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What sixty years of research says about the effectiveness of patient education on health: a second order meta-analysis

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ABSTRACT

Although meta-analyses have examined the association between patient education and health, the validity and quality of this evidence have not been comprehensively assessed. This second order meta-analysis combined previous meta-analyses that examined the effectiveness of patient education on health outcomes as an overall weighted grand mean $\bar{d}$. Further, measures of methodological quality, meaningful variability across first order meta-analyses, and evidence for publication bias were examined. Forty meta-analyses were identified, investigating 156 associations between patient education and health summarizing data from over 776 studies including more than 74.947 patients. Quantitative analyses showed that patient education positively affects health outcomes with $\bar{d} = 0.316$ (95% CI [0.304, 0.329]). Summarizing data exclusively from randomized controlled trials indicated a causal effect. Patient education was effective for patients with neoplasms, diabetes, mental and behavioral disorders, diseases of the circulatory system, the respiratory system, and the musculoskeletal system. Patient education was effective in the reduction of medication use, pain, and visits to medical facilities, and significantly improved physiological, physical, psychological outcomes, and patients' general function. Overall, the findings reveal firm evidence for the effectiveness of patient education on health outcomes. However, theory-based interventions are lacking and need to be implemented to enable a successful transfer from theory to practice.

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Patients and health professionals experience many challenges during healthcare delivery, especially since the number of chronic diseases grew rapidly within the last decades and is the largest cause of death and disabilities worldwide (World Health Organization [WHO], 2020). The high rate of growth in chronic diseases and medical innovations results in the need for different practices of health care including new roles for patients, physicians, and other health professionals (Holman & Lorig, 2004). Education has been discussed as an essential factor to achieve effectiveness and efficiency in today's health care, as the patient and health professional must share complementary knowledge and authority in the health care process (Holman & Lorig, 2004). Patient education is a planned, systematic, sequential, and logic process of teaching and learning provided to patients and clients in all clinical settings (Lorig, 2001). Such interventions are based on the patient's assessment, evaluation, diagnosis, prognosis, individual needs, and requirements related to the medical treatment. The rationale to

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implement patient education is wide and includes philosophical, medical, practical, legal, and economic reasons (e.g., Blaes, 1984; Feste & Anderson, 1995; Stenberg et al., 2018; World Health Organization, 1998). Although many meta-analyses have examined the association between patient education and health outcomes, the generalizability of this evidence has not been comprehensively assessed. It is, however, of scientific and practical interest whether patient education is effective across different patient groups, settings, or to improve various outcomes, as this would indicate that the mechanisms underlying the effectiveness of patient education are similar across contexts and further, that patient education should be an integral part of clinical interventions in general. The present second order meta-analysis aims to summarize the existing evidence and shed light on the generalizability of the effects of patient education on health.

History of patient education in health care

Despite the rather short history of systematic patient education, the concept has already gone through a number of alterations. These changes occurred due to several factors, for example, the development of professional health education as a discipline and its foundation in scientific research, cultural changes in society, and a shift from acute to chronic diseases in developed countries. Patient education gradually became more popular over the years due to governmental stimulation of patient education in primary health care (e.g., United States Department of Health Education and Welfare, 1971; Visser, 1984), active patient organizations (e.g., Roter et al., 2001), promotion of research on patient education (e.g., Roter et al., 2001; Visser, 1984), and the introduction of university programs (e.g., Deccache & van Ballekorn, 2001).

Many of the early patient education programs emphasized transfer from knowledge on health status alone, did not account for the more complex aspects of health behavior, and were frequently developed in an unsystematic way. As a result, most of the early interventions were only effective among the most educated and economically advantaged in the community (Hoving et al., 2010). Patient education was considerably strengthened by the development of more sophisticated, theory-informed interventions, which considered the social and economic circumstances of individuals and their health behavior. Following, patient skills training, behavior modification programs, and training of self-management skills were integrated in patient education (Hoving et al., 2010). It became an integral part of today's medical treatment (Nutbeam, 2000) and interdisciplinary standards for patient education were established and developed further (Giloth, 1993; Joint Commission on Accreditation of Healthcare Organizations, 1999). At present, the patient education literature is vast and includes approaches based on a number of behavioral theories (Bandura, 1997; Fishbein, 1979; Rosenstock, 1974). More recently, the beneficial role of learning theories (Mayer, 2005; Paivio, 1991; Sweller et al., 2011) and evidence from neuroscience (Ekhtiari et al., 2017) has been discussed when developing patient education interventions. Further, nationwide and international patient education programs have been developed aiming to empower patients to actively engage in their care (e.g., Joint Commission on Accreditation of Healthcare Organizations, 2020; National Institute of Diabetes and Digestive and Kidney Diseases, 2020). However, a low percentage of patient visits include patient education (Coonrod et al., 1994; Waitzkin, 1984), raising the question of why patient education is still a side issue in medical treatment.

Conceptualizations of patient education

Resulting from the broad range of application possibilities of patient education and the different paths in historical and scientific developments, educational interventions can greatly differ across different medical fields. As such, different terms have evolved describing patient education programs. Interventions termed *patient educational* interventions, *patient teaching*, or *patient instruction* provide information on diseases to enhance the patients' factual knowledge and conceptual understanding of mechanisms related to health maintenance and improvements (e.g., Forster et al., 2012;

Heisler et al., 2002; Williams et al., 1998). *Psychoeducational* interventions target the patients' attitude representing the levels of perception of responsibility toward their disease (de Weerdt et al., 1989; Masaki et al., 1990) and aim to improve the patients' coping with their illness. They are defined as an intervention with systematic, structured, and didactic knowledge transfer for an illness and its treatment, integrating emotional and motivational aspects (Ekhtiari et al., 2017). Psychoeducation is different from other psychological interventions, such as Cognitive Behavioral Therapy or Family-Focused Therapy, as it includes core elements that are not defining aspects of other psychological interventions, such as education about the illness (Bond & Anderson, 2015). As such, it is a patient education intervention focusing to enhance patients' knowledge and coping strategies. Sometimes, interventions termed as psychoeducation include more aspects than the education about the illness, for example, stress management techniques (Stafford & Colom, 2013). We do not consider meta-analyses including these multifaceted interventions in the current review as the effectiveness of patient education cannot be fully determined due to confoundation. *Self-management education* especially targets people with chronic diseases (Lorig & Holman, 2003), stresses the role of patient education in preventive and therapeutic health care activities, and commonly consists of organized learning experiences designed to facilitate the adoption of healthy behaviors (Warsi et al., 2004). While interventions on self-management education primarily provide information on different topics, such as problem-solving skills or dietary intake (Jonkman et al., 2016), some also include behavioral components, such as physical activities, relaxation training, or changes in medical treatment. For the current review, we only included meta-analyses that assessed the effectiveness of self-management education without combination with other treatments such as exercise or relaxation training. As such, self-management education interventions are educational programs aiming to encourage patients to enhance their knowledge, acquire self-management skills, and seek to guide their health behavior.

All of the above terms have in common that they describe interventions that focus on the knowledge and transfer of information about an illness and its treatment with the aim to maintain or enhance the patients' health status. As such, patient education is a gradual process of learning by which a person experiences changes in knowledge, behavior, skills, and attitude (Falvo, 1994; Pekkala & Merinder, 2002).

The effectiveness of patient education: strengths and weaknesses of previous meta-analyses

There exists broad evidence that patient education is an effective tool to enhance and maintain health. Several observational studies (e.g., Bordin et al., 2007), clinical case reports (e.g., Janson-Bjerklie et al., 1993), controlled trials (e.g., Roumie et al., 2006) and randomized controlled trials (e.g., Traeger et al., 2019) have suggested a positive effect of patient education on health outcomes. Moreover, narrative reviews (e.g., Gagliano, 1988), systematic reviews (e.g., Blackstone & Webster, 2007; Cooper et al., 2001), meta-analyses (e.g., Conn et al., 2009; Ellis et al., 2004), and reviews of systematic reviews (Woolley et al., 2018) summarized these studies and have generally supported the effectiveness of patient education.

Previous meta-analyses provide valuable insights on the effectiveness of patient education but do not provide a comprehensive integration of the existing literature on patient education thus far. Specifically, it is still unclear whether patient education is effective across (1) different diseases, (2) different health outcomes, and (3) what intervention characteristics determine its effectiveness. Firstly, previous meta-analyses summarized the effectiveness of patient education for a specific disease or patient groups but did not analyze the overall effectiveness of patient education. In these cases, the meta-analysis summarizes the effects of different educational interventions, performed in various clinical settings with patient education delivered by varying clinical staff members (e.g., physicians, nurses, health workers). These meta-analyses are useful to determine whether patient education is effective within a specific medical field as the effects of patient

education may vary due to the characteristics of the individuals (e.g., Davis et al., 1990; Fredericks et al., 2010; Mayeaux et al., 1996; Rosenstock, 1974) and disease-specific challenges (e.g., Tan et al., 2012). However, it remains unclear whether the effects of patient education generalize across health issues as this has not been systematically investigated in previous meta-analyses. Following, the current review includes meta-analyses investigating the effect of patient education on various health issues. Insights whether the effects of patient education show for various patient groups are useful in that regard that patient education can be seen as a universal tool to promote and maintain health, independent of the characteristics of the patients' disease.

Secondly, while the effectiveness of patient education is commonly assessed in previous meta-analyses, differences in the effects on different health outcomes are not systematically considered. However, this is relevant because patient education is proposed to improve health by enhancing the patients' knowledge, helping to transform knowledge about health behavior into effective strategies for health enhancement, which finally results in better health (Glanz et al., 2008; Rosenstock, 1990). Most commonly, meta-analyses include physiological or physical outcomes, for example, blood pressure (e.g., Brown, 1990; Devine & Reifenschneider, 1995) or pain (e.g., Guruge & Sidani, 2002; Jho et al., 2013). Some meta-analyses include psychological outcomes or measures of general functioning, such as anxiety (e.g., Faller et al., 2013; Ramesh et al., 2017) or quality of life (e.g., Rehse & Pukrop, 2003; Timmer et al., 2011). Others report changes in knowledge (e.g., Forster et al., 2012) and skills, for example, insulin injection skill (e.g., Brown, 1990), or health behavior, for example, medication adherence (e.g., Devine, 1996). Even less is known about the effect of patient education on clinical decision making (Devoe et al., 2016). As such, it is still unclear whether patient education is more effective for specific outcomes than others. To determine the effectiveness of patient education on different outcomes, we did not limit the included meta-analyses based on the outcomes included.

Thirdly, as patient education programs greatly differ in their delivered content, it is still unclear whether specific components are more effective than others. From a theoretical perspective, it is suggested that patient education is most effective when it targets the patients' knowledge, attitudes, and self-management to perform changes in health behavior (de Weerdt et al., 1989; Glanz et al., 2008). Most commonly, patient education programs provide information on diseases to enhance the patients' factual knowledge and conceptual understanding of mechanisms related to health maintenance and improvements (e.g., Forster et al., 2012; Heisler et al., 2002; Williams et al., 1998). Educational interventions can further target the patients' attitude representing the levels of perception of responsibility toward their disease (de Weerdt et al., 1989; Masaki et al., 1990), as for example, in psychoeducational interventions. Further, patient education can enhance the adoption of healthy behaviors (Warsi et al., 2004), as for example, in the form of self-management education. Despite the great variety in educational goals across interventions, only a few meta-analyses have examined the effect of specific components such as the provision of information (e.g., Gibson et al., 2015; Suls & Wan, 1989) or self-management interventions (e.g., Chodosh et al., 2005; Guevara et al., 2003; Minet et al., 2010). As such, it is still unclear whether some educational components are more useful than others. Following, the current meta-analysis includes different types of educational interventions and systematically considers their effectiveness.

The value of second order meta-analysis

First order meta-analyses can be summarized via second order meta-analyses to gain insights into the amount of true variance between meta-analyses. Whereas first order meta-analyses quantitatively combine the results from multiple primary studies to generate a synthesis of the outcomes on a given topic or relationship (Glass, 1976), second order meta-analysis is a meta-analysis of a number of methodologically comparable existing first-order meta-analyses that examined similar issues or relationships on a given topic (Cooper & Koenka, 2012; Schmidt & Oh, 2013). Second order meta-analyses are also referred to as overviews of reviews, systematic reviews of reviews, umbrella reviews, meta-meta-analyses, and meta-analyses of meta-analyses. The relationship

between a second order meta-analysis and related meta-analyses are quite similar to that of a meta-analysis to primary studies. While first order meta-analytic overviews provide valuable insights, they have been considered unsatisfactory, as an estimation of the amount of between-meta-analysis true variance is not possible (Cooper & Koenka, 2012). To address this issue, techniques for second order meta-analysis have been developed (Schmidt & Oh, 2013). Consequently, second order meta-analyses have gained an increase in importance and this relatively new form of scholarship can facilitate the accumulation of meta-analytic research to converge a more representative mean of the distribution.

Second order meta-analysis particularly aims to estimate to what extent second order sampling error (i.e., sampling error because the number of included studies is always smaller than the number of theoretically possible studies) accounts for the difference across meta-analytic means obtained in first-order meta-analyses on a specific topic. When combining results in a second order meta-analysis, first, first-order meta-analytic means are used to calculate a weighted grand mean. Second, the proportion of between-meta-analysis variance explained by second order sampling error is calculated. As such more accurate estimates of the overall mean are produced. Second order sampling error can either explain some of the true variance or all of the true variance. If the second order sampling error accounts for only a portion of the variance, different mechanisms for at least some of the results must be assumed. If it accounts for all variance, it's likely that the same mechanisms occur in the populations included in the first-order meta-analyses. Following, second order meta-analyses provide important information that cannot be obtained from first order meta-analysis, such as second order sampling error or the reliability of the first-order meta-analytic effect sizes (Schmidt & Oh, 2013).

Summarizing, second order meta-analyses serve some important purposes, such as (a) summarizing the existing evidence from more than one meta-analysis, (b) comparing findings and resolving discrepancies among these meta-analyses, and (c) identifying research gaps and potential directions for future research. In this way, the results can provide valuable insights into the generalizability of the effectiveness of patient education. As such, we employ second order meta-analytic techniques in the current review to summarize the effects of patient education on health outcomes studied with different patient populations.

The present study

While many meta-analyses have examined the association between patient education and health outcomes, the scope, validity, and quality of this evidence has not been comprehensively assessed. The previous investigations were specific to particular diseases and health conditions. We aimed to address these limitations and provide an integrative overview of the breadth and effectiveness of patient education for a wide range of diseases and health outcomes by means of a second order meta-analysis (Schmidt & Oh, 2013).

In line with the purposes mentioned above, the objective of this second order meta-analysis was to provide a comprehensive synthesis of the effects of patient education on health outcomes across different diseases. Our review addressed the following four research questions:

(1). How strong are the effects of patient education on health outcomes as shown by integrating findings of existing meta-analyses?
(2). How broadly and consistently generalize these findings over types of diseases?
(3). How broadly and consistently generalize the effects of patient education over health outcome types?
(4). How effective are different educational approaches of patient education?

Method

Eligibility criteria

Studies were included in this second order meta-analysis when they fulfilled each of the following four criteria:

(1). The study is a meta-analysis, that is, the study averages effect sizes from at least two original studies. Narrative reviews that did not report quantitative synthesis to aggregate effect sizes were excluded.
(2). The meta-analysis investigates the effect of a patient educational intervention, which is designed to convey or enhance patients' knowledge of a physical disease or psychological disorder, and/or its causes, symptoms, progression and potential for change.
   (a) The intervention can be in any form, that is, in an individual setting or group setting; with or without personal contact, in any clinical setting such as home care, outpatient treatment, inpatient care, among other settings, and delivered by general practitioners, nurses, pharmacists, or others.
   (b) The intervention addressed patients only. Meta-analyses that included studies with interventions for patients and caregivers, family members, and/or peers combined were not considered.
   (c) Whenever a control group was employed, the intervention and the control group differed only in terms of patient education. If this difference was confounded with other differences between the treatments of the two groups, as for example, for multicomponent interventions, the meta-analysis was excluded. As such, we only included interventions providing educational interventions components and excluded meta-analyses where a combination of different interventional strategies was summarized (e.g., education combined with physical exercise).
(3). The meta-analysis included studies that investigated the effect of patient education on health outcomes. Meta-analyses that focused exclusively on knowledge, attitudes, or behavior as outcomes were not included.
(4). The meta-analysis reports quantitative and standardized effect sizes (e.g., standardized mean difference, Odd's Ratios) and the respective number of included studies (*k*).

Search strategy and determining eligibility

We performed a standardized search of titles and abstracts in six major digital databases (i.e., Medline, PubMed, Cochrane Library, Web of Science, PsycINFO, and ERIC) for papers published from database inception to August 2020 limited to English or German language. The same search string was used for each database search, which was ((‘patient education’ or ‘educational intervention’ or ‘health education’ or ‘psychoeducation’ or ‘self-management’) and (‘meta-analysis’)). We additionally performed an exploratory hand search using other databases such as Google Scholar and Researchgate and looking through cross-references of included meta-analyses.

Two trained and independent raters (Rater A and Rater B) both screened a little over 25% of the same titles and abstracts for inclusion following best practice guidelines for the screening of abstracts (Polanin et al., 2019). Their inter-rater agreement for the inclusion of studies based on the abstracts was 84%. Disagreements were solved through discussion. The remaining abstracts were coded by Rater A. A total of 317 full texts were obtained for further investigation. Two raters (Rater A and Rater C) independently screened 49 full texts for inclusion in the meta-analysis. The inter-rater agreement for the inclusion of the full-texts was 81%. Again, disagreements were

solved through discussion. We initially identified 40 meta-analyses meeting the inclusion criteria of the current second order meta-analysis.

Data extraction

Data extraction was conducted following standardized coding rules and predetermined data extraction forms. From each study, we extracted the health issue, type of control, year range of included studies, number of studies, number of RCTs, number of participants, content of the education program, temporal distance of the post-test in relation to the intervention, outcome variable, category of the outcome variable, reported effect size type, effect size, 95% *CI* or *SD* or *SE* of the effect size, direction of the effect, and significance of the effect. For odds ratios and risk ratios, we further coded the contingency tables. We categorized the health issues according to the ICD-10 classification (World Health Organization, 2004). A medical practitioner double-checked these codes. We planned to systematically code the instructional methods used in the patient education intervention. However, due to a lack of detailed information reported in the meta-analyses, we were not able to include this information in our statistical analyses. Instead, we extracted the definition of patient education used by each meta-analysis and the specific educational components of the single studies included in the meta-analysis. We coded educational interventions as didactic interventions, psychoeducational interventions, and self-management education following the description of the authors, respectively. For all included meta-analyses, we additionally extracted effect sizes for the effects of patient education on knowledge and skills, as well as health behavior to allow for exploratory analyses of these possible mediators of education effects on health.

Missing data or additional information were requested from the corresponding authors of the articles by email. Two trained and independent raters (Rater A and Rater C) double coded 61 full texts (reporting 73% of the included effect sizes). The inter-rater agreement for the coding of all moderators and effect sizes was 96%. The rest of the full texts were coded by Rater A. Further, we extracted the specific components of patient education employed within the single studies for each meta-analysis included in our review (Rater A).

Assessing study overlap and methodological quality of the Analyses

Second order meta-analyses are hampered by the problem that the same original study can be included in several reviews (Cooper & Koenka, 2012). If we had included partly overlapping meta-analyses, the same original study would enter our second order meta-analysis not once, but twice or more. To account for this problem, whenever there was overlap between meta-analyses, we included only the most recent of these meta-analyses, which was usually also the largest. To identify any overlap, we screened the included single studies of the meta-analyses for duplicates whenever more than one meta-analysis reported data for the same combination of health issue and outcome. We had to exclude 20 effect sizes from eight meta-analyses. As a result, five of the eight meta-analyses were fully excluded from the analyses due to study overlap.

We assessed the methodological quality of the meta-analyses using an extended version of the Assessment of Multiple Systematic Reviews questionnaire (AMSTAR-2; Shea et al., 2017). We followed the recommendations on rating the overall confidence in the results of each meta-analysis by using a scheme for interpreting weaknesses instead of using an overall score. Rater A and Rater D performed the quality assessment and had 78% inter-rater agreement. Differences were resolved through discussion.

Preparation of effect sizes and statistical analyses

First, we converted all extracted effect sizes other than Cohen's *d* into Cohen's *d* to enable comparison across the outcomes. One study reported a correlation, which we converted with the following formula (Borenstein et al., 2009):

$$\bar{d} = \frac{2\bar{r}}{\sqrt{1-\bar{r}^2}} \tag{1}$$

We converted all odds ratios to Cohen's *d* as follows (Chinn, 2000):

$$\bar{d} = LogOddsRatio \times \frac{\sqrt{3}}{\pi} \tag{2}$$

When a risk ratio was reported, we calculated the odds ratios from contingency tables relating to the overall meta-analytic effect size. We used the following formula for the conversion (Higgins et al., 2019):

$$OR = \frac{cases\ bad\ outcome\ in\ PE\ group\ \times cases\ good\ outcome\ in\ control\ group}{cases\ good\ outcome\ in\ PE\ group \times cases\ bad\ outcome\ in\ control\ group} \tag{3}$$

where PE group stands for patient education group.

For the meta-analytic integration, we obtained or calculated the variances of the reported effect sizes. We used the information reported in the single meta-analyses to estimate the variance of the reported effect size. We computed the variance as the square root of the standard deviation, whenever possible. If no standard deviation was reported we calculated the standard deviation and derived the variance of the effect size as follows (Chinn, 2000; Schmidt & Hunter, 2015, p. 230, 298)

$$SD\ (\bar{d}) = \sqrt{k} \times \frac{(CI_U\bar{d} - CI_L\bar{d})}{2 \times 1.96} \tag{4}$$

$$Var(\bar{d}) = SD(\bar{d})^2 \tag{5}$$

Whenever the study reported odds ratios, each odds ratio and associated confidence interval was ln-transformed before estimating the variance (Chinn, 2000).

Whenever we converted an effect size to Cohen's *d*, we also converted the obtained variance using the following formulas, respectively. For the variance of the correlation we used (Borenstein et al., 2009, p. 48):

$$Var(\bar{d}) = \frac{4\ Var(\bar{r})}{(1-\bar{r})^3} \tag{6}$$

For the variance of odds ratios, we used (Borenstein et al., 2009, p. 47):

$$Var(\bar{d}) = Var(\text{logOddsRatio}) \times \frac{3}{\pi^2} \tag{7}$$

After identifying outliers, we integrated the mean effect sizes across meta-analyses using second order meta-analysis (Schmidt & Oh, 2013). We performed all second order meta-analytic analyses in R using the *psychmeta* package (Dahlke & Wiernik, 2020). We accounted for publication bias by analyzing the symmetry of the distribution around the mean through visual inspection of the funnel plots using the *metafor* package (Viechtbauer, 2010) in R.

Results

Overall, 1631 articles were identified in the literature search, of which 1314 were excluded after a screening of titles and abstracts (including duplicates). Of the 322 remaining articles, 282 were excluded after full-text screening for different reasons (see Figure 1). Finally, the second order

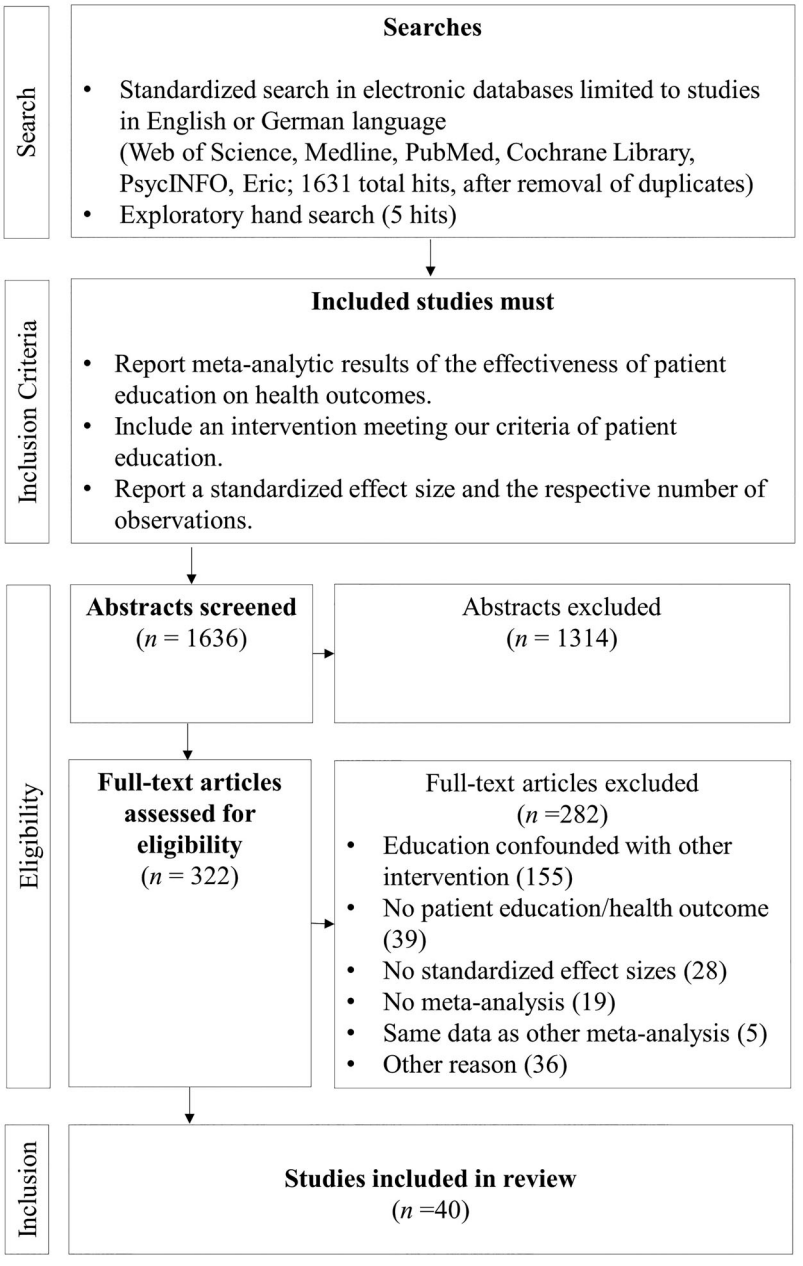

Figure 1. Flow chart of the literature search.

meta-analysis included 40 first order meta-analyses. The 40 eligible meta-analyses comprised data from more than 74.947 participants from over 776 primary studies and reported 156 meta-analytic effect sizes. Table 1 lists the details of the meta-analyses included in the review.

Methodological quality of the included meta-analyses

Of all 40 meta-analyses included in the review, two meta-analyses were rated as having low methodological quality, and 38 as having very low methodological quality according to the AMSTAR-

Table 1. Characteristics of the meta-analyses included in the second order meta-analysis.

Reference	Health issue	Description of educational intervention[a]	Components of patient education	List of outcomes	List of included comparison groups	Year Range	Number of ESs indicating positive /no/ negative effects	Mean Cohen's *d*	Methodological quality[c] (critical items)
Adiewere et al. (2018)	Diabetes	Patient education	• Individual sessions • Group sessions • Presentation • Handouts • Video • Discussion • Telephone call	• Diabetic foot ulcers	• Standard care	1987–2015	0/1/0	0.55	Critically low (3, 7, 10, 15)
Alahakoon et al. (2020)	Diabetes	Patient education '*Structured education provided to participants aimed at improving their knowledge and foot care*'	• Information provision • Leaflets • Face-to-face session • Group session	• Total amputations	• Standard care	2012–2019	0/1/0	0.17	Critically low (3, 7, 10)
Alipanah et al. (2018)	Tuberculosis	Adherence interventions '*Education and counseling interventions were those aimed at providing adequate knowledge and ensuring patient understanding of the disease process and risks and benefits associated with treatment adherence*'	• Oral and written educational materials	• Treatment success • Loss of follow up • Mortality	• Standard care	1999–2014	1/2/0	0.19	Critically low (2, 3, 5, 6, 7, 8, 10)
Bennett et al. (2016)	Cancer	Educational interventions '*Any advice, information, or self-management education (verbal, written, or audiovisual) provided in order to help people understand and manage cancer-related fatigue*'	• Telephone sessions • Provision of written information • Internet based education • Presentation • Audio-visual and computerized educational materials • Audiotape • Self-guided interactive videodisc module • Individualized intervention • One-to-one and education • Group education • Face to face group discussion	• General fatigue • Fatigue intensity • Fatigue distress • Fatigue interference • Use of fatigue management strategies • Activities of daily living or physical functioning • Depression	• Standard care • Waitlist • Attention control • Other intervention	2004–2015	5/2/0	0.32	Low (15)
Bernard-Bonnin et al. (1995)	Asthma	Teaching intervention on self-management of asthma	• NA	• Asthma attacks • Stay at the hospital in days	• Standard care	1981–1991	2/0/0	0.01	Critically low (1, 2, 3, 8, 10, 15)
Beynon et al. (2008)	Bipolar disorder	Group psychoeducation	• NA	• Relapses to hospital • Relapses (as stated by author) • Manic relapses • Depressive relapses	• Non-structured group meeting	2003–2003	4/0/0	0.74	Critically low (1, 2, 3, 4, 7, 10, 15)
Bond and Anderson (2015)	Bipolar disorder	Psychoeducation '*Discrete psychological intervention involving primarily the patient with bipolar disorder; providing information about bipolar disorder and/or its treatment; and relating this information to aiding self-management of the disorder*'	• Individual sessions • Group sessions • Individual and group sessions	• Relapse • Manic/hypomanic relapse • Depressive relapse	• Standard care • Non-directive group sessions • Relaxation group sessions • Individual brief medication explanation • Cognitive behavioral therapy • Family-focused therapy	1999–2011	0/3/0	0.10	Critically low (2, 3, 10)

(*Continued*)

Table 1. Continued.

Reference	Health issue	Description of educational intervention[a]	Components of patient education	List of outcomes	List of included comparison groups	Year Range	Number of ESs indicating positive /no/ negative effects	Mean Cohen's *d*	Methodological quality[c] (critical items)
					• Functional remediation				
Brand et al. (2013)	Osteoarthritis	Arthritis self-management education	• Skills mastery • Modeling • Reinterpretation of symptoms • Persuasion • Pain coping strategies • Provision of information (e.g., current research, medications, diet) • Practical demonstrations • Ergonomics	• Pain • Other symptoms • Function	• No control group • Standard care • Waitlist • Arthritis education spousal support	1993–2001	5/0/0	0.29	Critically low (2, 3, 4, 7, 10, 11, 14, 15)
Brown (1990)	Diabetes	Diabetes patient education	• Individualized and group instruction • Information sheets, handouts, booklets • Slides • Cassettes • Audiovisual materials • Computer-based instruction	• Insulin injection skill[a] • Urine testing skill[a] • Dietary compliance[b] • Glycosylated hemoglobin HbA1c • Blood sugar • Urine sugar • Insulin dose • Cholesterol • Blood pressure • Medical care	• No control group • Control group (N/A)	1954–1989	7/0/0	0.32	Critically low (1, 2, 3, 7, 10, 15)
Brown (1992)	Diabetes	Diabetes patient education	• NA	• Knowledge[b] • Weight loss • Skill performance[b] • Glycosylated hemoglobin HbA1c • Psychological outcomes	• No control group • Control group (N/A)	1961–1989	10/5/0	0.36	Critically low (1, 2, 3, 5, 6, 7, 10, 15)
Coffman et al. (2008)	Asthma	Pediatric asthma education	• Individual and group education • Educational computer game	• Number of hospitalizations	• Standard care	1981–2000	1/0/0	0.35	Critically low (1, 2, 3, 5, 6, 7, 9, 10, 12, 13)
Devine and Reifenschneider (1995)	Hypertension	Patient education	• Structured or self-directed content on hypertension	• Blood pressure • Knowledge[b] • Medication compliance[b]	• Standard care • Placebo • Placebo and routine care • No control group	1965–1993	4/0/0	0.33	Critically low (1, 2, 3, 5, 7, 10, 16)
Devine (1996)	COPD	Patient education	• Didactic content, for example, what is asthma, self-management of asthma, breathing techniques, and use of medication	• Asthmatic episode • Dynamic respiratory volume • Peak expiratory flow rate • Functional status • Medication adherence[b] • Utilization of health care • Use of PRN medication	• Standard care • Placebo/ alternate treatment • No control group	1965–1994	6/1/0	0.45	Critically low (1, 2, 3, 5, 7, 10)
Donker et al. (2009)	Depression	Passive psychoeducation '*A passive psychoeducational intervention is defined as an intervention which provides information, education materials, or feedback/advice. Examples of passive psychoeducation are programmes offered to*	• Website • Provision of information and feedback on test results via telephone calls and email • Leaflets	• Depression symptoms	• No intervention • Attention-placebo • Waitlist	1999–2008	1/0/0	0.26	Critically low (2, 3, 7, 10)

		individuals through leaflets, posters, audio-visual aids, lectures, internet material or software which aims to educate the recipient about the nature and treatment of depressive and/or anxiety disorders or psychological distress'							
Effing et al. (2007)	COPD	Self-management education	• Individual and group sessions • Patient brochure • Action plan • Medical management	• Medication • Respiratory-related hospital admissions • All cause hospital admission • Lung function	• Standard care	1991–2005	1/3/0	0.12	Critically low (3, 10, 15)
Faller et al. (2013)	Cancer	Information-only interventions *'Information-only interventions typically have short duration and low intensity, and they provide health information without the other components of psychoeducation'*	• NA	• Distress • Anxiety • Depression	• No intervention • Attention-placebo	1975–2010	0/7/0	0.04	Critically low (2, 3, 7, 10)
Forster et al. (2012)	Stroke	Information provision *'An intervention was classified as passive if the information was provided on a single occasion and there was no subsequent systematic followup or reinforcement procedure. An intervention was classified as active if, following the provision of the information, there was a purposeful attempt to allow the participant to assimilate the information and a subsequent agreed plan for clarification and consolidation or reinforcement'*	• Copy of medical history, clinical resumes, pertinent lab results, etc. • Leaflets • Action plan • Medical management	• Knowledge[b] • Death	• Standard care	1998–2007	1/1/0	0.11	Critically low (3, 10, 15)
Fredericks et al. (2009)	Coronary artery bypass graft surgery	Provision of post-operative self-care CABG information	• Face-to-face contact • Phone contact • Written resources	• Self-care Knowledge[b] • Self-care behavior[b] • Symptom experience	• Control group (N/A)	1986–2005	5/0/0	0.35	Critically low (1, 2, 3, 5, 6, 7, 9, 10, 12, 13, 14, 15)
Gad et al. (2020)	Diabetes	Ramadan focused education	• NA	• Glycosylated hemoglobin HbA1c • Fasting blood glucose • Weight • BMI • Waist circumference • Total cholesterol • LDL cholesterol • HDL cholesterol • Triglycerides • Systolic blood pressure • Diastolic blood pressure • Hypoglycemia	• Standard care	2008–2019	4/8/0	0.38	Critically low (1, 7, 8, 10)
Galdas et al. (2015)	Patients with long-term conditions	Education *'Includes any study where education is taught or educational materials are provided to patients'*	• NA	• Health-related quality of life • Depression • Anxiety • Fatigue	• Standard care	NA	2/2/0	0.20	Critically low (3, 4, 5, 7, 10, 15)
Guruge and Sidani (2002)	Various (Operation)	Preoperative teaching *'Provision of information about the preoperative experience'*	• NA	• Length of hospital stay • Pain	• No treatment	1970–1996	2/2/0	0.43	Critically low (2, 3, 5, 6, 7, 10, 13, 15, 16)
	Type 2 diabetes					2002–2017	1/0/0	0.23	Critically low (2, 3, 5, 7, 10)

(*Continued*)

Table 1. Continued.

Reference	Health issue	Description of educational intervention[a]	Components of patient education	List of outcomes	List of included comparison groups	Year Range	Number of ESs indicating positive /no/ negative effects	Mean Cohen's *d*	Methodological quality[c] (critical items)
Hildebrand et al. (2019)		Self-management education *'Educational topics included components to improve participants' knowledge, skills and ability to achieve self-management activities that can positively affect glycemic control'*	• Individual sessions • Group sessions • Combined individual and group sessions	• Glycosylated hemoglobin HbA1c	• Standard care • Waitlist				
Jho et al. (2013)	Cancer	Pain education	• Face-to-face Interview • Phone calls • Printed education materials	• Pain	• Standard care • Attention control	1986–2011	1/0/0	0.17	Critically low (1, 2, 7, 10, 14, 15)
Lincoln et al. (2007)	Psychotic disorders	Psychoeducation *'Focus on conveying relevant information about the disorder and its treatment while promoting better coping'*	• Individual and group education	• Prehospitalization • Symptoms	• Standard care • Other intervention • Waitlist	1982–2005	0/2/0	0.21	Critically low (2, 3, 7, 10)
McDonald et al. (2014)	Hip replacement	Preoperative education	• Video • Individual information session • Small group information session • Leaflets	• Pain	• Standard care	2000–2004	0/1/0	0.17	Critically low (3, 10)
Mugunthan et al. (2011)	Benzodiazepine users	Minimal interventions	• Consultation • Self-help booklet • Letter • Information sheets	• Benzodiazepine reduction • Cessation of benzodiazepine	• Standard care	1994–2004	2/0/0	0.57	Critically low (1, 2, 3, 7, 10, 15)
Osborn et al. (2006)	Cancer	Patient education *'Patient education (PE) typically includes information regarding the illness or symptom(s), symptom management, and/or discussion of treatment options and may include the use of booklets, videos or other educational materials'*	• NA	• Depression • Pain	• Standard care	2001–2004	0/2/0	0.09	Critically low (1, 2, 5, 6, 7, 10)
Paquette et al. (2019)	Patients treated with oral anticoagulation	Supplemental education *'Broad types of supplemental education interventions aimed at improving patient knowledge, TTR, or clinical outcomes were considered'*	• Information provision • Individual sessions • Group sessions • Instruction booklet • Video	• Thromboembolic events • Any bleeding events • Knowledge[b]	• Standard care	1972–2019	1/2/0	0.38	Critically low (2, 3, 5, 10, 15)
Pinquart et al. (2007)	Depression	Psychoeducation *'This intervention involves the provision of information about depression and related problems and ways to overcome the constituent symptoms. Intervention formats include reading materials (bibliotherapy), lectures and group discussion'*	• NA	• Depression	• No treatment	1974–2006	1/0/0	0.70	Critically low (2, 3, 5, 7, 10, 14, 15, 16)
Powell et al. (2016)	Surgery	Procedural information *'Describes the process the patient will undergo in terms of what will happen, when it will happen and how it will happen'*	• Leaflets • Oral information • Website	• Pain • Negative affect	• Standard care	1999–2012	0/2/0	0.34	Low (3)
Ramesh et al. (2017)	Cardiac Surgery	Preoperative education	• Individualized one-to-one education • Booklet • Audiotape • Video • Teaching through video • Lecture • Discussion • Interactive sessions • Group education	• Anxiety • Pain • Depression • Length of hospital stay	• Standard care	2000–2015	1/3/0	0.41	Critically low (2, 3, 7, 10, 12, 15)

Rehse and Pukrop (2003)	Cancer	Patient education	• NA	• Quality of life	• Standard care	1979–1999	1/0/0	0.95	Critically low (2, 5, 7, 8, 10, 16)
Riemsma et al. (2003)	Arthritis	Patient education *'We defined a patient education intervention as one that includes formal structured instruction on rheumatoid arthritis and on ways to manage arthritis symptoms'*	• Leaflets • Overhead projection • Discussion • One-to-one sessions • Self-instruction • Distribution of supporting literature • Films • Group sessions	• Pain • Disability • Joint counts • Patient global assessment • Psychological status • Anxiety • Depression • Disease activity	• No treatment • Standard care	1988–2001	0/15/0	0.03	Critically low (3, 10)
Saffari et al. (2014)	Diabetes (Type 2)	Health education	• Website • SMS	• Glycosylated hemoglobin HbA1c	• Standard care	2005–2013	1/0/0	0.60	Critically low (2, 3, 7, 10)
Suls and Wan (1989)	Medical or laboratory procedures designed to induce pain (e.g., dental extraction, gastrointestinal diagnostic, endoscopy)	Pre-operative information	• Sensory information • Procedural information • Combined sensory-procedural information	• Negative affect • Pain • Distress • Other outcomes	• No treatment • Attention control	1972–1983	7/4/0	0.49	Critically low (1, 2, 3, 5, 6, 7, 9, 10, 12, 13, 15, 16)
Timmer et al. (2011)	Inflammatory bowel disease	Patient education *'Programs aiming to improve self management skills, coping and social integration'*	• Group sessions • Patient-centered guidebook • Face-to-face information • Lectures	• Quality of life • Depression • Anxiety • Not in readmission • Disease activity	• No treatment • Other treatment	1986–2007	0/13/0	0.06	Low (10)
Traeger et al. (2015)	Lower back pain	Primary care-based education *'Any set of planned condition-specific educational activities in a one-to-one situation, designed to improve patients' health behaviors and/or health status in regard to the low back pain problem'*	• Booklet • Advice sessions • Brief pain management	• Number of primary care visits	• Standard care • Other treatment	1989–2011	0/1/0	0.14	Critically low (1, 2, 3, 7, 10)
Wong et al. (2013)	Patients taking oral anticoagulants	Supplemental patient education	• Video teaching sessions • Self-guided instruction booklet • One-to-one teaching • Written information • Group sessions • Interactive sessions	• Hemorrhagic events • Thromboembolic events	• Standard care	1972–2008	0/2/0	0.35	Critically low (2, 3, 7, 10, 15)
Xia et al. (2011)	Schizophrenia	Psychoeducation	• NA	• Relapse • Non compliance[b] • Readmission	• Standard care	1988–2008	2/0/0	0.31	Critically low (3, 10)
Zimmermann et al. (2007)	Cancer	Education *'Treatments primarily providing information about the nature of the cancer and its medical treatment (e.g., information about side effects of chemotherapy)'*	• NA	• Emotional adjustment	• Standard care	1980–2004	1/0/0	0.53	Critically low (1, 2, 7, 9, 10, 12)

Note: ESs: effects sizes, NA: not applicable.

[a]Whenever possible, we extracted (a) how the authors named the included interventions and (b) the respective definition. If one or more of these three components are not reported in this table, it has not been reported in the original paper.

[b]These outcomes were not included in the overall analysis.

[c]We rated the methodological quality using AMSTAR 2 recommending the following classification (Shea et al., 2017): *High*, Zero or one non-critical weakness, indicating that the systematic review provides an accurate and comprehensive summary of the results of the available studies that address the question of interest; *Moderate*, More than one non-critical weakness, indicating that the systematic review has more than one weakness, but no critical flaws. It may provide an accurate summary of the results of the available studies that were included in the review; *Low*: One critical flaw with or without non-critical weaknesses, indicating that the review has a critical flaw and may not provide an accurate and comprehensive summary of the available studies that address the question of interest; *Critically low*: More than one critical flaw with or without non-critical weaknesses, indicating that the review has more than one critical flaw and should not be relied on to provide an accurate and comprehensive summary of the available studies.

2criteria (Shea et al., 2017). The critical weaknesses of the specific meta-analyses are presented in the last column of Table 1. Most commonly, meta-analyses failed to report the sources of funding for the studies included (Item 10), followed by a missing explanation of the selection of study designs (Item 3), no protocol prior to conducting the review (Item 2), no provision of a list of excluded studies (Item 7), and a lack of publication bias analyses (Item 15).

Effects of patient education

Outlier analysis and publication bias

Outlier analyses for all included effect sizes indicated four outliers from three studies (Brown, 1990, 1992; Gad et al., 2020). We conducted sensitivity analyses by removing the outlier from estimating the overall effect size. The changes in the overall effect size were only marginal. We therefore did not remove the outliers for all following analyses.

We performed analyses of publication bias using a funnel plot (Lau et al., 2006) considering all effect sizes included in our second order meta-analysis. The funnel plot did not indicate any publication bias and is visualized in Figure 2.

Integrated outcomes across meta-analyses

Of all 156 effect sizes, 69 were statistically significant and positive (44%), 87 indicated no statistically significant effect (56%) and none was statistically significant and negative. Meta-analytic synthesis of the mean effects found in the 40 included meta-analyses indicated a positive and significant effect of patient education on health outcomes with $\bar{\bar{d}} = 0.302$ (95% CI [0.295, 0.309]). The proportion of the observed variance explained by the second order sampling variance was ProVar = 0.101, indicating meaningful variability between meta-analyses, that might indicate the influence of moderator variables.

When combing all 156 meta-analytic effect sizes reported in the 40 included meta-analyses, the effect was similar in magnitude with $\bar{\bar{d}} = 0.316$, 95% CI [0.304, 0.329]. ProVar was 0.063, indicating a high proportion of between-study heterogeneity not due to sampling error. When combining the 59 effect sizes from the 22 meta-analyses that included randomized controlled trials only, we also found a significant positive effect with $\bar{\bar{d}} = 0.271$, 95% CI [0.253, 0.290], indicating a causal effect of patient education on health outcomes. The second order meta-analytic results are presented in Table 2. We performed several moderator analyses based on the 156 meta-analytic effects described in the following.

Effects of patient education for different health issues

Second order meta-analysis revealed the effectiveness of patient education to maintain or enhance health for patients with neoplasms ($\bar{\bar{d}} = 0.151$), diabetes ($\bar{\bar{d}} = 0.331$), mental and behavioral disorders ($\bar{\bar{d}} = 0.366$), diseases of the circulatory system ($\bar{\bar{d}} = 0.315$), diseases of the respiratory system ($\bar{\bar{d}} = 0.155$), diseases of the musculoskeletal system and connective tissue ($\bar{\bar{d}} = 0.162$), and patients undergoing surgery due to various reasons or hospital patients in general ($\bar{\bar{d}} = 0.261$). Across the analyses, ProVar had low to medium values ranging from 0.021–0.505, indicating that the observed variance is mainly not attributable to second-order sampling error.

Effects of patient education on different health outcomes

Patient education was effective in the reduction of medication ($\bar{\bar{d}} = 0.179$), pain ($\bar{\bar{d}} = 0.226$), and visits of medical facilities ($\bar{\bar{d}} = 0.279$), and had positive effects on physiological functioning ($\bar{\bar{d}} = 0.339$), physical functioning ($\bar{\bar{d}} = 0.254$), psychological functioning ($\bar{\bar{d}} = 0.189$), and general functioning ($\bar{\bar{d}} = 0.392$). We did not find an overall effectiveness of patient education on mortality ($\bar{\bar{d}} = 0.086$). ProVar had values ranging from 0.028 to 1 indicating that the proportion of observed variance can be explained by second-order sampling error in some cases (e.g., mortality), but not in others

(e.g., general functioning). However, the values should be interpreted with caution, as the observed variance is close to zero for most moderator levels (Schmidt & Oh, 2013).

Effects of different forms of patient education

We found significantly positive effects of didactic interventions ($\bar{\bar{d}} = 0.147$), psychoeducation ($\bar{\bar{d}} = 0.359$), and self-management education ($\bar{\bar{d}} = 0.335$) on health outcomes. Based on the overlap of the confidence intervals, psychoeducation and self-management interventions seem to be more effective when compared to didactic interventions.

Effects of patient education on knowledge and skills and health behavior

For the included meta-analyses, we performed additional exploratory analyses to test whether patient education was also effective for enhancing knowledge and skills, and positive health behavior, because these are possible mediators that might partly explain the effect of patient education on health. Data from 7 meta-analyses reporting 19 meta-analytic sub-effects indicated a positive and strong effect of patient education on knowledge with $\bar{\bar{d}} = 0.748$, 95% CI [0.694, 0.803]. Similarly, data from 6 meta-analyses reporting 10 meta-analytic sub-effects indicated positive effects of patient education on health behavior with $\bar{\bar{d}} = 0.265$, 95% CI [0.231, 0.300]. The results are consistent with the view that knowledge, skills, and behavior mediate between patient education and health outcomes.

Discussion

Principal findings

The present second order meta-analysis summarized the evidence on the effectiveness of patient education on health outcomes by combining the results from first order meta-analysis across

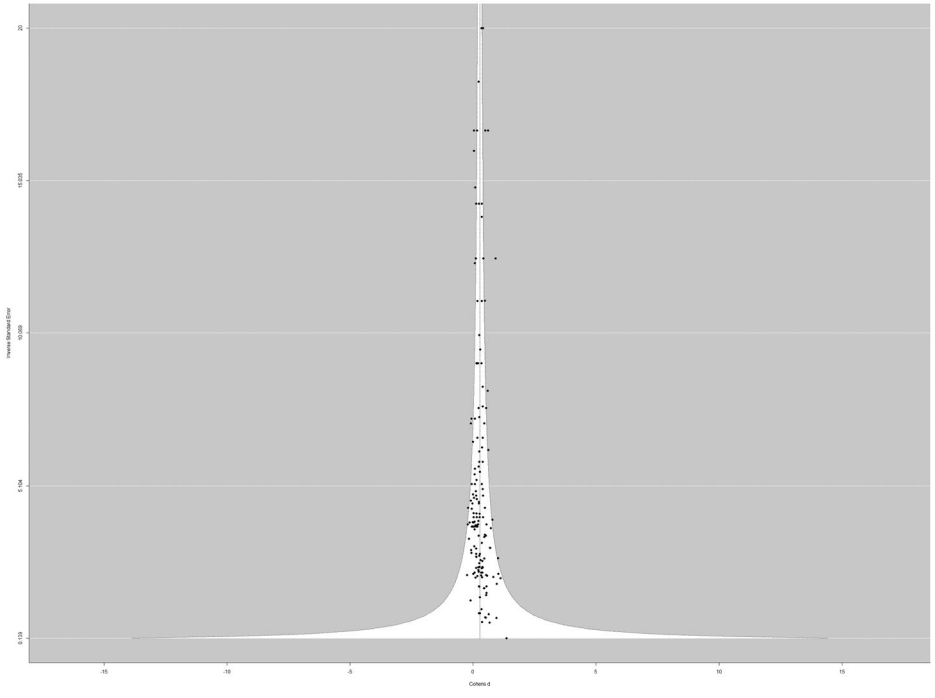

Figure 2. Funnel plot.

different diseases and health outcomes. The results provide four key insights. First, the overall effect of patient education on health outcomes is statistically significant and positive. Considering that patient education is cost efficient (Bartlett, 1995; Boren et al., 2009) and can enhance medical treatment, it should be implemented in clinical practice as an inherent part.

Second, the effects of patient education generalize across different health issues. While there already exists a great amount of evidence suggesting positive effects of patient education for specific diseases, a comparison of the effects has been outstanding thus far. In our review, we show that patient education is effective for a wide range of diseases and that patient education is most effective for patients suffering diabetes, diseases of the circulatory system, or undergoing any surgery. There are at least three possible explanations for the results. The longer history of implementing patient education in medical treatment in these areas may lead to more sophisticated and structured implementation of patient education which in turn may result in greater effects. Further, for all three health issues, changes in lifestyle play a major role, which is commonly addressed by patient education interventions. Further, it is also possible that the instructional methods used for patients with these diseases may differ from instructional methods designed for patients suffering from other health issues.

Third, patient education can improve a variety of health outcomes, including physiological, physical, and psychological outcomes. This is remarkable, as patient education has the potential to

Table 2. Second order meta-analytic results.

	Meta-analyses j	Meta-analytic effect sizes k	Overall grand mean $\bar{d}$	95% Confidence Interval	$E(S^2_{e_{d_j}})$	$S^2_{\bar{d}}$	$\sigma^2_{\bar{d}}$	ProVar
Overall								
Averaged over meta-analyses	40	40	0.302	[0.295, 0.309]	0.00109	0.01082	0.00972	0.101
Averaged over effect sizes	40	156	0.316	[0.304, 0.329]	0.00222	0.03534	0.03312	0.063
Averaged over effect sizes, RCTs only	22	59	0.271	[0.253, 0.290]	0.00446	0.02434	0.01988	0.183
Health issue[a]								
C	4	16	0.151	[0.113, 0.188]	0.01494	0.02958	0.01464	0.505
E	7	38	0.331	[0.311, 0.351]	0.00074	0.03460	0.03386	0.021
F	7	21	0.366	[0.327, 0.405]	0.00960	0.02624	0.01664	0.366
I	5	9	0.315	[0.276, 0.354]	0.00468	0.01932	0.01464	0.242
J	4	13	0.155	[0.098, 0.211]	0.00788	0.04285	0.03497	0.184
M	4	22	0.162	[0.131, 0.192]	0.01042	0.02103	0.00593	0.01061
Various (across single studies)	5	21	0.261	[0.227, 0.296]	0.01831	0.04203	0.02372	0.02372
Health outcome								
Physiological functioning	12	39	0.339	[0.218, 0.360]	0.00076	0.03610	0.03534	0.021
Physical functioning	10	17	0.254	[0.226, 0.281]	0.00536	0.02074	0.01538	0.258
Psychological functioning	14	37	0.189	[0.163, 0.216]	0.01108	0.03240	0.02132	0.342
Pain	9	13	0.226	[0.184, 0.267]	0.01020	0.02924	0.01904	0.349
Medication	4	5	0.179	[0.121, 0.237]	0.00173	0.01613	0.01440	0.107
Relapse or visits of medical facilities	14	25	0.279	[0.251, 0.308]	0.00533	0.02465	0.01932	0.216
Mortality	3	3	0.086	[−0.001, 0.173]	0.01300	0.00000	0.08600	1
General functioning	6	14	0.392	[0.302, 0.483]	0.00228	0.08237	0.08009	0.028
Intervention type								
Didactic	19	68	0.147	[0.125, 0.168]	0.00898	0.03960	0.03063	0.227
Psychoeducation	8	26	0.359	[0.328, 0.390]	0.01057	0.02403	0.01346	0.440
Self-management education	16	62	0.335	[0.318, 0.352]	0.00106	0.03168	0.03063	0.033

Note: The number of actually included single studies might be slightly lower than reported here due to overlap within meta-analyses when reporting several outcomes, see main text for more details. $E(S^2_{e_{d_j}})$: expectedsecond order sampling error variance; $S^2_{\bar{d}}$: observed between-first-order meta-analyses variance ; $\sigma^2_{\bar{d}}$: estimated population variance across the included meta-analyses without expected second order sampling error; ProVar: proportion of the variance across the first order meta-analytic means that is due to second order sampling error variance.

[a]The health issue was classified after ICD-10:

C: Neoplasms; E: Endocrine, nutritional and metabolic diseases, this category includes studies of diabetes patients only; F: Mental and behavioral disorders; I: Diseases of the circulatory system; J: Diseases of the respiratory system; M: Diseases of the musculoskeletal system and connective tissue.

address different kinds of disease parameters (e.g., lowering blood sugar, improving psychological status) whereas most other medical treatments, for example medication, primarily address single parameters (e.g., insulin shots). Further, patient education enhances knowledge and health behaviors, potentially serving as mediators for improving health outcomes. As such, patient education has the potential to lead to sustainable improvements.

Fourth, the effect sizes differ strongly across meta-analyses on patient education. This is likely due to the great variability of the educational interventions employed in the single studies. Differences can, for example, exist in the taught content, the delivery formats, the person delivering patient education, or the clinical contexts (Cooper et al., 2001; Friedman et al., 2011). The results suggest that differences in the intervention contribute to differences in their effectiveness, e.g., the provision of information has shown to be less effective when compared to more complex interventions such as psychoeducation or self-management education. More detailed analyses of differential effects of patient education interventions are needed to get an overall picture of its effectiveness and third variables moderating the effect.

Strengths and weaknesses of the study

We performed a quantitative second order meta-analysis instead of a qualitative umbrella review, and were able to quantitatively summarize the existing evidence from more than one meta-analysis. We found a positive effect of patient education across different health issues and health outcomes, indicating a robust effect of patient education.

The main limitations of the current review are those of the meta-analyses included, which mirror the limitations of the primary studies. Quality ratings assessed by AMSTAR-2 (Shea et al., 2017) indicated only low and critically low methodological quality. The most frequently reported shortcomings were no information on the sources of funding for the studies included, missing explanation of the selection of study designs, and absence of a review protocol describing review methods before conducting the review. Second, we were not able to cover the broad range of instructional methods of patient education in our statistical analyses. For example, we were not able to systematically analyze differential effects due to different components or teaching methods employed in the interventions due to the great heterogeneity across the interventions. A tandem approach of quantitative and qualitative analyses seems to be necessary to fully understand the mechanisms of patient education. Lastly, due to limited data from the first order meta-analyses, we were not able to investigate possible differential effects of patient education due to differences in the characteristics of the patients, for example, socioeconomic status or age, and their conditions, for example, acute vs chronic condition.

Future research directions and practical implications

Given the great variability of effects of patient education after adjusting for second order sampling error and the variety of different patient education programs, it is important to test for potential moderations regarding characteristics of the patient education intervention. While we report the different educational components and strategies narratively, a lack of meta-analyses collecting primary evidence of whether the effects vary due to the characteristics of the intervention permitted a quantitative analysis. Previous reviews focusing on the effects of different educational strategies in chronic disease patient education found similar results, with the nature of the interventions being poorly described and failing to adhere to theoretical models (Cooper et al., 2001; Lima de Melo Ghisi et al., 2014; Sudre et al., 1999). Decades later, we come to the same conclusion. Furthermore, in many cases, patients rarely receive any form of patient teaching (Coonrod et al., 1994). It is still open to analyze why such a limited implementation of patient education exists, especially when considering the extensive empirical evidence favoring the deployment of patient education. One reason might be a lack of knowledge among practitioners and health care workers on how to effectively

implement patient education as one component of regular medical treatment, time constraints, or lack of earnings (cf. Girois & Sanson-Fisher, 1996). Another reason might be that patient education is optional in many facilities and patients are reserved attaining such a program due to lack of support (cf. Kielmann et al., 2010). A structured and standardized approach for designing and implementing patient education programs is needed, especially when patients inform themselves using false or misleading information, for example, on the internet (Cline & Haynes, 2001).

While it has been shown that patient education does not cause side effects (Howland et al., 1990), a systematic analysis of adverse effects of patient education across different educational programs and patient groups is still lacking. None of the included studies of the current review assessed potential side effects, leaving it open whether patient education, besides its positive effects, can lead to adverse effects. As such, it is currently unknown whether patient education may, for example, negatively influence patients' attitudes and expectations, may cause insecurities, distress, or anxiety, or may lead to nocebo effects, so that negative expectancies may cause adverse outcomes (Colloca & Miller, 2011). Characteristics of the intervention, such as positive framing (e.g., negative frame: 20% will experience anxiety vs positive frame: 80% will not experience anxiety) can help to reduce such nocebo effects (Barnes et al., 2019). Hence, an important future research direction is the investigation of adverse effects of patient education, the examination of nocebo effects in form of controlled trials (e.g., Colloca & Barsky, 2020), and how interventions need to be designed to reduce potential nocebo effects. On the other side, patient education may cause placebo effects, i.e., facilitate positive expectancies that lead to positive outcomes, due to, for example, a response to the patient-practitioner relationship (Kapchuk et al., 2008). Future research can shed light on potential placebo effects of patient education by investigating such effects similar to research on placebo effects of other types of medical treatment (e.g., Linde et al., 2011).

To promote and establish educational interventions in clinical contexts, a link between theory and practice is needed. For practitioners, established learning theories may serve as a useful framework to guide and establish interventions. As such, future studies have the potential to fill this research gap and establish theory driven interventions that may be used as best practice guidelines. This is especially important, as patient education aims to empower patients to make informed choices and actively participate in their treatment (Jotterand et al., 2016; Yeh et al., 2018). It seems valid to question why so many researchers neglect existing theories in their research and whether new theories need to be established that may better address the needs of researchers and health care workers. There exists a great amount of research on instructional effectiveness based on established learning theories which has been summarized in over 800 meta-analyses and several reviews (Hattie, 2009; Schneider & Preckel, 2017). There are first attempts connecting results from instructional science and patient education (Hewson, 1993; Pusic et al., 2014). Parts of the principles of effective teaching are already included in guidelines for health practitioners (American Academy of Ambulatory Care Nursing, 2020; American Academy of Family Physicians, 2000), however comprehensive standards and guidelines are still needed. It is likely that the effectiveness of patient education programs is even higher when considering principles of effective teaching based on established learning theories. As such, patient education programs can benefit from the insights provided by research on instructional effectiveness which have the potential to promote evidence based and highly effective instruction.

Conclusions

Patient education is a useful and cost-beneficial intervention without any known side effects that enhances health outcomes across patient with different diseases. More research is needed on differential effects due to different teaching strategies, the provider of the education, and the clinical setting. Further, future studies investigating adverse effects and nocebo and placebo effects of patient education are needed. Theories on patient education and research on instructional

effectiveness are commonly neglected in research thus far, but have the potential to serve as a foundation to establish interventions that broadly and reliably improve patients' health in clinical practice.

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