: Enhanced usual care involving 1-6 contacts with diabetes educator or NP over a period of 3 months + educational materials Duration of I: 2-6 sessions over a 3-month period. Timing of measurements: Baseline, 3 months and 6 months (primary); baseline and 6 months (secondary)	P: Significant improvements in HbA1c at 3 months (d = -0.42). No significant improvements in HbA1c at 6 months (d = -0.07) S: Significant increase in self-efficacy (Perceived Diabetes Self-Management Scale, d = 0.23). No significant differences found for SM behaviors (Diabetes Self-Care Activities scale, (data missing to calculate Cohen's D) or satisfaction (Diabetes Treatment Satisfaction Questionnaire, d = 0.09)	9
Low Income and Low Health Literacy						
<i>Cardiovascular Disease</i>						
Cordasca et al. (55) USA	Evaluate the effect of a low-literacy medication education tool on medication adherence and knowledge among cardiac patients.	Sample size: 210 Mean Age: C: 55.7, I: 55.7 % Male: C: 68.7%, I: 63.6% Ethnicity: C: 70%; I: 81% Latino Income Measure: Safety net hospital LHL Measure: TOFHLA C: 43.4%; I: 51.6% had inadequate literacy	English or Spanish	I: Nurse-led intervention in which patient received a 30-day supply of medications + teaching with low literacy materials including a customized medication tool C: Usual care. Duration of I: One session Timing of measurements: Week 2 (12-18 days) and Week 4 (26-32 days) post discharge	P: No significant difference in self-reported medication adherence (Medication Knowledge and Compliance Scale, data missing to calculate Cohen's d) between intervention and control S: No significant increase in medication knowledge (OR = 1.17) between intervention and control group	7
<i>Hypertension</i>						
Bosworth et al. (56) USA	Evaluate the effectiveness of two SM interventions on BP control among patients with hypertension	Sample size: 636 Mean Age: C+I ₁₋₃ : 61 % Male: C+I ₁₋₃ : 34% Ethnicity: C+I ₁₋₃ : 49% African American Income Measure:	English	I: Nurse-led intervention; patients received: (I ₁) home BP monitoring intervention (BP measured 3 times/week) or (I ₂) telephone-delivered intervention with low health literacy materials focused on social support, self-care behaviors, and communication with HCP or (I ₃) behavioral intervention +	P: Significant improvements in the proportion of patients with adequate BP control (data missing to calculate Cohen's D) for the combined intervention group S: Significant improvements in systolic and diastolic BP at 24 months (data missing to calculate Cohen's D) in the combined intervention group	11

Table 1 (continued)

		Self-reported financial difficulties Literacy Measure: REALM C+I ₃ ; 27% had literacy level below the 9 th grade (≤ 60)		home BP monitoring C: Usual care Duration of I: 24 months; patients in behavioral condition received bi-monthly phone calls from the nurse Timing of measurements: Baseline, and 6, 12, 18 and 24 months	
<i>Multiple Chronic illnesses</i>					
Gazmararian et al. (57) USA	Evaluate a 3-part intervention intended to increase refill adherence through attention to health literacy	Sample size: 275 Mean age: C: 52.9, I: 40.5 % Male: C: 12.8%, I: 35.3% Ethnicity: C: 91.9%; I: 89.6% African American Income measure: area serving a minority population Literacy Measure: REALM C: 60%; I: 58.6% reading level below the 7 th grade	Not specified (implicit English only)	I: Pharmacist-led intervention involving telephone-reminders to fill prescriptions, a “picture prescription” card and health communication training for the pharmacists C: Other pharmacy Duration of I: 6 months Timing of measurements: Baseline & 6 months	P: No significant improvements in refill adherence (d = 0.11) 5

ED emergency department, HbA1c hemoglobin A1c, HCP healthcare provider, QoL quality of life, SM self-management, SMBG self-monitoring blood glucose. *Effect size was calculated as the mean difference (using the last time point, unless a primary endpoint was specified) of the two study groups divided by the pooled standard deviation of the difference

“low-income” or “urban” community or public health centers.^{39,42,45,47} Three studies identified the target communities as “underserved”⁴³ or low income.^{40,57} Seven studies reported the level of participant income in dollar amounts, with the majority of annual family incomes being under \$10,000 USD.^{38,40,42,44,45,47,57}

Low literacy defined. Five studies measured literacy using the Rapid Estimate of Adult Literacy in Medicine (REALM) scale,^{51,53,54,56,57} with three of these studies defining low health literacy as a score between 44 and 60 (6th to 9th grade reading level^{51,54,56}). Three studies utilized the Short Test of Functional Health Literacy in Adults (S-TOFHLA),^{49,50,52} with cutoff scores of less than 22^{49,52} or less than 16.⁵⁰ The remaining study used the Test of Functional Health Literacy in Adults (TOFHLA), whereby a score of 0 to 59 constitutes inadequate literacy.⁵⁵

Types of Self-Management Interventions. Intervention duration was variable lasting from a single session to 24 months. Most interventions were delivered face to face by a healthcare professional ($n = 17$).^{39,41,42,44–57} As detailed in Table 2, interventions were also found to vary in terms of which of the five self-management skills was targeted. Most interventions focused on four to five skills. The most common self-management skill addressed was decision-making ($n = 20$) and partnership with a healthcare provider ($n = 19$). These skills were followed by resource utilization ($n = 16$) and taking action ($n = 16$). Although problem-solving was the least addressed skill, it was still included in 15 studies.

Methodological Quality

Table 1 provides the methodological quality score of each study (detailed quality assessment in Electronic Supplementary Material S3). Ten studies were assessed to be of high methodological quality,^{38–40,42,45,46,49,51,54,56} seven of moderate methodological quality,^{35,36,43,48,50,52,55} and the remaining six studies were assessed to be of low methodological quality.^{37,41,44,47,53,57}

Efficacy of Self-Management Interventions

Efficacy Assessment Based on Self-Management Skills. Of the 23 interventions, 10 were found to be effective (Table 2). Nine of these used problem-solving and eight used taking action and/or resource utilization.

Five Skills. Of the nine interventions that included all five skills, only three were effective on the primary outcomes (Table 2), representing a mix of low income and low health literacy studies. Two of these were of high methodological quality and one of moderate quality. Improved primary outcomes included hemoglobin A1C levels,⁴² dose inhaler technique,⁵² asthma symptom-free days, and disease-specific quality of life.⁴⁶

Four Skills. All five interventions utilizing four self-management skills were effective on the primary and secondary outcomes measured, most of which were of moderate-high methodological quality, but including both low income and low health literacy studies. All five effective interventions included taking action, with most of

Table 2 Self-Management Skills Utilized

Studies	Low income (LI) and/or low health literacy (LHL)	Self Management Skills					Effective
		Problem -Solving	Taking action	Decision making	Partnership	Resource Utilization	
FIVE CORE SKILLS							
Bennett et al. (45)	LI	X	X	X	X	X	No
DeWalt et al. (50)	LHL	X	X	X	X	X	No
DeWalt et al. (49)	LHL	X	X	X	X	X	No
Frosch et al. (38)	LI	X	X	X	X	X	No
Kiser et al. (52)	LHL	X	X	X	X	X	Yes
Krieger et al. (46)	LI	X	X	X	X	X	Yes
Martin et al. (44)	LI	X	X	X	X	X	No
Thom et al. (42)	LI	X	X	X	X	X	Yes
Wilson et al. (53)	LHL	X	X	X	X	X	No
FOUR CORE SKILLS							
Bosworth et al. (56)	LI + LHL		X	X	X	X	Yes
Cavanaugh et al. (54)	LHL	X	X	X	X		Yes
Fischer et al. (37)	LI	X	X		X	X	Yes
Gregg et al. (39)	LI	X	X	X	X		Yes
Riley et al. (47)	LI	X	X	X		X	Yes
THREE CORE SKILLS							
Fischer et al. (36)	LI		X		X	X	Mixed*
Gazmararian et al. (57)	LI + LHL			X	X	X	No
Piette et al. (40)	LI	X		X		X	Yes
Rudd et al. (48)	LHL	X			X	X	Yes
TWO CORE SKILLS							
Arora et al. (35)	LI		X	X			No
Cordasco et al. (55)	LI + LHL			X	X		No
Kripalani et al. (51)	LHL			X	X		No
Sequeira et al. (41)	LI			X	X		No
ONE CORE SKILL							
Bove et al. (43)	LI			X			No

Note: Definitions of core skills: (a) Problem solving: the ability to define the problem, generate and implement solutions, and evaluate outcomes; (b) taking action: involves the creation of action plans and the development of self-efficacy; (c) decision-making: includes self-monitoring and responding to changing disease condition; (d) partnership: involves forming an ongoing client-healthcare provider partnership; (e) resource utilization: the ability to seek out and use multiple health-promoting resources. *Four interventions were tested in this study, and significant outcomes were noted for the enhanced provider PRC treatment group

them also including problem-solving or partnership (Table 2). Primary outcomes targeted were blood pressure,⁵⁶ hemoglobin A1C,^{39,54} lipids,³⁷ and socio-environmental resources.⁴⁷ Secondary outcomes were self-efficacy,⁵⁴ cost to the healthcare system,³⁷

acceptance,³⁹ self-management behavior,³⁹ medication adherence,⁴⁷ and minutes of physical activity.⁴⁷

Three Skills. Two of the four studies targeting three self-management skills were effective^{40,48}; these were the only

interventions that included problem-solving and resource utilization. No pattern was noted across the low income versus low health literacy studies. Primary outcomes favorably affected by the interventions were self-efficacy,⁴⁰ depression,⁴⁰ days spent in bed because of illness,⁴⁰ and self-efficacy.⁴⁸ The only intervention that was not effective according to Gazmararian et al.⁵⁷ was the only one to omit problem-solving or taking action.

Two or One Skill(s). None of the interventions utilizing one or two self-management skills were effective. No pattern was noted across the low income versus low health literacy studies.

Efficacy Assessment by Outcomes. There was no consistency across studies regarding the outcomes favored, with many outcomes only measured in 1–2 studies. Those measured in at least four analyses are summarized; the remaining analyses are presented in Table 1. Of note, as no efficacy patterns were noted across the low income and low health literacy studies, these are presented together. The most frequently measured outcome was blood pressure; however, only 4^{36,56} of the 16 analyses were significant. A1C was the next most frequent outcome, with 5^{36,39,42,54} of the 13 analyses found to be significant. Lipids were included in 12 analyses, whereby 2³⁷ were significant. Of the nine analyses focusing on medication adherence, only one⁴⁷ was significant. For health behaviors, one⁴⁷ out of eight analyses was significant. None of the six analyses reporting healthcare utilization were significant.^{37,46,49,50} One⁵⁰ out of five analyses was significant for knowledge. For self-care and self-management, two^{39,52} out of the seven analyses were significant. A more positive result was found for empowerment, with four^{40,48,50,54} of the five analyses reporting significant effects. Similarly, two^{46,49} of the four studies for disease-specific quality of life were significant. Based on this review, only two outcomes met the criterion of being effective in at least 50% of the analyses: empowerment or self-efficacy and disease-specific quality of life.

Efficacy Based on Tailoring. Ten interventions^{36,38,40,44–47,50,53,57} tailored their content, and only three (all with individuals of low income) were effective.^{40,46,47} No pattern in terms of skills targeted was noted.

DISCUSSION

This review sought to critically appraise the empirical evidence on the efficacy of self-management interventions in a population of low-income and/or low health literate adults diagnosed with a chronic physical illness. A thorough understanding of the components of effective self-management

interventions is essential given the increased number of underserved patients living with a chronic illness.²⁶

According to the 2015 United States federal poverty guidelines, low income is defined as a family income of \$24,250 USD annually or less for four people living in the same residence.⁵⁸ Fifteen of the 16 studies that examined low-income populations failed to report the participant household income relative to federal poverty guidelines. Instead, the authors reported the use of self-management interventions in “federally qualified health centers,” “safety net clinics,” or low-income clinics or neighborhoods. This assumes homogeneity of the population regarding socioeconomic status. According to Darnell,⁵⁹ safety net clinics may service both low income and uninsured populations. As such, based on the studies reviewed, drawing meaningful conclusions about the efficacy of self-management interventions within a low-income population presented some challenges. This is in contrast to all studies ($n = 10$) examining a population of low health literate adults using a validated measure of health literacy.

Reviews of self-management interventions have further found that face-to-face contact between participants and intervention leaders is associated with better outcomes.^{18,60} The present review did not note any patterns potentially linking the mode of delivery or the person implementing the intervention to efficacy. Similarly, although Battersby et al.⁶⁰ found that numerous intervention sessions yielded better outcomes, this pattern was not noted and both single and multi-session interventions yielded positive outcomes in the present review. Other reviews have also found that chronic illness typology may moderate the efficacy of self-management interventions.^{18,60,61} The present review found no discernable pattern across illness type, which may be due to the limited research on self-management in chronically ill populations with low income and/or low health literacy.

The current review found that proportionally interventions using three or four self-management skills were more effective than those presenting less than three or five skills. This likely relates to the multifaceted nature of these interventions through the use of social, behavioral, and cognitive approaches to improve disease management.¹⁰ However, participants in interventions with five skills might have felt overwhelmed and/or might not have been given enough time to develop all skills. While the use of four skills appears promising, economic constraints and/or a lack of resources may hinder the development and implementation of multifaceted self-management interventions. If only one self-management skill can be targeted, findings of the current review would suggest problem-solving, as more than half of the 15 interventions with problem-solving were effective on primary outcomes and two additional studies found significant changes in secondary outcome measures.^{49,50} According to Savery,⁶² problem-solving skills help in the development of higher-order thinking. Studies examining the use of problem-based learning have shown that such an approach enables learners to identify and understand the important elements of the

situation, develop an understanding of the relationship between elements, and facilitates improved decision-making, communication, and collaboration.⁶²⁻⁶⁴ This is likely mediated through improvements in the client's engagement, knowledge, confidence, skills, and commitment to making optimal health adjustments.⁶⁵ Arguably, the development of problem-solving skills is implicitly linked to improvements in the other four self-management skills. As such, it has the most potential for influencing behavioral, cognitive, and social health changes. In support of this, many studies have found that problem-solving is a key component of effective self-management across various chronic conditions.^{66,67} In addition to problem-solving, two other self-management skills were found to be effective in half of the interventions that used them: taking action and resource utilization.

In terms of efficacy of the interventions reviewed on health-related outcomes, this review highlighted that self-management interventions among individuals with a chronic illness with low health literacy and/or low income may benefit in terms of enhanced empowerment (or self-efficacy) and disease-specific quality of life. Although a central aim of self-management interventions is to increase participants' self-efficacy to carry out a behavior,¹⁰ only five interventions measured this outcome. For many outcomes considered, less than 50% of the analyses were not significant. Partially, this finding might be explained by the reliance on mostly 'distal' outcomes (e.g., lipids, blood pressure), which depend on a number of factors that are not directly influenced by the interventions.⁶⁸ Reliance on proximal outcomes or outcomes that can be directly affected by the interventions' content and goals might have been more appropriate.⁶⁸

Tailoring was another feature considered in the present review, as it is hypothesized to increase the relevance, interest, and use of interventions.^{69,70} In general, the process of tailoring prunes out the superfluous or irrelevant information and highlights only what individuals would find most pertinent.^{69,70} Tailored print^{71,72} and web-based⁷³ interventions have been found to be more effective than non-tailored approaches. Contrary to these results, less than 50% of interventions with tailored content were found to be overall effective.

Strengths and Limitations

Methods are described in great detail to enhance reproducibility. However, one limitation is that several studies did not explicitly explain the core components of their self-management intervention. However, to reduce bias, five reviewers independently assessed each intervention to identify its self-management skills. Another limitation is the low methodological quality of some studies. Also, for many outcomes and some illnesses the number of analyses was small, and findings should be interpreted with caution. Furthermore, mental health comorbidities were typically not documented across studies, which precludes any subgroup analyses.

Implications for Future Research

Further inquiry is warranted regarding the use of problem-solving, taking action and resource utilization in self-management interventions, and determining which combination of these three skills result in the highest efficacy. In addition, measuring both proximal and distal outcomes in future studies might assist in further determining those interventions that are most effective for what type of outcome. Future studies would also benefit from some consensus on the type of outcomes that should be measured. Replication studies outside the US are also needed.

CONCLUSION

Low income and low health literacy are both associated with poorer health outcomes and higher rates of chronic disease. Thus, self-management represents an important healthcare strategy for these populations. This systematic review described the current use of self-management interventions in populations with low income or low health literacy and synthesized their efficacy. Overall, the current review found that effective interventions tended to focus on problem-solving and to a certain extent taking action and resource utilization. A wide range of health-related outcomes were considered, but only empowerment (or self-efficacy) and disease-specific quality of life were found to be positively affected by the interventions. Tailoring did not seem to impact on efficacy. Future high-quality trials further evaluating problem-solving in combination with taking action and resource utilization among individuals with low health literacy and/or income and replication studies outside the US are needed.

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Corresponding Author: Sylvie D. Lambert, RN, BSc(N), PhD; Ingram School of Nursing, McGill University, Quebec, Montreal, Canada (e-mail: sylvie.lambert@mcgill.ca).

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