ABSTRACT

Asthma outcomes are significantly worse for minority groups, including South Asians (SAs), in high-income settings. Despite this, comparatively few existing studies have focused on SAs when studying the effectiveness of behavioral interventions on asthma self-management, and no prior study has synthesized these findings. We review the effectiveness of behavioral interventions on asthma management in adults and children of SA origin across low- (LICs), middle- (MICs), and high-income countries (HICs).

Data sources included EMBASE, MEDLINE, Cochrane Library and Trial registries: WHO, ICTRP and ClinicalTrials.gov. Eligibility criteria: randomized controlled trials (RCTs), quasi-RCTs and non-RCTs (controlled before-after [CBA] studies), published in English, with no publication year or country restrictions in adults and children of South Asian origin. Exclusion criteria: those focusing solely on pharmacological interventions. Search terms were “asthma” and “South Asian”.

We included 33 studies, 27 from MICs and 6 from HICs (education [*n*=10], self-management plans [*n*=6], yoga/breathing exercises [*n*=10]) organizational interventions [*n*=1], diet therapy [*n*=1] and combined interventions [*n*=5]). Outcome measures included: blood biochemistry, lung function, healthcare utilization and quality of life. A meta-analysis was not performed due to significant study heterogeneity.

Behavioral interventions for asthma management in SAs are effective. Educational interventions that aim to optimize asthma knowledge, control, and inhaler technique, and yoga/breathing exercises are most effective for improved long-term outcomes in adults and children across LICs and MICs. Further research is needed to evaluate the effectiveness of all behavioral interventions for SAs in HICs to better inform current guidance by policy makers and health care providers.

KEYWORDS

Asthma; Asian; South Asian; behavioral; effectiveness

INTRODUCTION

The global prevalence of asthma is 300 million and rising [1]. As a significant source of morbidity and mortality, asthma represents a substantial burden for adults, children and health services. For example, in 2013 the total cost of asthma for the United States (U.S) was estimated to be $81.9 billion, which included medical costs, absenteeism and mortality [2].

Asthma morbidity [3, 4], under-recognized and uncontrolled symptoms, and hospital admissions for acute asthma [5, 6] disproportionately affect South Asian minority groups in high-income settings, compared with majority populations. For example, in a meta-analysis of ethnic variations in asthma outcomes in the United Kingdom (UK), South Asians had an odds ratio of 2.9 (95% CI 2.4-3.4) relative to white people for admission to hospital for asthma [7]. Known exacerbating factors include inequitable healthcare access and alternative cultural understandings [7], and may contribute towards growing health inequalities.

Culturally appropriate behavioral interventions offer potential to address these barriers for optimal asthma self-management. Reviews assessing behavioral change techniques, irrespective of ethnicity, have been previously published [8]. Yet there is limited evidence assessing the effectiveness of behavioral interventions for South Asians in high-income countries (HICs), or how successful behavioral interventions offered to South Asians in low (LICs) and middle-income countries (MICs) may be efficiently utilized in resource-stretched HIC settings. This is despite the inequities in outcomes for this group.

To address this knowledge gap, we undertook a systematic review to assess the effectiveness of behavioral interventions for South Asian adults and children across LICs, MICs and HICs. Our review may assist in the adoption or adaptation of culturally-sensitive, behavioral interventions for South Asian minority diasporas. Increased understanding of interventions that can encourage behavior change and improve agency may lead to reduced individual and societal inequities for this group.

METHODS

The protocol for the systematic review is registered in the PROSPERO database and can be accessed with CRD Registration No: CRD42016033718.

Search Question

- Patient or population: South Asian adults and children with asthma and/or caregivers of children with asthma in LICs, MICs or HICs
- Intervention: behavioral (i.e. non-pharmacological) interventions
- Comparator: routine standards of care
- Outcomes: all measures of asthma control

Eligibility criteria

We defined South Asians (hereafter SAs) as individuals who are native of the southern part of Asia (including India, Pakistan, Bangladesh, and other territories). LICs, MICs, and HICs were classified according to the World Bank assignment of the world's economies, which is based on gross national income (GNI) per capita (2019) [10]. Studies were included if they met the following criteria:

- Participants: SA adults and children of all ages in LICs, MICs or HICs
- Language: studies published in English or with translation available
- Intervention: any behavioral intervention aimed at managing asthma
- Design: randomized controlled trials (RCTs), quasi-RCTs and non-RCTs (controlled before-after [CBA] studies)

Studies that solely focused on pharmacological interventions for asthma management were excluded, unless they assessed a behavioral element e.g. improving compliance towards pharmacological treatment using an educational programme. We did not perform a meta-analysis of results owing to study heterogeneity in intervention delivery, statistical reporting and outcome. Outcome measures were not pre-specified. Instead, we identified and described interventions that emerged from individual full papers only.

Information sources

The following databases were searched by RL and NO supported by LM: MEDLINE, EMBASE and Cochrane Library. Trial registries WHO, ICTRP and ClinicalTrials.gov were also searched for completed and ongoing studies. Reference lists of all relevant articles were also hand-searched by RL and NO for possible additional publications, returning one eligible article. No year or country limits were set. Searches were conducted from February to May 2016 and updated by CL and EA between April and May 2018.

Search strategy

The search strategy comprised of the two overall terms “asthma” and “South Asian” (including terms specifying all major subgroups). “Southeast Asian” was also included to ensure a comprehensive search that may capture Sri Lanka, which is sometimes considered as part of Southeast Asia, as well as any maritime islands of Southeast Asia which are part of South Asian countries. The pilot search included the additional specific terms “Sri Lankan” and “Myanmar”. These terms did not yield additional results and hence were not included in the final search strategy. For example, the search strings used for MEDLINE were:

Term 1: Asthma

Asthma OR asthma* OR abnormal respiratory sound OR respiratory sound* AND

Term 2: South Asians

India OR india OR Pakistan OR pakistan* OR Bangladesh OR bangladesh* OR punjab* OR gujurat OR South Asia OR south asia* OR south* asia* OR Southeast Asia OR southeast asia* OR south-east asia* OR indian subcontinent OR indian sub-continent OR indian subcontinent

Study selection and data extraction

The study selection process is denoted in Figure 1, which provides a summary of all articles shortlisted and excluded at each stage of the review. In total, 5896 articles were identified in the initial search. RL and NO screened titles and abstracts, excluding 22 duplicates and a further 5494 articles due to ineligibility in line with the inclusion and exclusion criteria. This left 378 potentially eligible articles, which underwent full-text review. Conflicts were resolved via discussion with LM. One additional article was

included from hand searches of reference lists. After full-text review, 348 articles were excluded leaving 31 articles to be quality assessed by RL and NO. The most common reason for exclusion at this stage was that the articles were not evaluating interventions. After quality assessment, one study was excluded due to high risk of bias [11] leaving 30 studies. In 2018, 428 title and abstracts were screened, leaving 17 potentially eligible articles shortlisted full-text review, and three additional articles to include for data extraction and quality assessment. Overall, 33 articles were deemed suitable for inclusion in the review.

Data was extracted in the initial review by RL using a piloted modified worksheet that included: study type; country; inclusion and exclusion criteria; participant age and ethnicity; numbers recruited, lost to follow up and analyzed; intervention design and delivery method; control; sampling; randomization; blinding; method of data collection; study duration or follow up; outcomes measured; factors contributing to intervention engagement and acceptability; theoretical models; data collection, statistical methods and results. NO checked each extraction. In the 2018 update, data was extracted using the modified worksheet and quality assessed by CL and checked by EA.

[insert Figure. 1. Study selection flow diagram according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines*]*

Risk of bias assessment

Risk of bias in both RCTs and non-randomized studies was measured using the relevant 'Risk of Bias's tools developed by Cochrane [12]. Six components of RCT studies were assessed as either low, high or unclear risk of bias: (1) random sequence generation, (2) concealment of allocation, (3) blinding, (4) incomplete outcome data, (5) selective outcome reporting and (6) additional sources of bias. Components (1) and (2) accounted for sequence bias, (3) encompassed performance and detection bias, (4) attrition bias, and finally (5) covered reporting bias.

For non-randomized studies, five components were assessed as either low, moderate, severe, or critical: (1) bias in measurement of interventions, (2) bias due to departures from intended interventions, (3) bias due to missing data, (4) bias in measurement of outcomes, (5) bias in selection of the reported result. Overall bias in both RCTs and

non-randomized studies was then determined based on the average weightings of each component. RCTs with an overall high risk of bias and non-randomized studies with a critical risk of bias was excluded from our analyses [12, 13].

Results synthesis

In view of the heterogeneity across methods, participants, interventions and outcomes, we narratively synthesized results. We use guidance developed from the University of York Centre for Reviews and Dissemination (CRD) and the Economic and Social Research Council (ESRC).

RESULTS

Study characteristics

Of the 33 studies included, 27 were based in MICs (*n*=25 - India [14-38], *n*=1 - Pakistan [39], *n*=1 - Malaysia [40]), and 6 in HICs (*n*=2 - Canada [41, 42], *n*=3 - UK) [43, 44], *n*=1 - Singapore [45]. Supplementary File S1 denotes a summary of all studies included.

[insert Supplementary File S1. Table 1 Summary of Included Studies]

For RCTs, overall risk of bias was judged as low for eight studies [16, 18, 23, 31, 40, 42, 45-45], moderate for one [17] and unclear for 17 [15, 19-22, 25, 28, 29, 33-39, 41, 43]. For non-randomized studies, overall risk of bias was judged as moderate for two studies [26, 30], and severe for five studies [14, 24, 27, 32, 46].

Interventions were grouped into the following: educational or counselling interventions (*n*=10), self-management plans (*n*=6), yoga therapy or breathing exercises (*n*=10), organizational interventions (*n*=1), diet therapy (*n*=1), combined educational intervention and self-management plan (*n*=1); combined self-management plan and written asthma action plan (*n*=1), combined self-management plan and cognitive behavioral therapy (CBT; *n*=1), combined nature care, diet and yoga therapy (*n*=2). Outcome measures identified included pharmacological and blood biochemistry, lung function, healthcare utilization (i.e. hospital visits, work or school days missed) and qualitative measures (i.e. quality of life; QoL). Supplementary File S2 denotes a results summary of all studies included.

[insert Supplementary File S2. Results Summary of Included Studies]

Results of studies assessing individual interventions

Educational/counselling interventions

significant improvements on inhaler technique performance scores.

Two MIC-based studies in India used written instructions [24] or educational booklets [27], although both were judged at severe risk of bias. One further India-based study utilized personalized health education [26], judged at moderate risk of bias. All three studies reported significant improvements on inhaler technique performance scores. Mishra *et al.,* [29] offered an education programme and reported improvements across frequency of attacks and hospitalization. These authors note that booklets written in culturally appropriate languages (i.e. Hindi) may aid participant's acceptability of educational interventions and that educational interventions in combination with inhaler technique demonstration may improve patient understanding.

Two large HIC-based RCTs, both conducted in Canada (97 and 87 total participants), made use of either a physician-led knowledge- or a patient-generated community video [41, 42] - unclear and low risk of bias, respectively. Pourseslami *et al*., [42] reported a significant percentage change in correct inhaler use in groups who watched a physician-led video (52% change 3 months' post intervention, $p \leq 0.001$). However, this did not occur for groups who watched the patient-generated video or both, compared with controls who received standard care. Two other larger HIC-based RCTs conducted in the UK [43, 44] (342 participants and 105 eligible general practices, respectively) found no significant improvements in asthma symptoms, unscheduled care or long-term improvements in Qol. The risk of bias in these two studies was judged as low.

Self-management plans

Three large RCTs in India [19-21], all at unclear risk of bias, found self-management training and self-care manuals as effective in asthma management across Indian adults. Behera *et al.,* [19] provided self-care manuals and reported improved symptom scores, adopted self-care measures during acute attacks, and patient knowledge of asthma and its precipitating factors at all three follow ups. Behera *et al.,* [20] later

reported self-care manuals which included ways to avoid asthma triggers were associated with an increased number of patients avoiding triggers. In this study, the percentage of patients who started avoiding cigarette smoke increased from 90.7% at first visit, 94% (2 weeks follow up), to 100% (6 months and 1 year follow up; χ^2=16.53, $p \leq 0.001$). The corresponding figures for the control group were 95.6%, 96.6% and 98.4% (χ^2=2.45, $p \geq 0.05$). This trend was similar for other triggers listed including dust, changes in weather, exercise and emotions. Another study conducted in Singapore, a HIC, reported no change in self-management [46], although this study was judged at severe risk of bias. No change in asthma exacerbations or Qol score were reported in children with asthma and their caregivers in the MIC Malaysia. Of note, the outcomes in most of these studies [19-21, 40, 46] were measured via self-reports.

Yoga therapy/breathing exercises

Three MIC-based RCTs [25, 28, 36], all at unclear risk, assessed the effectiveness of yoga training in Indian adults. These authors reported significant improvement in patients' forced expiratory volume (FEV1), forced vital capacity (FVC), FEV1/FVC ratio, peak expiratory flow rate (PEFR), chest expansion, 40mm Hg endurance test and respiratory rate. Similar results were reported in other MIC-based RCTs that assessed the effectiveness of yoga training in Indian children [17, 18] - moderate and low risk respectively. Agnihotri *et al.,* [16] found that hemoglobin levels increased by 7.52% in the case group after 6 months, compared to a 3.97% increase in the control group who received standard medical treatment. Longer-term improvements in FVC, FEV1 and Qol have been reported in RCTs across India [35, 38] - both unclear risk. Sodhi *et al.,* [37] also report improvements in the number and severity of attacks - although this study was judged at severe risk of bias. Finally, Singh *et al*., [34] promoted breathing exercises and reported improvements in PEFR. Results suggest yoga and breathing therapy may be effective in improving asthma related symptoms practiced as an adjuvant therapy with standard medical treatment [15, 34]. However, the long-term benefits and cost-effectiveness remain to be fully explored.

Organizational/dietary interventions/cognitive behavioral therapy

One study [39] conducted in Pakistan involved 428 adults receiving an organization-wide intervention that included improved availability of context-sensitive guidelines and case management materials. Results from this study are yet to be released. Only

one small study judged at severe risk [14] conducted an elimination diet based intervention. Significant improvements in IgE titres in 17 children were observed. However, there was no improvement for 25% of children observed and a negative difference in one child compared to the control group. One study [22] that used CBT found significant improvement in PEFR, asthma symptoms and Qol, compared with standard pharmacological treatment.

Results of studies assessing mixed interventions

Self-management plan and written asthma action plan or educational intervention and medication counselling

Mixed interventions involved a combination of educational and/or self-management plans with any other behavioral approach e.g. diet or yoga/breathing exercises. One UK-based RCT [45] combined an educational intervention with individually tailored written self-management plans. This was delivered to 593 participants aged 11-59 who were of White European (WE) or Indian Sub-continent (ISC) ethnic groups in the UK. Significant improvements in hospital admissions, out of hour's home visits by GPs or deputizing services, number of GP consults, steroids and antibiotics prescription and Qol across all participants were reported. Another RCT [33] based in India and judged at unclear risk combined education with a care diary and medication counselling and found improved outcomes in PEFR, asthma control scores and Qol. Although combined interventions may have their place in improving Qol, there appears limited long-term or cost benefit to adults at risk of asthma morbidity such as SAs.

Diet therapy, yoga therapy and nature care treatment

Two MIC-based CBAs assessed the effects of diet therapy, nature care treatment and yoga therapy on a small sample of Indian adults [30, 32]. Although one of these studies [32] was judged at severe risk of bias, both demonstrated a significant improvement in lung parameters such as FVC, FEV1, PEF and MVV. No significant changes in hemoglobin, white blood cell count, and red blood cell count measurements were reported [30].

DISCUSSION

To our knowledge, this is the first systematic review to assess the effectiveness of behavioral interventions in SA adults and children across LICs, MICs and HICs. The

majority of studies were conducted in the MIC India and used educational interventions, self-management plans and yoga/breathing exercises. These interventions generally improved asthma symptoms, knowledge, and QoL. In addition, educational interventions were most effective for long-term improved patient outcomes. At present, there appear no individual or cost benefit in diet elimination, CBT or combined interventions. Only six studies across three HICs were relevant to our review. There also exist no high-quality studies across the U.S. that evaluate the effectiveness of behavioral interventions for asthma management in SAs. This is of particular concern given that Indians (3.8 million; 14.1%) are one of the largest ethnic groups across the U.S and rising [47]. Nonetheless, our results support the U.S Department of Health and Human Services guidelines that encourage policy makers and health care providers to support provision of educational asthma self-management programs.

Implications of key findings

Behavioral management interventions, in some cases, may have other benefits for health. Educational interventions and self-care plans allow patients to avoid adverse side effects from typical pharmacological treatment including tremors and tachycardia induced by salbutamol inhalers [48] and oral candidiasis and dysphonia from steroid inhalers [49]. As such, behavioral interventions may be used either in refractory cases of asthma or as an adjunct to current treatment.

The improvements observed may be attributed to the co-development of plans by patients and healthcare professionals, which involve personalization to the patient's needs as well as cultural beliefs. Some studies [41, 42] suggested simple, culturally and linguistically appropriate media may make interventions more widely accepted by and accessible to participants. For instance, dietary advice is not advised by the U.S Department of Health & Human Sciences guidelines for asthma management [50]. Yet, beliefs and practices concerning food and asthma are prevalent amongst SA communities [6]. Personalized interventions that tackle these unhelpful beliefs and practices as well as stigma may be offered to minority groups to better improve their asthma self-management [36]. It is concerning that for many of the reviewed studies, the quality appraisal process indicated an unclear risk or severe risk of bias. This

indicates that SAs with asthma are not only under-researched but are being left out of high-quality studies with strong reporting standards.

Structural health reforms offer new opportunities to incorporate new and re-design existing services and to reduce health inequalities. Interventions aimed at improving knowledge alone are unlikely to lead to practice change. Rather, interventions that combine behavioral change techniques and involve active participant co-development will be important for long-term asthma management. Adopting patient-focused approaches may be necessary for upstream empowerment and improvements in asthma management for minority groups at high-risk of asthma morbidity such as SAs.

Study limitations

Our study has a number of limitations. Our data sources were confined to MEDLINE, EMBASE, Cochrane Library and trial registries only. We excluded papers not published in English, although valuable studies may have been published in other languages. We excluded behavioral interventions targeted at other ethnic minority groups, which may have allowed direct comparison of non-pharmacological interventions across ethnic groups. Only six out of 33 studies included SA participants in HICs with the rest focusing on SA participants across MICs, and no studies conducted in LICs. This limits the generalizability of our findings particularly towards SAs living in LICs and partially towards SAs living in HICs. It is possible that individuals between LICs and MICs, and even between lower- and upper-middle income countries, experience different issues around asthma recognition and health service access. Furthermore, we focused on a select number of countries to refine the scope of our review, which may have limited the number of potentially eligible articles.

A further limitation is that many of the studies reported statistically significant results, but publication bias is likely to be present. Most studies did not use standardized measures or explain which aspects of their interventions made them more accepted by participants. There were some mixed interventions delivered to either adults or children, making it difficult to distinguish if any of the interventions worked separately for each of the age groups. Future longitudinal studies investigating specific features of successful behavioral and that use validated measures are now paramount.

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