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Review

Effectiveness of health literacy- and patient activation-targeted interventions on chronic disease self-management outcomes in outpatient settings: a systematic review

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Abstract. Chronic diseases are the leading causes of morbidity and mortality and account for approximately 60% of all deaths worldwide. Self-management is a key strategy to manage chronic diseases, and there is emerging evidence recommending targeting both health literacy (HL) and patient activation (PA) to improve chronic disease self-management outcomes. The aim of this systematic review is to summarise the current evidence on the impact of HL- and PA-led interventions on self-management outcomes using randomised control trials (RCTs). Six well known databases (MEDLINE, Web of Science, Scopus, Science Citation Index, EMBASE and Academic Search Complete) were searched for RCTs of chronic disease self-management interventions targeting both HL and PA and published between 2004 and June 2021. The search terms included chronic disease, self-management, patient activation/engagement and health literacy/education. Ten studies were eligible for inclusion. We found that patients with low HL and PA levels are most likely to benefit from the interventions. The moderate improvements in PA and HL in the reviewed studies were translated into some improvements in physical activity and mental health outcomes but failed to improve patients' quality of life and healthcare utilisation outcomes. Patients with low HL were more likely to have higher PA levels after the interventions. This review suggests that both HL and PA are essential pillars for improving chronic disease self-management outcomes. However, more studies are needed to explore the long-term impacts of a combination of HL and PA on chronic disease self-management outcomes.

Keywords: patient activation, health literacy, chronic diseases, self-management, outpatient settings, health related-outcomes, patient related outcomes, behavioural outcomes.

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Introduction

The prevalence of chronic disease has been increasing exponentially worldwide over the past decades due to the aging population and the availability of better diagnostic tools (Hajat and Stein 2018). Globally, the number of people aged >60 years increased from 382 million in 1980 to 962 million in 2017, and this is expected to double in 2050 (United Nations 2017). In 2019, non-communicable chronic diseases such as ischaemic heart disease, stroke, lung cancer, depression and diabetes were the top conditions contributing to the highest percentage of morbidity and mortality worldwide (Lujic *et al.* 2017; Hajat and Stein 2018; Niknami *et al.* 2018; Jeganathan and Hosseinzadeh 2020). This has resulted in increasing healthcare costs due to health care utilisation, low productivity and negative effects on individuals' quality of life (Edwards and Hosseinzadeh 2018; Hajat and Stein 2018; Dahal and Hosseinzadeh 2019; Almutairi *et al.* 2020; Ansari *et al.* 2021). Globally, the economic burden of chronic diseases over the next two decades is estimated to cost approximately US$47 trillion (Bloom *et al.* 2011).

Self-management has been adopted as a key strategy in the management of chronic diseases (Yang *et al.* 2017). The available evidence suggests that improving disease knowledge and adopting healthy behaviours, such as increasing physical activity levels, medication adherence and smoking cessation, have been associated with better outcomes, including improving patients' quality of life and reducing health care-associated expenditure (Dadich and Hosseinzadeh 2013; Yang *et al.* 2017; Ho *et al.* 2018; Ansari *et al.* 2020; Hosseinzadeh *et al.* 2020).

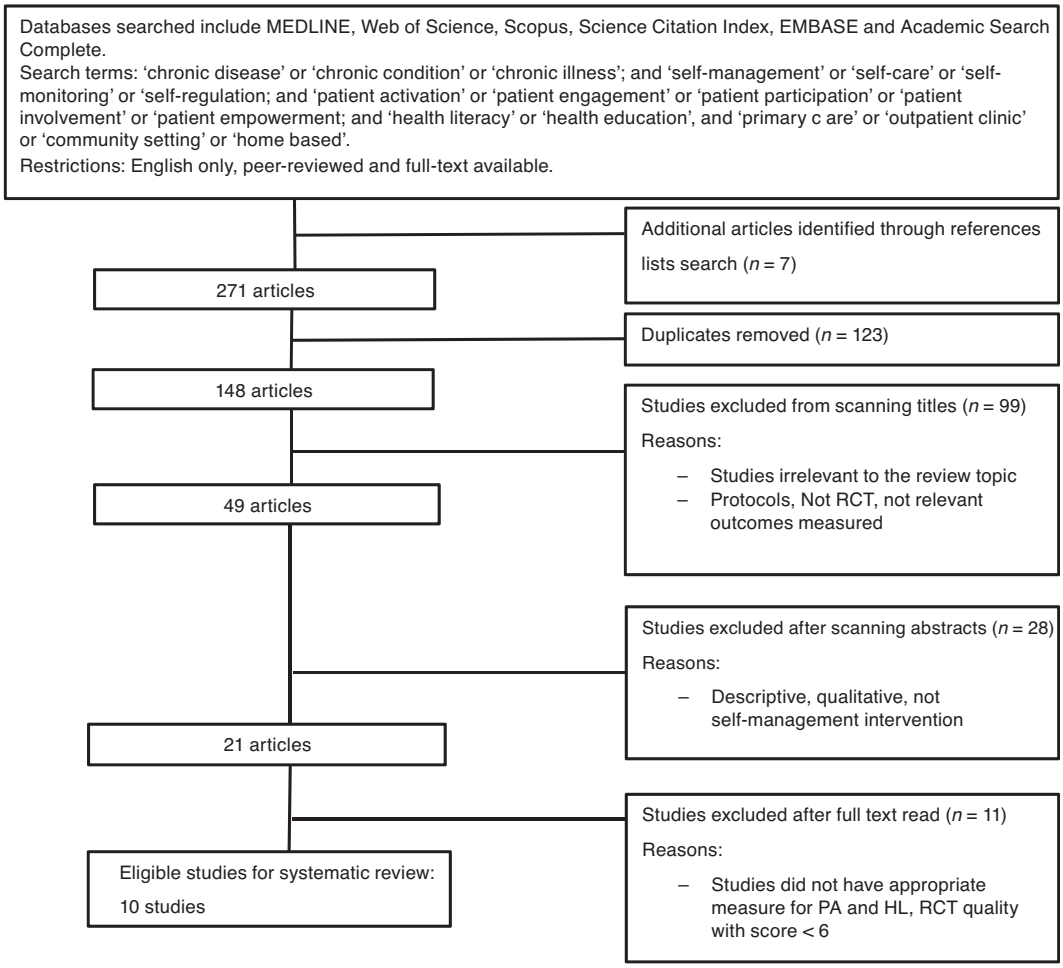

Fig. 1. Flow chart for the study search and selection criteria.

Patient activation (PA) and health literacy (HL) are associated with improved self-management outcomes (Smith *et al.* 2013; Hibbard 2017). PA refers to having the knowledge, skills and confidence to manage a health condition. Highly activated patients tend to have an active role in their disease management through shared decision making, goal setting and involvement in health behaviours change (Hibbard and Greene 2013; Greene *et al.* 2015).

HL has been defined at three levels: functional, communicative and critical HL (Nutbeam 2008). Functional HL includes basic literacy skills in reading and writing, communicative HL includes the cognitive skills that enable a patient to access and navigate the healthcare system and ensure effective communication with healthcare professionals and critical HL includes advanced social and cognitive skills that enable the patient to appraise and integrate health information to have control over their health (Nutbeam 2008). Patients with low HL are more likely to have poorer outcomes due to limited understanding of disease management (Kale *et al.* 2015). Low HL also leads to limited access to available supportive services and poor communication with healthcare providers (Omachi *et al.* 2013).

The literature suggests that targeting both PA and HL in self-management interventions could result in more promising health outcomes and behaviour change than using PA or HL alone (Smith *et al.* 2013; Yadav *et al.* 2019). However, there are inconsistent findings about the effectiveness of such interventions on chronic disease self-management outcomes. The aim of this systematic review is to fill this gap and summarise the available evidence from randomized control trials (RCTs) that evaluated the effectiveness of PA- and HL-driven self-management interventions to improve health-related outcomes among patients with chronic diseases in outpatient settings.

Methods

Search strategy

Six well known databases (MEDLINE, Web of Science, Scopus, Science Citation Index, EMBASE and Academic Search Complete) were searched. The search aimed to identify RCTs that assessed both PA- and HL-driven chronic diseases self-management interventions published since January 2004 until June 2021. The literature was reviewed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Moher *et al.* 2009; Fig. 1; Box 1). Search terms included chronic disease, health literacy/health education, patient activation/engagement, self-management/self-care and primary care/outpatient clinic/community setting (Fig. 1). This review was not registered.

Box 1. Sample search strategy for reviewing the effectiveness of PA- and HL-informed self-management interventions among patients with chronic diseases in outpatient settings

1. 'Chronic disease' or 'chronic illness' or 'chronic condition'
2. 'Self-management' or 'self-care' or 'self-monitoring' or 'self-regulation'
3. 'Patient activation' or 'patient engagement' or 'patient participation' or 'patient involvement' or 'patient empowerment'
4. 'Health literacy' or 'health education'
5. 'Primary care' or 'outpatient clinic' or 'community setting' or 'home based'
6. 1 and 2 and 3 and 4 and 5
7. Limit to English language, peer reviewed and full-text available

A logic model was developed from reviewing the included articles (Fig. 2).

Study selection criteria and data extraction

Inclusion and exclusion criteria

RCTs were only eligible for inclusion if they had appropriate measures of PA and HL, used a PA- and HL-driven self-management intervention, were peer reviewed and were published in English (Table 1). The trials were reviewed independently by all three authors. Any disagreements were resolved by discussion. Data were extracted and tabulated by one author (MS) and double-checked by the other two authors (HH, SD).

Data analysis and quality assessment

The Cochrane Back Review Group (CBRG) assessment criteria were used to assess the quality of the trials reviewed. Only trials scoring ≥6 CBRG points were included in the present study. The included interventions were reviewed using the PRISMA protocol (Moher *et al.* 2009). Narrative synthesis was used to analyse the literature due to heterogeneity of the chronic diseases, the interventions and the outcomes measured.

Results

Study selection

The literature search identified 271 potential studies; of these 123 (duplicates) and 99 (not an RCT or not measuring PA and HL) were excluded. The titles and abstracts of the remaining 49 studies were reviewed, and only 21 studies met the selection criteria. The full text of these 21 studies was further assessed, with 10 studies finally included in the review (Table 2).

Patient characteristics

The ratio of males to females ranged from 24% to 91%, with a higher proportion of females in most studies. The age of the participants ranged between 30 and 84 years, and the sample size ranged from 60 and 4283 patients (Table 2).

Trial quality

The studies included scored ≥6 points on the CBRG assessment criteria (Furlan *et al.* 2009), which indicates a moderate or high quality of the study and a low risk of bias. Most studies were single blinded.

Description of interventions

Components of the interventions are described in Table 2. The reviewed studies targeted a wide range of chronic diseases, including hypertension (Ryvicker *et al.* 2013), diabetes (Lorig *et al.* 2009; Kim and Utz 2019), heart failure (Young *et al.* 2016), chronic obstructive pulmonary disease (COPD; Eikelenboom *et al.* 2016; Chang and Dai 2019) and HIV (Carroll *et al.* 2019). HL was assessed using outcome measures such as functional, communicative and critical outcomes, social support and disease knowledge. PA was assessed using the Patient Activation Measure (PAM; Hibbard *et al.* 2005). Several strategies and techniques have been used to tackle patients' low PA and HL levels. The strategies and techniques applied included motivational interviewing (Ryvicker *et al.* 2013; Dwinger *et al.* 2020), collaborative goal setting (Lorig *et al.* 2009; Chang and Dai 2019; Westland *et al.* 2020), building patients' skills to encourage shared decision making (Lorig *et al.* 2009; Carroll *et al.* 2019) and self-management support, either through the use of social media and/or telephone (Young *et al.* 2016; Kim and Utz 2019; Dwinger *et al.* 2020) or through communication with a community health worker (Kangovi *et al.* 2018).

Most of the interventions were delivered by nurses (Ryvicker *et al.* 2013; Eikelenboom *et al.* 2016; Young *et al.* 2016; Chang and Dai 2019; Kim and Utz 2019; Dwinger *et al.* 2020; Westland *et al.* 2020), but some were delivered by peer coaches (Lorig *et al.* 2009; Carroll *et al.* 2019), one was delivered by collaboration between peer coaches and facilitated nurses (Carroll *et al.* 2019) and one was delivered by a community health worker (Kangovi *et al.* 2018). The duration of the interventions ranged from 3 months to 4 years.

The impact of the interventions was reviewed using four outcome domains: patient-related outcomes such as HL and PA and self-efficacy; behavioural outcomes such as physical activity; and health-related outcomes, including quality of life, mental health and health care use outcomes. Table 2 describes the measured outcomes and Table 3 summarises the findings of the studies.

Patient-related outcomes

HL outcomes

Functional, communicative and critical HL outcomes were used across the studies. The impact of HL on patients' understanding of their disease was assessed by two studies (Young *et al.* 2016; Chang and Dai 2019), but only one of them reported a significant improvements in patients' disease knowledge (Chang and Dai 2019). Similarly, the effect of interactive HL on physician communication was assessed in two studies (Lorig *et al.* 2009; Carroll *et al.* 2019), but only one reported significant improvements in physician communication (Lorig *et al.* 2009). Critical HL was assessed by one study that found significant improvement among patients in the intervention group (Kangovi *et al.* 2018).

PA and self-efficacy

PA levels in all 10 trials were assessed using the PAM (Hibbard *et al.* 2005), with six studies reporting improvements

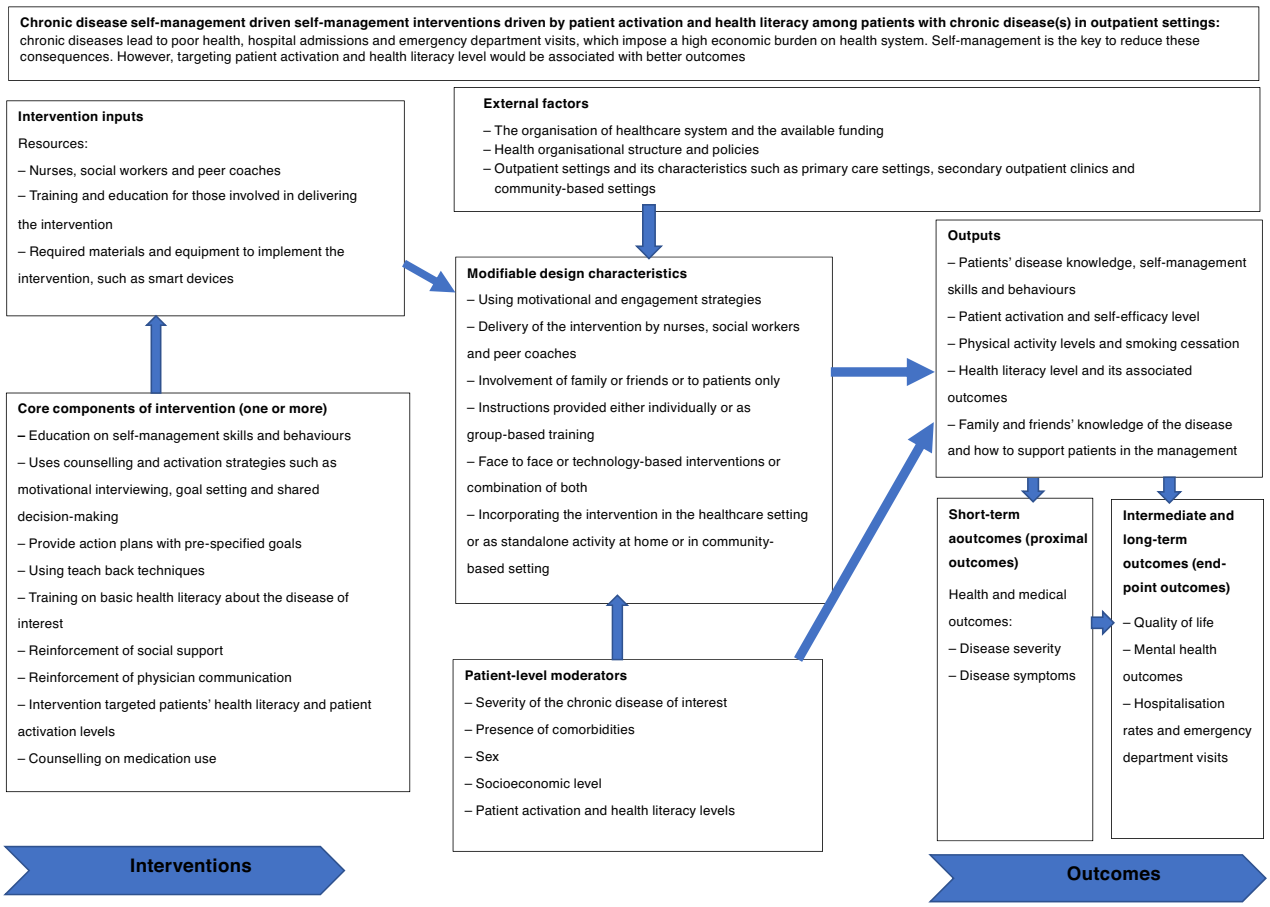

Fig. 2. Logic model of HL and PA targeted chronic disease self-management interventions.

Table 1. Inclusion and exclusion criteria

	Inclusion criteria	Exclusion criteria
Study type	RCTs only	Pilot RCTs or RCTs with a small sample size (<50)
Population	Studies recruited patients with chronic disease(s), except cancer	Studies that recruited patients with cancer
Intervention	Studies used both PA- and HL-driven self-management intervention	Studies that did not use both PA and HL in the self-management intervention
Outcomes	Chronic diseases self-management trials that measured PA, HL and any proximal or end-point health outcomes Outcome variables measured at least at baseline and at the end of the intervention	Trials that did not measure PA, HL or any proximal or end-point health outcomes
Setting	Trials conducted in outpatient settings, such as primary care, community setting or outpatient clinics	Trials conducted in an inpatient setting

in PA levels (Lorig *et al.* 2009; Young *et al.* 2016; Carroll *et al.* 2019; Chang and Dai 2019; Kim and Utz 2019; Dwinger *et al.* 2020). Five studies assessed self-efficacy (Lorig *et al.* 2009; Young *et al.* 2016; Carroll *et al.* 2019; Chang and Dai 2019; Westland *et al.* 2020). The changes in self-efficacy were consistent with changes in PA levels in four studies (Lorig *et al.* 2009; Young *et al.* 2016; Chang and Dai 2019; Westland *et al.* 2020); three of these studies showed improvement in both PA and self-efficacy (Lorig *et al.* 2009; Young *et al.* 2016; Chang and Dai 2019), whereas Westland *et al.* (2020) failed to find improvements in either measure.

Behavioural outcomes

Physical activity

Five studies assessed patients' physical activity levels (Lorig *et al.* 2009; Eikelenboom *et al.* 2016; Young *et al.* 2016; Dwinger *et al.* 2020; Westland *et al.* 2020); of these, three reported improvements in self-reported physical activity levels (Lorig *et al.* 2009; Young *et al.* 2016; Dwinger *et al.* 2020). PA was found to be the major mediator of improvement in self-management behaviours, including physical activity levels, especially among patients with low levels of disease knowledge

Table 2. Characteristics of the studies eligible for inclusion in this review

AADES, American Association of Diabetes Education Standards; AUDIT-C, Alcohol Consumption Questions of the Alcohol Use Disorders Identification Test; BP, blood pressure; BS, blood sugar; CAT, COPD Assessment Test; CHWs, community health workers; COPD-Q, Chronic Obstructive Pulmonary Disease knowledge Questionnaire; CVD, cardiovascular disease; DSMP, diabetes self-management program; ePHR, electronic personal health record; EQ-5D, EuroQol-5 Dimension; EQ-5D-3L, EuroQol-5 Dimension –3 levels; FCCHL, Functional Communicative Critical Health Literacy; FFKA, Freiburg Questionnaire for Physical Activity; HADS, Hospital Anxiety and Depression Scale; HF, heart failure; MARS-D, Medication Adherence Report Scale; JNC7, Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; MET, metabolic equivalent; MI, motivational interviewing; PAM-13, 13-item patient activation measure; Pam AM300, personal activity monitor; PHQ-9, Patient Health Questionnaire-9; PRAISE, Pulmonary Rehabilitation Adapted Index of Self-Efficacy; QoL, quality of life; RHFSCBS, Revised Heart Failure Self-Care Behaviour Scale; SCHFI, Self-Care of Heart Failure Index; SDM, shared decision-making; SDSCA, Summary of Diabetes Self-care Activities; SeMas, Self-Management Screening; SF-12, Short Form 12 Health Survey; SM, self-management; SM-HL, social media health literacy; SOC, Stages of Change Across 10 Health Risk Behaviors for Older Adults; T2D, Type 2 diabetes; TEL-HL, telephone-based health literacy; VAS, visual analogue scale

Reference	Country	Setting	Targeted disease(s)	Sample	Intervention	Control	Outcome measurements
Dwinger *et al.* (2020)	Germany	Community-based settings	Chronic diseases (diabetes, hypertension, HF), chronic mental diseases (depression and schizophrenia)	4283 patients Mean (±s.d.) age (years): Intervention: 66.9 ± 9.3 Control: 67.3 ± 9.5 Sex (M/F): Intervention: 1387/1674 Control: 519/703	Provided telephone-based health coaching intervention tailored to important chronic conditions that require similar self-management strategies. The intervention was delivered by nurses and involved important components and counselling strategies such as MI, individual and collaborative goal setting and SDM. The set goals were recorded by the coach and followed up in the upcoming calls. The minimum call frequency was one telephone contact every 6 weeks, with a maximum intervention duration of 1 year	Usual care	At baseline, 12, 24 and 36 months Primary outcomes: Mental and Physical QoL subscales on SF-12 Health status with the visual analogue scale of the EQ-5D Secondary outcomes: Health behaviours, including alcohol consumption, which was assessed with AUDIT-C Medication adherence, assessed using MARS-D Exercise, assessed using FFKA Specific disease outcomes were assessed using self-developed, ordinal-scaled instruments for assessment of the rate of self-measurement of BP and BS, self-monitoring of feet and foot monitoring by their physician PA using the German version of the PAM, HL using the FCCHL and the process of behaviour change using an adaptation of the SOC Changes in depression and anxiety assessed using HADS
Chang and Dai (2019)	Northern Taiwan	Medical centres	COPD	60 patients Mean age (years): Intervention: 70.5 Control: 73.5 Sex (M/F): Intervention: 27/3 Control: 28/2	The self-management program, with flipped teaching, customised action plans and scheduled telephone interviews, was implemented in the experimental group for 3 months. In the flipping program, the nurse case manager encouraged patients to self-learn the self-management booklet and discussed with them the goals of their chosen self-management action plans	Conventional patient education	At baseline and 1 and 3 months after the intervention Outcomes: Disease knowledge measured by COPD-Q; self-efficacy measured by PRAISE; PA level measured by PAM; health status measured by CAT
Carroll *et al.* (2019)	US	Primary care	HIV	359 patients Mean (±s.d.) age (years): Intervention: 63.9 ± 9.6 Control: 66.0 ± 10.0 Sex (M/F): Intervention: 112/68 Control: 101/78	The intervention group received a smart device and a customised ePHR developed for disadvantaged people living with HIV and included the following: menus for common HIV medications with accompanying pill pictures; common laboratory tests with brief, understandable explanations; the ability to set reminders for appointments, as well as for taking and refilling medications; and a personalised 'prompt list' of potential questions for the patient to ask their clinician	Usual care according to their practice's guidelines and resources.	At baseline, 6–8 weeks and 12 months: Primary outcome: PA measured by PAM Secondary outcomes: eHealth literacy scale, decision self-efficacy scale, Perceived Involvement in Care scale, instrument on doctor–patient communication skills, HIV Adherence Self-Efficacy Scale, health status measured by SF-12 (mental and physical)

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Table 2. (Continued)

Reference	Country	Setting	Targeted disease(s)	Sample	Intervention	Control	Outcome measurements
					The intervention consisted of six 90-min group training sessions, cofacilitated by staff coaches and trained peer educators. The sessions focused on basic HIV literacy, the development of basic eHealth competency, the use of the ePHR and how to ask questions. Cofacilitators encouraged participants to assist each other in learning and to celebrate successes After completing the group training sessions, each patient received one 20- to 30-min individual coaching session. A staff coach met with each patient before the patient's next HIV office visit to reinforce skills learned during the group training and to prepare participants to be engaged at their office visit, including identifying questions/concerns they wanted to address during the visit		
Ryvicker *et al.* (2013)	US	Community-based setting	Hypertension	587 patients Mean (±s.d.) age (years): Intervention: Basic: 65.0 ± 10.4 Augmented: 64.4 ± 11.1 Control: 63.2 ± 10.9 Sex (M/F): Intervention: Basic: 67/124 Augmented: 56/132 Control: 70/138	Patients received usual home health services: skilled nursing services, including patient education, monitoring and hands-on care as necessary In addition, patients were allocated to Arm A (basic intervention) or Arm B (augmented intervention): Arm A consisted of: (1) two emails delivered to the patient's home care nurse with detailed, hypertension-specific recommendations (the first email shortly after the patient enrolled in the study and the second 7 days later); and (2) a home BP monitor and hypertension guide for the patient Arm B included usual care, all the components of the basic intervention and, extending over 12 months, a study-trained 'hypertension support' nurse and health educator who, following explicit protocols, provided hypertension medication assessment, monitoring, education and behavioural counselling that incorporated principles of activation and used MI techniques to help patients identify achievable goals, experience small successes and build their confidence and skills in SM. The study nurse made biweekly telephone calls to review the patient's BP log and, as needed, discuss the patient's medication regimen	Usual home health services (skilled nursing services), including patient education, monitoring and hands-on care as necessary	At baseline and 12 months: Primary outcome: change in patient activation level as measured by PAM score Change in both systolic and diastolic BP, and whether the patient achieved BP control according to the JNC7 guidelines (Chobanian *et al.* (2003), as cited in Ryvicker *et al.* 2013) Health literacy measure was based on a three-question scale—each question with a 5-point Likert-type scale—that assessed patients' ability to read, understand, and complete medical forms on their own

Westland *et al.* (2020)	Netherlands	Primary care setting	Patients at risk of CVD	195 patients Mean (±s.d.) age (years): Intervention: 61.9 ± 9.1 Control: 63.4 ± 8.3 Sex (M/F): Intervention: 52/41 Control: 67/35	The Activate intervention consisted of four nurse-led consultations to enhance patients' level of physical activity, offered at Weeks 1, 3, 7 and 12 in patients' own general practice, with a duration of 20–30 min. The consultations consisted of raised awareness about patients' CVD risk profile and their physical activity level, goal setting, self-monitoring, problem solving and giving feedback on patients' level of goal attainment and, when needed, adjusting goals and action plans. In addition, nurses discussed relapse prevention and the formation of new activity habits	Usual care according to the Dutch guidelines for CVD risk management	At baseline, 3 and 6 months: Primary outcome: change (0–6 months) in minutes of moderate to vigorous physical activity (3–6 MET), assessed by the Pam AM300 Secondary outcomes: Change (0–6 months) in sedentary behaviour based on Pam AM300 data, measured as the percentage of the wear time of the Pam AM300 spent in the sedentary category (<1.8 MET) Self-efficacy for physical activity measured with the exercise self-efficacy scale Patient activation for self-management measured with the PAM-13 Health status measured on five dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression measured with the EQ-5D-3L Patients' self-rated health assessed using the EQ-VAS Social support using the multidimensional scale of perceived social support Depression using HADS Patient–provider relationship using the communication assessment tool Baseline level of physical activity
Kim and Utz (2019)	South Korea	Outpatient clinics	T2D	151 patients Mean (±s.d.) age (years): Intervention: SM-HL: 46.0 ± 15.5 TEL-HL: 52.0 ± 17 Control: 56.0 ± 10 Sex (M/F): Intervention: SM-HL: 31/21 TEL-HL: 23/28 Control: 19/33	The intervention group consisted of two arms that differed in mode of self-management support for 8 weeks. As the following: Arm A: the SM-HL group was provided with smartphone-based technology for the social media intervention and were provided with instructions about accessing and navigating the social media service Arm B: the TEL-HL group was supported with traditional telephone calls Both arms received initial diabetes self-management education, consisting of general information on diabetes, its complications, blood glucose monitoring, nutritional management, exercise and medication utilisation. In addition, both groups received an easy-to-read diabetes education brochure, with the teach-back method used during the initial education session. Patients in both arms were encouraged to make an action plan for each week and provide answers to their questions whenever needed via social media or a telephone call	Usual education using a conventional diabetes education brochure	At baseline, 9 weeks and 12 weeks PA level was assessed with the Korean version of the Patient Activation Measure 13 (PAM13-K) Diabetes self-care behaviours were assessed using a validated 17-item revised Korean version of the SDSCA at baseline and 9 weeks after enrolment HbA1c level (%) at baseline, 9 weeks and 12 weeks Health literacy was measured at baseline using the Short Form of the Korean Functional Health Literacy Test

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Table 2. (Continued)

Reference	Country	Setting	Targeted disease(s)	Sample	Intervention	Control	Outcome measurements
					The navigation menu for action planning in the social media service was developed in a form suitable for patients with low health literacy. The diabetes self-management information was also provided in both video and short text formats, including information regarding diet, exercise, foot care and complications, every week and patients were encouraged to share their diabetes management experiences on the discussion board		
Eikelenboom *et al.* (2016)	The Netherlands	Primary care	COPD	644 patients Mean age (years): Intervention: 66.2 Control: 65.4 Sex (M/F): Intervention: 161/135 Control: 182/166	Using SeMas questionnaire as a tool to personalise COPD self-management support and how to cope with possible barriers including health literacy level	Usual care	At baseline and 6 months Primary outcome: PAM-13 Secondary outcomes: Health literacy, rapid assessment of physical activity, rapid eating assessment for participant_short and smoking status assessment
Young *et al.* (2016)	US	Community-based settings	HF	100 patients Mean (±s.d.) age (years): Intervention: 68.7 ± 11.8 Control: 71.8 ± 12.6 Sex (M/F): Intervention: 24/27 Control: 12/37	Patients received usual care and a 12-week home-based SM training and coaching program delivered by telephone and tailored to subjects' activation levels, pre-set goals and specific SM needs The intervention comprised two phases: a one-on-one in-hospital SM training session and post-discharge reinforcement sessions (twice a week for the first 2 weeks, once a week for Weeks 3–6, and every other week for Weeks 7–12) delivered by telephone. The duration of the session was ~45–50 min. The content was delivered either verbally, written or visual with interactive ability. Each participant was provided with SM workbooks, an SM toolkit, including a calendar for weight and salt daily logging, a step-on weight scale with large and bright readings and an electronic pill organiser reminder alarm. Booster sessions were administered to subjects struggling with SM at home	Usual care consisted of the standard discharge teaching for HF that includes written and verbal information about HF self-care and scheduled follow-up doctor appointments	At baseline, 3 and 6 months: Subscale C (i.e. self-care confidence scale) of the SCHFI was used to assess self-efficacy for SM Patient activation was assessed by the PAM HF SM behaviours were assessed by the 29-item RHFSCBS SM knowledge was measured by a 7-item HF management knowledge questionnaire SM support was assessed by the Medication Adherence in Heart Failure Patients subscale Physical functioning was assessed by a waist-worn accelerometer

Lorig *et al.* (2009)	US	Community-based settings	T2D	345 patients Mean (±s.d.) age (years): Intervention: 67.7 ± 11.9 Control: 65.4 ± 11.4 Sex (M/F): Intervention: 70/116 Control: 54/105	The intervention was a community-based, peer-led DSMP The DSMP was a 6-week program offered for 2.5 h weekly by two peer leaders. Programs were held in community settings, such as churches and seniors' centres. The sessions included the participants and their family and friends. The content included all areas of the AADES (American Association of Diabetes Educators, as cited in Lorig *et al.* (2009)), except that the actual process of glucose monitoring is not taught, although monitoring is discussed and there was a general discussion of medications, but there was no discussion of specific medications, nor was insulin injection taught. All participants also received a copy of the book *Living a Healthy Life With Chronic Conditions* (Lorig *et al.* (2006), as cited in Lorig *et al.* (2009)), whereby each week, specific chapters or pages of the book were suggested as a source for additional information. The program was highly interactive with emphasis on action planning and problem solving. It used skill building, goal setting, and reinforcement with the goal of enhancing participants' self-efficacy	Usual care	At baseline, 6 and 12 months: Health status, health behaviours, health care utilisation and self-efficacy were measured at each time point HbA1C was measured using self-administered BIOSAFE kits Symptoms of hyperglycaemia and hypoglycaemia were measured using scales developed by Piette (Piette (1999), as cited by Lorig *et al.* (2009)) Depression was measured by the PHQ-9 Fatigue was measured using a visual numeric scale Health-related distress was measured by the health distress scale adopted from the Medical Outcome Study (Stewart and Ware (1992) and Lorig *et al.* (1996), as cited in Lorig *et al.* (2009)) A single item from the National Health Survey measured self-rated health Health behaviours were assessed by a physical activities scale measuring total minutes per week of aerobic exercise and by weekly glucose monitoring A 3-item scale measured communication with physicians. It used a 6-point scale (never–always) to measure how often the participant prepared a list of questions for the physician, asked questions of the physician regarding things the participant did not know and discussed personal problems with the physician related to the illness A 3-item scale to measure healthy eating was developed for this study Patient activation assessed with the 9-item short form of the PAM Self-efficacy was measured using the diabetes self-efficacy scale Health care utilisation over the prior 6 months was measured by self-report
Kangovi *et al.* (2018)	US	Community setting	Chronic conditions (patients were diagnosed with two or more of the following chronic diseases: hypertension, diabetes, obesity, tobacco dependence)	302 patients Mean (±s.d.) age (years): Intervention: 56.6 ± 13.6 Control: 56.2 ± 12.6 Sex (M/F): Intervention: 35/115 Control: 39/113	Patients received the IMPaCT intervention in which CHWs provided tailored coaching, social support, advocacy and navigation for low-income patients with multiple chronic conditions for 6 months. The intervention focused on supporting patients with the post-hospital transition Patients used a low literacy visual aid to select one of their multiple chronic conditions to focus on during the study period and, along with their primary care provider, set a disease management goal for that disease	Collaborative goal setting only	At baseline and 6 months: change in chronic disease control, mental health measured by the SF-12, quality of primary care assessed by Consumer Assessment of Healthcare Providers and Systems, supportive of disease self-management, hospitalisation rate, patient activation measured by PAM, self-rated physical health Health literacy at baseline

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Table 2. (Continued)

Reference	Country	Setting	Targeted disease(s)	Sample	Intervention	Control	Outcome measurements
					The intervention consisted of three stages: action planning, tailored support and connection with long-term support CHWs did not provide any disease-specific education or clinical care (e.g. checking BP); rather, they navigated the patients to an appropriate clinician (e.g. diabetes educator) The CHWs communicated with their patients at least once a week for 6 months by telephone, text or visits. As a third component of the intervention, CHWs led a weekly patient support group intended to create social networks among patients who could support each other even after the intensive 6-month CHW support ended. The goal of this support group was to establish long-term support leading to sustained change The CHWs sent electronic messages to primary care providers at 0, 3 and 6 months of the intervention describing the patient action plans and progress. They also sent ad hoc messages or made telephone calls as needed for any clinical matters (e.g. patient running out of medications)		

(Young *et al.* 2016). Lorig *et al.* (2009) reported significant improvements in PA leading to slight improvements in aerobic exercise among patients in the intervention group, and Westland *et al.* (2020) found that patients with low perceived social support reported improvements in their physical activity levels.

Health-related outcomes

Mental health

Three studies assessed mental health outcomes, such as depression and/or anxiety (Lorig *et al.* 2009; Kangovi *et al.* 2018; Dwinger *et al.* 2020). Of these, Lorig *et al.* (2009) found significant improvements in symptoms of depression and Kangovi *et al.* (2018) also reported improvements in patients' mental health.

Quality of life

Five studies assessed quality of life parameters (Kangovi *et al.* 2018; Carroll *et al.* 2019; Chang and Dai 2019; Dwinger *et al.* 2020; Westland *et al.* 2020). None of the studies found improvements in quality of life after the interventions.

Health care use

Four studies assessed health care utilisation (Lorig *et al.* 2009; Young *et al.* 2016; Kangovi *et al.* 2018; Chang and Dai 2019), with none finding improvements after the interventions. Unexpectedly, Young *et al.* (2016) reported a significant increase in hospitalisations among patients in the intervention group at the 6-months follow-up; however, this was reduced to insignificant levels at the 12-month follow-up compared with the control group.

Interactions between HL, PA and self-management outcomes

Three studies reported significant positive associations between PA and HL levels (Ryvicker *et al.* 2013; Eikelenboom *et al.* 2016; Kim and Utz 2019), whereby Kim and Utz (2019) found that patients with low HL at baseline were more likely to have higher PA levels at the 9-week follow-up. In addition, five studies evaluated the association between PA levels and self-management outcomes (Ryvicker *et al.* 2013; Young *et al.* 2016; Carroll *et al.* 2019; Kim and Utz 2019; Westland *et al.* 2020). Patients with low PA levels showed the most benefit from the intervention compared with those who had high PA levels at baseline (Ryvicker *et al.* 2013; Carroll *et al.* 2019; Westland *et al.* 2020).

Discussion

This review aimed to summarise the available literature on the effectiveness of PA and HL on chronic disease self-management in outpatient settings.

The studies reviewed varied in many aspects, such as type of chronic disease, intervention components, delivery mode, follow-up duration, sample size and outcome variables. Some studies focused on social support to motivate patients and tackle low HL and PA levels (Dwinger *et al.* 2020), whereas others focused on other techniques, such as motivational interviewing (Ryvicker *et al.* 2013; Young *et al.* 2016; Kangovi *et al.* 2018;

Table 3. Summary of outcomes results

BMI, body mass index; BNP, B-type natriuretic peptide; BP, blood pressure; CHW, community health worker; CI, confidence interval; COPD, chronic obstructive pulmonary disease; DSMP, diabetes self-management program; EQ-5D, EuroQol-5 Dimension; EQ-5D-3L, EuroQol-5 Dimension –3 levels; EQ-VAS, EuroQol Visual Analogue Scale; PATCH, Patient AcTivated Care at Home; QoL, quality of life; SM, self-management; SM-HL, social media health literacy; TEL-HL, telephone-based health literacy

Study	Duration of intervention	Summary of outcomes results (compared with baseline)
Dwinger *et al.* (2020)	4 years	Significant improvement in physical activity measured in hours per week ($P = 0.030$) and physical activity measured in metabolic rate per week ($P = 0.048$), BMI ($P = 0.009$; although mainly at baseline), measuring BP ($P < 0.001$), PA ($P < 0.001$) and HL ($P < 0.001$) Significant difference in stages of change time × group ($P = 0.005$) No improvement in mental QoL, health status, alcohol, smoking, adherence, measuring blood sugar, foot monitoring, anxiety ($P = 0.646$), depression ($P = 0.758$) and mental distress ($P = 0.815$); campaign-specific subgroup effects detected for 'foot monitoring by a physician' and 'blood sugar measurement' No significant difference regarding the course of mental ($P = 0.963$) and physical ($P = 0.441$) QoL from baseline to 3 years No significant difference in the health status reported with EQ-5D ($P = 0.147$) No difference regarding alcohol consumption ($P = 0.238$), smoking ($P = 0.531$), medication adherence ($P = 0.939$), measuring blood sugar ($P = 0.619$), self-monitoring of foot ($P = 0.352$) or foot monitoring by a physician ($P = 0.720$)
Chang and Dai (2019)	3 months	Significant improvements in COPD knowledge ($P < 0.05$), self-efficacy ($P < 0.01$) and PA level ($P < 0.01$) Significant improvement in QoL at 1 month ($P = 0.011$), but this was not sustained at the end of the intervention (3-month follow-up; $P = 0.18$) No significant difference in the frequency of unexpected medical care ($P = 0.919$)
Carroll *et al.* (2019)	3 months	Significant improvement in PA ($P = 0.0271$), eHealth literacy ($P < 0.0001$) and patient perceptions of involvement in care ($P = 0.0038$) No significant improvement in decision self-efficacy ($P = 0.2631$), patient perception of clinician communication ($P = 0.049$), adherence self-efficacy ($P = 0.8251$) or adherence ($P = 0.7014$), viral suppression ($P = 0.9113$), receipt of HIV preventive services ($P = 0.9937$) or change in physical or mental health status ($P = 0.762$ and $P = 0.4787$ respectively) Interaction between the intervention and PAM level was significant among those in the lowest PAM quartile at baseline ($P = 0.0175$) Intervention effect was stronger for minority participants (non-white race) only for eHealth literacy compared with non-minority participants (non-white/non-Hispanic race) ($P = 0.0275$) Note: although the authors found improvements in PA levels after the intervention, they failed to show improvement in self-efficacy
Ryvicker *et al.* (2013)	12 months	The following data were obtained from African American population: Neither the basic nor augmented intervention yielded a significant positive change in PAM score relative to usual care The strongest predictor of an increase in PAM score was a lower PAM score at baseline ($P < 0.0001$) Only health literacy was significant; a decrease in PAM score was associated with lower HL levels, as measured by the amount of help needed with reading hospital material ($P < 0.05$) Change in PAM score was not associated with change in systolic BP ($P > 0.05$) and had a significant ($P < 0.01$) but small coefficient in relation to diastolic BP change; change in PAM score was not associated with an increased likelihood of achieving BP control ($P > 0.05$)
Westland *et al.* (2020)	6 months	No significant between-group difference was found for physical activity ($P = 0.28$) No change in daily sedentary time ($P = 0.5$) No improvement in exercise self-efficacy scale ($P = 0.68$) No improvement in PA level ($P = 0.99$) No change in patients' health status as measured on EQ-5D-3L ($P = 0.17$) or in patients' self-rated health assessed using the EQ-VAS ($P = 0.92$) Patients with low perceived social support ($P = 0.01$) and patients with a low baseline activity level ($P = 0.02$) benefited more from the intervention
Kim and Utz (2019)	8 weeks	Patients with low HL had the highest PA level at the 9-week follow-up when provided with the SM-HL (95% CI 70.70–85.30) compared with the TEL-HL group (95% CI 68.05–79.38) and the usual care control group (95% CI 64.55–75.98), but these differences were not significant Patients with high HL had a significantly higher PA level when provided with the usual care control (95% CI 76.26–87.59) than the TEL-HL (95% CI 72.24–84.34) and the SM-HL (95% CI 68.54–78.84) Significant differences among the treatment groups for self-care behaviours at the 9-week follow-up ($P = 0.035$) Patients in the TEL-HL group had a significantly higher score for self-care behaviours than the usual care control group at follow-up (95% CI 0.11–0.86). However, no difference was observed in self-care behaviours between the SM-HL and the usual care control groups (95% CI –0.26–0.56) No significant differences among the treatment groups for HbA1c at the 9- and 12-week follow-up ($P = 0.193$ and $P = 0.139$ respectively). However, all three groups showed improvements in HbA1c levels from baseline to follow-up HL was significantly associated with age ($P < 0.001$), education ($P < 0.001$) and PA level at baseline ($P = 0.001$) At baseline, the PA level was significantly correlated with self-care behaviours ($P = 0.035$) but not with HbA1c ($P = 0.633$); at follow-up, the PA level at 9 weeks was significantly correlated with self-care behaviour at 9 weeks ($P = 0.001$) and HbA1c at both 9 ($P = 0.001$) and 12 weeks ($P = 0.021$)

(*Continued*)

Table 3. (Continued)

Study	Duration of intervention	Summary of outcomes results (compared with baseline)
Eikelenboom *et al.* (2016)	6 months	Significant increase in the number of individual action plans ($P = 0.01$) Significant increase in self-monitoring ($P = 0.01$) No improvement in PA level ($P = 0.59$) No improvement in exercise ($P = 0.49$), nutrition ($P = 0.4$) or smoking ($P = 0.86$) Patients with higher HL and education have healthier nutrition habits ($P = 0.012$) Strong association for both HL and higher education with PA level ($P < 0.001$ and $P = 0.006$ respectively)
Young *et al.* (2016)	12 weeks	The following data were obtained from rural patients: At $\alpha = 0.1$, the PATCH intervention showed significantly greater improvement compared with usual care in patient-reported SM adherence: weighing themselves, following a low-sodium diet, taking prescribed medication and exercising daily (all $P < 0.0005$) at 3 and 6 months after discharge No difference among groups in physical activity assessed by actigraphy ($P = 0.693$) or in clinical biomarkers (BNP or mean daily sodium intake (<1500 mg; $P = 0.512$ and 0.818, respectively) The 30-day readmission rate was significantly ($P = 0.088$) higher in the intervention than control group (19.6% vs 6.1% respectively), with no differences at 90 or 180 days. This was explained by the increase in patients' knowledge and skills to recognise early symptoms of disease and refer to doctors as a result of improvements in both PA and HL levels among patients in the intervention group Significantly greater increases in self-efficacy for heart failure SM ($P = 0.034$), SM strategies ($P < 0.0005$) and PA scores ($P = 0.069$) No group differences were found for SM knowledge, which changed approximately two points in each group ($P = 0.337$)
Lorig *et al.* (2009)	6 weeks	At 6 months, DSMP participants did not demonstrate improvements in HbA1c compared with controls Significant improvements in depression, symptoms of hypoglycaemia, communication with physicians, healthy eating and reading food labels ($P < 0.01$) Aerobic exercise was slightly improved ($P = 0.49$) Significant improvement in glucose testing ($P = 0.024$) Significant improvements in PA ($P = 0.001$) and self-efficacy ($P = 0.017$) At 12 months, DSMP intervention participants continued to demonstrate improvements in depression, communication with physicians, healthy eating, patient activation, and self-efficacy ($P < 0.01$) There were no significant improvements in utilisation measures
Kangovi *et al.* (2018)	6 months	The following data were obtained from a low-income population with a high African American representation (94.3% of participants): There were no significant differences in the 6-month change in chronic disease control between the CHW support and goal setting-alone arms (changes in HbA1c, –0.4 vs 0.0; BMI, –0.3 vs –0.1; cigarettes per day, –5.5 vs –1.3; systolic BP, –1.8 vs –11.2; respectively; $P = 0.08$) Although most patients had incremental improvement in their selected condition, few patients in either arm achieved the goal they had set with their provider at the time of study enrolment ($P = 0.81$) Patients receiving CHW support showed greater improvements in mental health ($P = 0.008$) and reported higher-quality primary care that was comprehensive ($P = 0.010$) and supportive of disease SM ($P < 0.001$) No significant improvements in hospitalisation rates between the intervention and control groups at 6 months (16% vs 17.8% respectively; $P = 0.68$) or at 12 months (23.3% vs 31.6% respectively; $P = 0.11$). At 1 year, there were 68 total hospitalisations (278 hospital days) in the CHW arm compared with 98 (414 hospital days) in the goal-setting arm ($P = 0.17$) There were no differences in the change in PA ($P = 0.66$) or changes in self-rated physical health ($P = 0.67$)

Kim and Utz 2019; Dwinger *et al.* 2020) and building patient skills, such as problem solving and asking questions to improve patient–provider communications (Lorig *et al.* 2009; Carroll *et al.* 2019). Many studies focused on using instructions appropriate for patients with low HL levels. Due to these wide variations, the results will be interpreted with some caution.

The reviewed studies evaluated interactions between PA and HL (Ryvicker *et al.* 2013; Eikelenboom *et al.* 2016; Carroll *et al.* 2019; Kim and Utz 2019; Westland *et al.* 2020) and their effects on chronic disease self-management outcomes (Lorig *et al.* 2009; Young *et al.* 2016; Kangovi *et al.* 2018). Most of the studies included showed improvements in patients' HL outcomes, including HL levels (Carroll *et al.* 2019; Dwinger *et al.* 2020), disease knowledge (Chang and Dai 2019), communication with healthcare providers (Lorig *et al.* 2009) and social support (Kangovi *et al.* 2018; Westland *et al.* 2020). Some studies also reported improvements in PA levels (Lorig *et al.* 2009; Young *et al.* 2016; Carroll *et al.* 2019; Chang and Dai 2019; Kim and Utz 2019; Dwinger *et al.* 2020). Improvements in HL and PA resulted in better physical activity levels (Young *et al.* 2016; Dwinger *et al.* 2020) and mental health status (Lorig *et al.* 2009; Kangovi *et al.* 2018). However, these benefits were not translated into improvements in quality of life (Kangovi *et al.* 2018; Carroll *et al.* 2019; Chang and Dai 2019; Dwinger *et al.* 2020; Westland *et al.* 2020) and healthcare utilisation (Lorig *et al.* 2009; Young *et al.* 2016; Kangovi *et al.* 2018;

Chang and Dai 2019). This is in line with the findings from previous systematic reviews, which concluded that improving PA and HL results in changes in patients' behaviours (Taggart *et al.* 2012; Lundell *et al.* 2015).

Nevertheless, the evaluation of the interaction of PA and HL with self-management outcomes found a positive association between self-management outcomes and PA and HL levels (Ryvicker *et al.* 2013; Eikelenboom *et al.* 2016; Carroll *et al.* 2019; Kim and Utz 2019; Westland *et al.* 2020), in that patients with low PA and HL levels benefited most from the interventions. This finding is consistent with the currently emerging evidence that suggests that PA and HL are essential factors to ensure the success of self-management and should be combined to further achieve improvements in long-term chronic disease self-management outcomes (Smith *et al.* 2013; Yadav *et al.* 2019, 2020).

Our review further revealed that the interventions were not associated with improved quality of life and hospital admissions. This could be explained, in part, by the inability of some interventions to successfully change patients' activation levels across the range of baseline PA levels. Thus, this highlights the importance of providing intervention tailored to patients' PA levels (Adams 2010). This concurs with our previous systematic review among COPD patients, which suggested that changing self-efficacy is central to bringing about positive changes in endpoint outcomes (Hosseinzadeh and Shnaigat 2019). This further highlights the need for long-term interventions to support patients and achieve consistent and long-term benefits (Hosseinzadeh and Shnaigat 2019).

To conclude, this review suggests that both HL and PA have a major role in improving chronic diseases self-management intervention outcomes. Future studies should address patients' PA and HL levels to achieve long-term outcomes.

Limitations

This review has some limitations, including the inclusion of different chronic diseases, which could have a direct effect on the measured outcomes. In addition, conceptualisation of HL was different in each RCT, and this is an issue for comparability. Some studies focused on patients, whereas others were focused on the practitioner and social levels. Many studies were based in US, which may limit the generalisability of the results to other countries. In addition, the populations of some studies were not representative of the wider population, because some studies had related to minority only and others had high minority representations. Furthermore, there was variability in the follow-up duration between studies.

Conclusion

HL- and PA-targeted chronic diseases self-management has yielded moderate improvements in HL, PA and self-efficacy levels. There were some improvements in physical activity and mental health outcomes, and, interestingly, patients with low PA levels gained the most benefits from the interventions. Future studies should focus on using PA- and HL-tailored interventions to further improve outcomes for patients with chronic disease. Furthermore, there is a need to consider a comprehensive HL tool measuring functional, communicative and critical HL to obtain conclusive outcomes.

Data availability

Data sharing is not applicable because no new data were generated or analysed during this study.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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References

Adams RJ (2010) Improving health outcomes with better patient understanding and education. *Risk Management and Healthcare Policy* **3**, 61–72. doi:10.2147/RMHP.S7500

Almutairi N, Hosseinzadeh H, Gopaldasani V (2020) The effectiveness of patient activation intervention on type 2 diabetes mellitus glycemic control and self-management behaviors: a systematic review of RCTs. *Primary Care Diabetes* **14**, 12–20. doi:10.1016/j.pcd.2019.08.009

Ansari S, Hosseinzadeh H, Dennis S, Zwar N (2020) Activating primary care COPD patients with multi-morbidity through tailored self-management support. *npj Primary Care Respiratory Medicine* **30**, 12. doi:10.1038/s41533-020-0171-5

Ansari RM, Harris M, Hosseinzadeh H, Zwar N (2021) Healthcare professionals' perspectives of patients' experiences of the self-management of type 2 diabetes in the rural areas of Pakistan: a qualitative analysis. *International Journal of Environmental Research and Public Health* **18**, 9869. doi:10.3390/ijerph18189869

Bloom DE, Cafiero ET, Jané-Llopis E, Abrahams-Gessel S, Bloom LR, Fathima S, Weinstein C (2011) The global economic burden of noncommunicable diseases. (World Economic Forum: Geneva, Switzerland) Available at https://world-heart-federation.org/wp-content/uploads/2017/05/WEF_Harvard_HE_GlobalEconomicBurdenNonCommunicableDiseases_2011.pdf [Verified May 2021]

Carroll JK, Tobin JN, Luque A, Farah S, Sanders M, Cassells A, Fine SM, Cross W, Boyd M, Holder T, Thomas M, Overa CC, Fiscella K (2019) 'Get Ready and Empowered About Treatment' (GREAT) study: a pragmatic randomized controlled trial of activation in persons living with HIV. *Journal of General Internal Medicine* **34**, 1782–1789. doi:10.1007/s11606-019-05102-7

Chang YY, Dai YT (2019) The efficacy of a flipping education program on improving self-management in patients with chronic obstructive pulmonary disease: a randomized controlled trial. *International Journal of Chronic Obstructive Pulmonary Disease* **14**, 1239–1250. doi:10.2147/COPD.S196592

Dadich A, Hosseinzadeh H (2013) Healthcare reform: implications for knowledge translation in primary care. *BMC Health Services Research* **13**, 490. doi:10.1186/1472-6963-13-490

Dahal PK, Hosseinzadeh H (2019) Association of health literacy and diabetes self-management: a systematic review. *Australian Journal of Primary Health* **25**, 526–533. doi:10.1071/PY19007

Dwinger S, Rezvani F, Kriston L, Herbarth L, Härter M, Dirmaier J (2020) Effects of telephone-based health coaching on patient-reported outcomes and health behavior change: a randomized controlled trial. *PLoS One* **15**, e0236861. doi:10.1371/journal.pone.0236861

Edwards J, Hosseinzadeh H (2018) The impact of structured physical activity on glycaemic control in diabetes prevention programmes: a systematic review. *Proceedings of Singapore Healthcare* **27**, 193–204. doi:10.1177/2010105817739924

Eikelenboom N, van Lieshout J, Jacobs A, Verhulst F, Lacroix J, van Halteren A, Klomp M, Smeele I, Wensing M (2016) Effectiveness of personalised support for self-management in primary care: a cluster randomised controlled trial. *The British Journal of General Practice* **66**, e354–e361. doi:10.3399/bjgp16X684985

Furlan AD, Pennick V, Bombardier C, van Tulder M (2009) 2009 updated method guidelines for systematic reviews in the Cochrane Back Review Group. *Spine* **34**, 1929–1941. doi:10.1097/BRS.0b013e3181b1c99f

Greene J, Hibbard JH, Sacks R, Overton V, Parrotta CD (2015) When patient activation levels change, health outcomes and costs change, too. *Health Affairs (Project Hope)* **34**, 431–437. doi:10.1377/hlthaff.2014.0452

Hajat C, Stein E (2018) The global burden of multiple chronic conditions: a narrative review. *Preventive Medicine Reports* **12**, 284–293. doi:10.1016/j.pmedr.2018.10.008

Hibbard J (2017) Patient activation and health literacy: what's the difference? How do each contribute to health outcomes. *Studies in Health Technology and Informatics* **240**, 251–262.

Hibbard JH, Greene J (2013) What the evidence shows about patient activation: better health outcomes and care experiences; fewer data on costs. *Health Affairs (Project Hope)* **32**, 207–214. doi:10.1377/hlthaff.2012.1061

Hibbard JH, Mahoney ER, Stockard J, Tusler M (2005) Development and testing of a short form of the patient activation measure. *Health Services Research* **40**, 1918–1930. doi:10.1111/j.1475-6773.2005.00438.x

Ho T, Hosseinzadeh H, Rahman B, Sheikh M (2018) Health literacy and health-promoting behaviours among Australian–Singaporean communities living in Sydney metropolitan area. *Proceedings of Singapore Healthcare* **27**, 125–131. doi:10.1177/2010105817741906

Hosseinzadeh H, Shnaigat M (2019) Effectiveness of chronic obstructive pulmonary disease self-management interventions in primary care settings: a systematic review. *Australian Journal of Primary Health* **25**, 195–204. doi:10.1071/PY18181

Hosseinzadeh H, Verma I, Gopaldasani V (2020) Patient activation and Type 2 diabetes mellitus self-management: a systematic review and meta-analysis. *Australian Journal of Primary Health* **26**, 431–442. doi:10.1071/PY19204

Jeganathan C, Hosseinzadeh H (2020) The role of health literacy on the self-management of chronic obstructive pulmonary disease: a systematic review. *COPD* **17**, 318–325. doi:10.1080/15412555.2020.1772739

Kale MS, Federman AD, Krauskopf K, Wolf M, O'Conor R, Martynenko M, Leventhal H, Wisnivesky JP (2015) The association of health literacy with illness and medication beliefs among patients with chronic obstructive pulmonary disease. *PLoS One* **10**, e0123937. doi:10.1371/journal.pone.0123937

Kangovi S, Mitra N, Norton L, Harte R, Zhao X, Carter T, Grande D, Long JA (2018) Effect of community health worker support on clinical outcomes of low-income patients across primary care facilities: a randomized clinical trial. *JAMA Internal Medicine* **178**, 1635–1643. doi:10.1001/jamainternmed.2018.4630

Kim SH, Utz S (2019) Effectiveness of a social media-based, health literacy–sensitive diabetes self-management intervention: a randomized controlled trial. *Journal of Nursing Scholarship* **51**, 661–669. doi:10.1111/jnu.12521

Lorig K, Ritter PL, Villa FJ, Armas J (2009) Community-based peer-led diabetes self-management. *The Diabetes Educator* **35**, 641–651. doi:10.1177/0145721709335006

Lujic S, Simpson JM, Zwar N, Hosseinzadeh H, Jorm L (2017) Multimorbidity in Australia: comparing estimates derived using administrative data sources and survey data. *PLoS ONE* **12**, e0183817. doi:10.1371/journal.pone.0183817

Lundell S, Holmner A, Rehn B, Nyberg A, Wadell K (2015) Telehealthcare in COPD: a systematic review and meta-analysis on physical outcomes and dyspnea. *Respiratory Medicine* **109**, 11–26. doi:10.1016/j.rmed.2014.10.008

Moher D, Liberati A, Tetzlaff J, Altman DG, The PG (2009) Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Medicine* **6**, e1000097. doi:10.1371/journal.pmed.1000097

Niknami M, Mirbalouchzehi A, Zareban I, Kalkalinia E, Rikhtgarha G, Hosseinzadeh H (2018) Association of health literacy with type 2 diabetes mellitus self-management and clinical outcomes within the primary care setting of Iran. *Australian Journal of Primary Health* **24**, 162–170. doi:10.1071/PY17064

Nutbeam D (2008) The evolving concept of health literacy. *Social Science & Medicine* **67**, 2072–2078. doi:10.1016/j.socscimed.2008.09.050

Omachi TA, Sarkar U, Yelin EH, Blanc PD, Katz (2013) Lower health literacy is associated with poorer health status and outcomes in chronic obstructive pulmonary disease. *Journal of General Internal Medicine* **28**, 74–81. doi:10.1007/s11606-012-2177-3

Ryvicker M, Feldman PH, Chiu YL, Gerber LM (2013) The role of patient activation in improving blood pressure outcomes in Black patients receiving home care. *Medical Care Research and Review MCRR* **70**, 636–652. doi:10.1177/1077558713495452

Smith SG, Curtis LM, Wardle J, von Wagner C, Wolf MS (2013) Skill set or mind set? Associations between health literacy, patient activation and health. *PLoS One* **8**, e74373. doi:10.1371/journal.pone.0074373

Taggart J, Williams A, Dennis S, Newall A, Shortus T, Zwar N, Denney-Wilson E, Harris MF (2012) A systematic review of interventions in primary care to improve health literacy for chronic disease behavioral risk factors. *BMC Family Practice* **13**, 49. doi:10.1186/1471-2296-13-49

United Nations (2017) Population ageing and sustainable development. (UN) Available at https://www.un.org/en/development/desa/population/publications/pdf/popfacts/PopFacts_2017-1.pdf

Westland H, Schuurmans MJ, Bos-Touwen ID, de Bruin-van Leersum MA, Monninkhof EM, Schröder CD, de Vette DA, Trappenburg JC (2020) Effectiveness of the nurse-led Activate intervention in patients at risk of cardiovascular disease in primary care: a cluster-randomised controlled trial. *European Journal of Cardiovascular Nursing* **19**, 721–731. doi:10.1177/1474515120919547

Yadav UN, Hosseinzadeh H, Lloyd J, Harris MF (2019) How health literacy and patient activation play their own unique role in self-management of chronic obstructive pulmonary disease (COPD)? *Chronic Respiratory Disease* **16**, 1479973118816418. doi:10.1177/1479973118816418

Yadav UN, Lloyd J, Hosseinzadeh H, Baral KP, Harris MF (2020) Do chronic obstructive pulmonary diseases (COPD) self-management interventions consider health literacy and patient activation? A systematic review. *Journal of Clinical Medicine* **9**(3), 646. doi:10.3390/jcm9030646

Yang IA, Brown JL, George J, Jenkins S, McDonald CF, McDonald VM, Phillips K, Smith BJ, Zwar NA, Dabscheck E (2017) COPD-X Australian and New Zealand guidelines for the diagnosis and management of chronic obstructive pulmonary disease: 2017 update. *The Medical Journal of Australia* **207**, 436–442. doi:10.5694/mja17.00686

Young L, Hertzog M, Barnason S (2016) Effects of a home-based activation intervention on self-management adherence and readmission in rural heart failure patients: the PATCH randomized controlled trial. *BMC Cardiovascular Disorders* **16**, 176. doi:10.1186/s12872-016-0339-7