TITLE

Psycho-educational interventions for adults with severe or difficult asthma: a systematic review

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ABSTRACT

Research highlights psychosocial factors associated with adverse asthma events. This systematic review therefore examined whether psycho-educational interventions improve health and self-management outcomes in adults with severe or difficult asthma. Seventeen controlled studies were included. Characteristics and content of interventions varied even within broad types. Study quality was generally poor and several studies were small. Any positive effects observed from qualitative and quantitative syntheses were mainly short-term and, in planned subgroup analyses (involving <5 trials), effects on hospitalisations, quality of life and psychological morbidity in patients with severe asthma did not extend to those in whom multiple factors complicate management.

INTRODUCTION

A significant minority of asthma patients have severe or poorly controlled disease resulting in daily symptoms, reduced quality of life, absences from work and frequent use of health services[1]. When persistent despite medical management according to guidelines[2] this is sometimes referred to as “difficult” asthma[3-5], which encompasses clinical subgroups with brittle, refractory or therapy-resistant disease[3-7] and is estimated to affect <10% of patients[1,3,5,7].

The UK burden of severe, poorly controlled and difficult asthma is most evident in the 1,400 deaths and over 70,000 hospital admissions attributable to asthma anually[1]. These contribute to a disproportionate share of asthma-related costs[8], with half the costs stemming from the 10% of patients experiencing the highest morbidity accounting and three-quarters resulting from uncontrolled disease[9].

Various pathophysiological mechanisms are suggested to underlie severe and difficult asthma[3,5,6]. Increasingly, patient-related factors are also implicated[10]. Studies[11-16] identify adverse behavioural/psychological characteristics and social problems, as the major potentially modifiable factors associated with fatal and near-fatal asthma. Psychosocial problems also appear common amongst hospitalised patients[16,17] and those with brittle asthma[6]. Relationships between psychosocial factors and asthma are complex and two-way: symptoms and attacks impact on psychosocial well-being, whilst psychosocial factors can affect asthma via neuroimmunological pathways and by influencing adherence and other self-management behaviours[10].

Psycho-educational programmes involving education, training in self-management and/or targetting psychosocial issues resulting from or impacting on asthma, are increasingly advocated. A Cochrane review of 36 trials[18] suggests that interactive self-management education improves health outcomes in general adult asthma populations. A meta-analysis of a broader range of psycho-educational interventions concluded that they are effective[19]. However, a Cochrane review of psychotherapeutic interventions for asthma identified a lack of good evidence[20] and a systematic review of relaxation techniques found limited effects[21].

Patients in whom clinical and psychosocial factors complicate management, including those with severe or difficult asthma, tend to be excluded by design or default from studies of psycho-educational interventions summarised in most existing reviews[18-21]. It is thus unclear whether evidence is likely to be generalisable to this group. A previous review focussed specifically on "high risk" asthma patients discussed eight education programmes in adults and children[22] but failed to provide definitions of relevant patients or interventions, describe review methods, or formally synthesise and appraise results. A Cochrane review of educational interventions for adults attending the emergency room for asthma remains in protocol form[23], and data on broader psycho-educational interventions in a range of "at-risk" patients have not been formally summarised. This is important, however, given contradictory assertions regarding whether interventions are likely to be more effective, given greater capacity to benefit[8,22], or less effective, given potential psychosocial barriers to education and behaviour change[10,17,24], in these patients.

We therefore conducted a systematic review using recommended methods[25] to assess whether a range of psycho-educational interventions improve outcomes for adults with severe

or difficult asthma, and in doing so identify options for best practice and areas for further research. This forms part of, and updates, a broader review conducted in 2002-2003[26].

METHODS

Searching

Thirty-two health-related electronic data sources (including standard bibliographic indices, research registers, grey literature and non-English language databases), study reference lists, abstracts from 16 recent conferences, current contents from 81 journals and the last five years of past issues of three key journals (Thorax, Journal of Asthma, Patient Education and Counseling) were initially searched during 2002. Further detail on these and the complex permutations of terms and headings used to search for asthma-related educational, self-management, psychosocial and multi-faceted interventions is provided elsewhere[26]. Update searches of six key bibliographic databases (Medline, Embase, Cumulative Index of Nursing & Allied Health Literature, PsycInfo, Web of Knowledge Science & Social Science Citation Indices and Applied Social Science Index & Abstracts), chosen on the basis that non-indexed, unpublished and foreign language literature identified from other sources did not contribute to the syntheses of high quality research in the initial review[26], were conducted to the end of 2005.

Study screening and selection

Titles were screened to exclude obviously irrelevant papers. A second reviewer repeated searching and screening for one year (1999) across three primary databases to check the validity of screening procedures, which suggested that no relevant studies were likely to have been missed.

Abstracts from retained records (or titles where abstracts were unavailable) were assessed independently by two reviewers against a checklist based on definitions developed at the start of the review[26], to identify potentially relevant studies for which full texts were obtained and/or additional information sought where necessary (e.g. via author contact, Internet searching).

Studies selected for in-depth review, following duplicate assessment of full texts and resolution of disagreements by a third reviewer:

1. Evaluated an educational, self-management, psychological/psychosocial, or multi-faceted programme deemed to be a psycho-educational intervention on the basis that a major component of it:

   (a) involved *interaction* (i.e. more than just didactic transfer of information) between a *patient* (i.e. not a health professional or caregiver alone) and intervention provider; and

   (b) involved taking an *educational, cognitive, behavioural and/or social approach* to improving outcomes in asthma; and/or

   (c) addressed *educational, cognitive, behavioural or social issues impacting on asthma* or its management; and/or

   (d) addressed *educational, cognitive, behavioural or social issues resulting from the consequences of asthma*.
2. Targetted a sample or subgroup of patients with a *defined form of or one or more risk factors or indicators associated with severe or difficult asthma*. Although potentially relevant, studies of asthma patients argued to be at risk on the basis of geographical location (e.g. living in an area of high asthma morbidity, mortality or social deprivation) or attendance at accident and emergency (A&E) or an emergency department (ED) on a

single occasion were not ultimately selected. These were deemed unlikely to have recruited more than a minority of relevant patients. Furthermore, the impact of educational interventions on the latter group is already the subject of a proposed Cochrane review[23].

3. Included an independent control or comparison group receiving an alternative form of care.

For the purposes of the more focussed review reported here, selected studies also:

1. Targetted a sample or subgroup of adult patients or a sample in which the majority (i.e. >50%) were adults.
2. Compared the intervention to usual care or a minimal (e.g. didactic or "placebo") intervention.
3. Were published in English.
4. Provided sufficient detail in published sources or following author contact on patients, intervention and outcomes to allow in-depth review.

Study classification

Following selection, two reviewers independently classified and reached agreement regarding categorisation of studies according to:

1. The degree to which, on the basis of background work on definitions[26] and informed by emerging evidence from the review, they were judged to target severe or difficult asthma, graded as "likely" (a single clear risk factor/indicator or two weak risk factors/indicators only), or "definite" (two or more clear risk factors/indicators).

2. Intervention type, divided into education, self-management (i.e. including formal self-monitoring and use of an action plan), psychosocial, or multi-faceted interventions (i.e. a psycho-educational intervention incorporating a non-psycho-educational component (e.g. medical treatment) in addition to education and self-management).
3. Study design, comprising randomised or non-randomised controlled trials (RCTs, CCTs) and prospective or retrospective controlled observational studies (COSs).

Data extraction

Data describing general study characteristics, patients, interventions, methodological quality (see 'quality assessment'), outcomes assessed, a descriptive summary and the significance of reported findings, and numerical outcome data where available in a suitable form (see 'data synthesis') were extracted from all available information sources, including any provided by authors (although it was not possible to contact authors for all missing information), tabulated and checked by a second reviewer. Disagreements or uncertainties were resolved via discussion.

Data synthesis

Findings for outcomes reported by four or more included studies were qualitatively synthesised. Where two or more trials reported adequate data about comparable outcomes, summary relative risk ratio (RR) statistics for binary outcomes and standardised mean differences (SMD) for continuous data were calculated for individual studies using Cochrane Revman software (version 4.2). If Forest plots with 95% confidence intervals (CIs) and statistical tests suggested there was not significant heterogeneity between individual study

estimates ($p>0.05$), quantitative syntheses (meta-analyses) were undertaken to calculate pooled effect sizes using a random effects model. Where there were sufficient data, subgroup or sensitivity analyses were planned to explore relative effectiveness across different patient groups and intervention types, and effects of the analysis model and summary statistic used.

Quality assessment

As recommended[25], methodological characteristics related to randomisation/selection of comparison group (as appropriate), outcome assessment, study sample and attrition, and analysis and reporting of results were assessed to explore study quality.

RESULTS

Extent and selection of research (Figure 1)

Figure 1 shows the research identified, screened and assessed for selection from initial and update searches. A number of studies initially considered for inclusion were excluded based on the stricter criteria for the current review (references available on request). Seventeen adult studies with control groups, published in English and for which adequate information was available for in-depth review were included[27-43].

General study characteristics (Table 1)

All but one of the included studies[33] were published since 1990, eight since 2000. Seven were conducted in the USA, four in the UK, three in other European countries and one each in Australia, Canada and New Zealand. The majority (12 studies) appeared to be led by secondary care organisations. Most findings are therefore likely to be reasonably generalisable to Western health service settings where care is guided by recent management guidelines.

Patients (Table 1)

Fourteen studies explicitly recruited adults only, of which nine had a minimum age of 18 and three of 16 years. Two did not specify ages but included patients attending an adult clinic[42] or of working age[38]. One study did not explicitly state that adults were recruited but the sample appeared to be adults[33], one included small numbers of children aged over 14

years[39] and one recruited patients aged two years and above but a majority were adults and it reported some adult subgroup analyses[31]. Eleven studies set an upper age limit, ranging from 40 to 72 years. One study recruited women only[41].

Seven studies were judged to have "definitely" targetted patients with severe or difficult asthma. These included two studies by the same investigators[34,35] of ethnic minority patients with moderate-severe asthma who had multiple hospitalisations, emergency department attendances or an intensive care admission, and a study of primarily low income, ethnic minority patients, again with multiple hospitalisations or emergency attendances, referred to as having "difficult" asthma[36]. Four further studies[27,29,33,42] identified patients on the basis of a clear indicator of severe or poorly controlled asthma (e.g. diagnosis of severe asthma, hospitalisation, multiple emergency attendances) in combination with other socio-demographic (e.g. ethnic minority), behavioural (e.g. poor compliance) or clinical (e.g. previous hospitalisation or emergency attendances) risk factors, with most referring to patients as being "high risk".

Of the remaining ten studies, judged "likely" to have targetted severe or difficult asthma, four recruited hospitalised patients[28,37,39,43], one of which[39] included a subgroup analysis of patients with previous admissions, judged to be at higher risk. Three studies[30-32] targetted patients on the basis of a relatively weak indicator of severity/poor control (emergency attendance with or without hospitalisation) in combination with social deprivation or ethnic minority status. This was identified in two cases on the basis of geographical location alone[31,32] and in one on the basis of reporting a subgroup analysis from an RCT targeting a broader patient group which had been excluded from this review in its own right[30]. The remaining studies selected asthma patients with high anxiety/panic[41], taking sick leave due

to asthma[38], and with persistent symptoms despite adequate treatment[40]. It was not clear how the latter were identified.

All studies were judged to provide a clear description of the target population, usually justified on the basis of increased risk of mortality, morbidity or service use. However, two studies did not make explicit reference to patients being "at risk"[33,43] and 10 specified criteria related to disease severity or the presence of physical, psychosocial or behavioural co-morbidities that would have excluded some of the most at-risk patients[29,30,32,34-37,40,41,43].

Interventions (Box 1, Table 1)

All studies evaluated a single psycho-educational programme of which three were classified as educational[28,30,31], four as self-management[27,37,39,43], three as psychosocial[33,40,41] and seven as multi-faceted[29,32,34-36,38,42]. Details of individual interventions are provided in Table 1 and an overview provided in Box 1.

Comparisons (Table 1)

All studies included a comparison group receiving usual care, of which 14 gave at least some description. In all but one old study[33], the usual care appears similar to current recommended management. However, referencing of guidelines as the basis for this was variable even in the recent studies and in five identification of inadequacies in medical care in light of guidelines either generally (e.g. lack of routine education), or for the particular patients targetted (e.g. under-use of preventive medication for ethnic minority patients),

provided a rationale for implementation of the intervention[34,35,37,39,43]. Three further studies identified inadequacies in standard care as a result of providing their intervention[31,41,42].

Study quality (Table 2)

Randomisation/selection of controls

There were thirteen trials, all RCTs, in which the unit of randomisation was the patient. Only six described randomisation methods[32,36,38-40,42], of which five were considered adequate [32,38-40,42]. Four referred to concealed allocation[29,38-40].

One study[28] described as randomised was classified as a COS since intervention patients comprised those admitted to the study hospital and controls those admitted to other local hospitals, all of whom appeared to be identified prospectively. In two other COSs[34,35] intervention patients were followed prospectively but a naturally occurring control group, comprising patients meeting criteria but treated elsewhere in the district, were identified retrospectively. In the final COS[33], intervention and control patients appeared to be identified retrospectively from the same site over a similar timeframe.

Outcome assessment

Six RCTs[27,30,31,39,40,43], and one COS[28] made reference to blinding those involved in assessing or scoring outcomes. In only five RCTs[29,30,36,39,42] and one COS[33] was

there clearly *both* a single primary outcome and endpoint. In five further RCTs and two COSs *either* a single primary outcome[38] or endpoint[27,28,31,32,34,43] was apparent.

Sample and attrition

Sample sizes ranged from 25[40] to 500 patients[31], with a median of 86. The largest study conducted some subgroup analyses of children and adults considered separately here.

All but one RCT[40] was judged to have provided clear selection criteria. Only five RCTs reported sample size estimates[27,30,31,39,42] but several appeared to fail to meet these. The proportion of patients approached who agreed to participate ranged from 41%[43] to 100%[29,36], with a median of 65%, in the 12 RCTs for which this could be ascertained. In three[31,42,43] of the six RCTs[30,31,38,41-43] that assessed the comparability of non-participants, there was some evidence of differences, suggesting difficulties in recruiting patients truly representative of the target population.

All RCTs and all but one of the COSs[28] presented data on, or reported assessment of, group comparability at baseline. In five RCTs[27,29,37,40,41] minor differences were judged unlikely to have any major impact on results but two RCTs[39,42] and two COSs[33,34] examined effects of various group differences using adjusted analyses.

Numbers for whom follow up data were available could not be ascertained for two COSs[34,35]. Within other studies, follow up rates often varied for different outcomes at different time points. An assessment of the minimum follow up reported ranged from 39%[40] to 100%[30,36], with a median of 75%. Only five studies[30,31,33,36,38,39]

reported <15% loss to follow up, sometimes considered a maximum acceptable to prevent attrition bias. However, in the three RCTs that reported assessment of the comparability of withdrawals, no clear differences were found[31,41,42].

Analysis and reporting

Details of analyses were reported or could be ascertained for all RCTs but only two of the COSs[33,35]. Six RCTs[29-32,38,42] specified that analyses, for at least some outcomes, were undertaken on an intention-to-treat (ITT) basis. A further two RCTs[36,37] and one prospective COS[34] in fact conducted what appeared to be equivalent to ITT analyses. Eight of the 14 RCTs[27,29,30,38-43], and three of the four COSs[33-35] were judged to have adequate reporting of outcome data.

Outcomes and effectiveness (Tables 2, 3)

Details of follow ups, categories of outcomes assessed and a descriptive summary of findings for individual studies are provided in Table 2.

The maximum duration of follow up ranged from three months[40] to three years[38], with a median of 12 months (10 months for RCTs). Thirteen studies had more than one follow up, many including a short-term assessment of outcomes, often during an early intensive phase of longer interventions or soon after the end of shorter interventions, plus a medium- and/or long-term assessment beyond the end of any intervention. Results are summarised and synthesised on the basis of short-, medium- and long-term categories and, where appropriate, across all time points using data from the latest follow ups reported.

All studies reported assessment of one or more health outcomes (with at least a third reporting assessment of admissions, A&E attendances, symptoms, health status/quality of life and psychological morbidity). Nine studies reported one or more variables related to self-management (with at least a third reporting assessment of medication use, other self-management behaviours, and knowledge). The number of outcome categories assessed per study ranged from two[33] to 13[31], with a median of four, although the number for which comparative, numerical outcome data were actually reported and could thus be considered in synthesising results (Table 3), was often less.

No studies reported statistically significant effects favouring control groups, and only one small RCT (N=27) failed to show any significant positive effects of psycho-educational interventions[27]. The main analyses from nine of the 13 RCTs and three of the four COSs showed statistically significant impacts on one or more health outcomes. Eight of the nine studies reporting self-management outcomes, including four that did not find any significant impacts on health outcomes[28,37,38,42], showed significant effects on one or more aspects of self-management. However, in several studies[28,29,34,36,38,42] effects were confined to isolated outcomes at single time points. Only two very small RCTs (N<35)[40,41] showed consistent statistically significant effects across all outcomes reported.

Table 3 presents a summary of findings in relation to outcomes reported as assessed by at least four studies, thus allowing meaningful synthesis. Qualitative syntheses of individual study results show a lack of positive effects of psycho-educational interventions on health status/quality of life, psychological morbidity and time lost from work, conflicting findings with respect to admissions, A&E attendances and symptoms, and mainly positive effects on

various aspects of self-management, medication use, knowledge and respiratory function. However, most of the latter were assessed by small numbers of studies and any positive effects appear to be mainly short-term.

Calculation of meaningful summary statistics and limited quantitative syntheses were able to be undertaken for several health outcomes for which there were a sufficient number of RCTs measuring and adequately reporting outcomes in similar ways. Generally, these studies were of higher quality than others. Using data from the latest follow ups reported, pooled estimates summarised in Table 3 suggest psycho-educational interventions have little effect on A&E attendances (RR=1.03, 0.82 to 1.29, p=0.8) or composite symptom measures (SMD=-0.08, -0.39 to 0.23, p=0.63), and small but non-significant effects on admissions (RR=0.79, 0.55 to 1.14, p=0.21; Figure 2), asthma-specific quality of life (SMD=0.45, -0.07 to 0.98, p=0.09; Figure 3) and psychological morbidity (e.g. depression) (SMD=0.17, -0.15 to 0.49, p=0.30; Figure 4). Effects on symptoms, quality of life and psychological morbidity appeared greater in the short-term (Table 3).

Sensitivity analyses demonstrate that admissions and quality of life data were sensitive to the analysis methods used: statistically significant effects were observed (RR=0.75, 0.56 to 0.99, p=0.04; SMD=0.36, 0.00 to 0.72, p=0.05 respectively) when a fixed effects model was applied and for admissions, when odds-ratio statistics calculated (OR=0.70, 0.49 to 0.99, p=0.04) (Table 3). Limited subgroup analyses suggest that significant positive effects of psycho-educational interventions on admissions and quality of life observed across studies with “likely” targetting, do not extend to studies with “definite” targetting (Figures 2,3). Small but non-significant effects on psychological morbidity are also largely eliminated when analyses are confined to studies of the most at-risk patients (Figure 4). Furthermore, subgroup

analyses of higher risk patients in individual studies suggest a similar pattern with respect to symptoms[29] and time lost from work[28]. The relative effectiveness of different intervention types could not be examined since all meta-analyses included studies examining at least three different types.

DISCUSSION

Principal findings

There is a recent and growing literature on psycho-educational interventions for adults with severe and difficult asthma, but high quality RCTs targetting the most at-risk patients remain limited. Overall, qualitative and quantitative syntheses provided no clear, consistent evidence of the effectiveness of psycho-educational interventions on health outcomes in a range of adults with severe or difficult asthma. Largely positive effects on self-management-related outcomes, statistically significant effects on health outcomes from individual studies and potentially important but non-significant pooled effects on admissions, quality of life and psychological morbidity were mainly confined to the short-term. However, many studies were small and likely underpowered, and the limited numbers of studies and patients included in meta-analyses resulted in wide confidence intervals.

Limited subgroup and sensitivity analyses suggest psycho-educational interventions may have important effects on admissions (leading to ~30% reduction), quality of life and possibly psychological morbidity in patients with severe asthma or single risk factors alone. However, these effects do not appear to extend to patients with multiple factors complicating management. Although based on small numbers of studies, the consistency of this finding across several outcomes where results from different studies were pooled, and observation of a similar failure of effects to extend to higher risk patients in two individual studies including subgroup analyses, point to its authenticity. This is also supported by our review of a larger number of studies in children[26]. Due to the limited number of studies suitable for inclusion in meta-analyses, range of interventions assessed and tendency for more intensive

interventions to target more complex patients, we were unable to explore the relative effectiveness of intervention types.

Strengths and weaknesses

This review complements and expands upon existing systematic reviews in this field which have suggested that some psycho-educational interventions for asthma are effective[19-22]. We had some success in answering questions regarding the generalisability of findings from these to the clinically and economically important subgroup that accounts for the majority of morbidity, mortality and costs associated with asthma. Unlike the only previous review focussed on high risk patients[23], we undertook wide and thorough searching and used explicit definitions and systematic methods in selecting, assessing and synthesising literature in an attempt to provide a comprehensive and unbiased picture of the evidence. The criteria we used to select studies judged to have targetted patients who, on the basis of previous literature[3-7,11-17], were considered to be at-risk from their asthma could be argued to be somewhat arbitrary. However, the criteria were rigorously applied and we were, to some extent, able to assess the impact of the criteria on our conclusions via our subgroup analyses to explore the relative effectiveness of interventions across different patient groups.

In contrast to some other reviews[19,21,22], our criteria for selection of relevant interventions were very explicit and, because they were wide, allowed us to examine in detail the characteristics of a broad range of potentially related interventions, and in so doing challenge previous distinctions made between educational, self-management, multi-faceted and some psychosocial programmes. The fact that there were often greater differences across interventions classified as being of the same type than of different types in terms of, for

example, their content, delivery and intensity, can be argued to justify our synthesis of findings across a spectrum of psycho-educational programmes. Due to the diversity of interventions, range of parameters on which they varied and relatively small number of studies that were able to be included in meta-analyses we were not, however, able to explore the impact of differences in interventions on our conclusions.

Having focussed on patients who are commonly excluded from existing studies, we included a broader range of study designs than is common in systematic reviews, on the assumption that well-conducted COSs might usefully supplement data from RCTs in an area where research is limited and challenging. However, conclusions are little influenced by the COSs since they made a minimal contribution to qualitative syntheses and did not contribute to quantitative syntheses due to limited assessment and reporting of outcomes. Even amongst the RCTs, the generally poor quality of studies must also be considered. For example, none reported on, or adequately met, all quality criteria and less than half[29,30,38-40,42] reported on, or adequately met, all criteria within any one of the dimensions assessed. However, poor reporting, apparent in the frequent failure to provide details of patient flow, baseline group comparability and statistical analyses, may have masked study quality.

In an attempt to overcome biases, non-English language and unpublished data sources were originally searched but, in line with recent methodological research[44], we found that these ultimately contributed little to initial syntheses of higher quality research, hence their exclusion from the updated review reported here. However, at least two RCTs with potential to contribute to the findings have remained published only as abstracts since 2002 and were thus excluded. Furthermore, two very small published RCTs that were included reported the most consistently positive findings[40,41]. This may indicate the potential for publication bias

to have influenced our results. The summaries of results are also somewhat dominated by several trials reporting multiple outcomes[31,42,43] and may be influenced by selective reporting, apparent in numerous studies.

Implications

With regards to clinical practice, our results suggest that for adults with *severe* asthma or single risk factors associated with adverse outcomes, provision of psycho-educational interventions *may* improve self-management, reduce hospital admissions and improve some health outcomes in the short-term. There is currently a lack of evidence, however, to warrant significant changes in the care of patients in whom multiple clinical and psychosocial factors complicate management. Since several studies identified continued inadequacies in the medical care these patients receive, it appears that until further research is available the emphasis should be on optimisation of routine care to address clinical concerns and also, ideally, acknowledge potential complicating psychosocial factors.

In terms of further research, our review highlights opportunities for additional primary and secondary studies to identify key risk factors for severe and difficult asthma, clarify how these interact with each other and over time, and develop tools to better identify patients susceptible to adverse outcomes to ensure appropriate targeting of any future interventions. Our review also suggests scope for further work on developing and evaluating psycho-educational interventions for at-risk groups. The apparent increasing overlap between different types of interventions suggest that an alternative conceptualisation of these, in light of the pathways by which psychosocial factors and asthma interact[10], may be a necessary precursor to this. Given its established effectiveness in general[18] and function as a core component of many

of the more effective interventions reviewed, self-management is likely to be a central feature. However, it is increasingly recognised that use of formal psycho-educational theories and techniques, which appeared to be lacking from the majority of studies reviewed, may be necessary to achieve self-management-related behavioural changes, particularly amongst complex patients[10]. For example, psychosocial consequences of living with a severe illness or recurrent exacerbations (e.g. depression, anxiety), may need to be addressed and patients' coping improved prior to attempts at behavioural change[10]. Given the need for provision of optimal medical care alongside any psycho-educational interventions, multi-faceted, multi-disciplinary programmes addressing the numerous factors impacting on asthma, may be the most promising future approach. These might target key issues (e.g. stress management) in selected patients (e.g. those with high anxiety) or address multiple issues and be individualised to needs amongst broader groups of complex patients. Given identified difficulties with at-risk patients attending healthcare facilities, interventions tied to opportunistic contacts in emergency, primary care or community settings may also be desirable. The development of future interventions might also usefully be guided by reference to the wider range of programmes identified in our original review which have not been evaluated via controlled studies[26].

Although several studies reviewed mentioned difficulties in conducting high quality research in the groups targetted, most demonstrated some success in recruiting and following up at-risk patients. It thus appears feasible to conduct further well-designed, pragmatic RCTs of psycho-educational interventions in at-risk groups to assess their relative effectiveness, and ideally cost-effectiveness given potentially high costs and lack of current data on this[26]. These might address remaining unanswered questions regarding the key components, most effective settings, delivery methods and timing of interventions (e.g. whether scheduled to follow acute

events). Adequate reporting of these is also essential to allow ongoing evidence syntheses to further inform future research and practice.

Conclusion

There is some evidence to suggest that psycho-educational interventions can reduce admissions, improve quality of life and possibly reduce psychological morbidity in patients with severe asthma or single characteristics associated with difficult asthma. However, effects appear to be mainly short-term and do not appear to extend to the most at-risk patients in whom multiple factors complicate management. There is thus a need for further research in these groups prior to changes being made to the standard care these patients receive.

COMPETING INTERESTS

None.

CONTRIBUTORS

JS developed the study proposal and protocol, conducted some of the searching and screening, undertook study selection, data extraction, data syntheses and analyses, drafted and revised the original review report and this paper and is guarantor for the work. MM and RH assisted with study selection, data extraction and checking, advised on data synthesis and analysis and provided detailed comments on drafts. MN and BH provided clinical advice, acted as secondary reviewers in resolving queries or disagreements, assisted with data checking and commented on drafts. All authors approved the final manuscript.

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Box 1 Overview of intervention characteristics

Setting

All but two studies, both of psychosocial interventions[33] [41], indicated the setting for intervention delivery. Seven, including all but one self-management intervention, were delivered at least partly in an inpatient setting[27][28][29] [32] [37][38][39], four solely on an outpatient basis[35][36] [40] [43], two in the emergency department[30] [34] and two in community or home environments[31] [42].

Providers

Twelve studies involved nurses and five doctors, all but one of which evaluated a multi-faceted intervention incorporating additional medical treatment. One educational[31], one psychosocial[33], and four multi-faceted interventions[35] [36] [38] [42] involved additional professionals (e.g. psychologists, community health workers, pharmacists, physiotherapists, dieticians). In three studies[34] [40] [43] the providers' professions were unclear. Eleven studies reported on the number of providers[27] [29][30][31] [33] [36][37] [39][40][41][42], ranging from one to four. Six referred to specific training undertaken by, or supervision given to, providers[28] [30][31] [33] [39] [42]. Four studies included details of providers' experience, gender or shared ethnic, linguistic or cultural background with patients[31] [33] [41][42].

Format, structure and timing

All but one study[38] provided information on the delivery format. In 12, delivery was on an individual basis, two delivered interventions to medium-sized groups[30] [43], one to a small group [41], and one to a group of unspecified size[33]. Only seven studies provided complete information on the number, duration and frequency of intervention contacts and total intervention duration[31] [34] [36][37] [41][42][43]. Across all studies where one or more of these dimensions was reported, they often varied according to patient needs, time available for contact (e.g. during an admission) or at different stages of the intervention, but where specific figures could be ascertained:

- the number of sessions varied from one, for a self-management intervention[43], to 12, for a psychosocial intervention[41];
- individual session duration varied from a minimum of 30 minutes, for one educational[28] and two self-management interventions[37] [39], to up to three hours, for a self-management intervention[43], with sessions most commonly lasting around an hour;
- the frequency of contacts ranged from daily, in one self-management programme[37], to initial contacts at monthly intervals in a multi-faceted intervention[35];
- the intervention duration ranged from the time taken to deliver a single session in one self-management programme[43] to several years in a psychosocial intervention[33]; and
- total contact time ranged from a minimum of 30 minutes during a single educational session[28] to nine hours for a psychosocial intervention[41].
- judgements about the overall intensity of the intervention could only be made for a small number of studies, but appeared greatest for psychosocial and multi-faceted interventions.

Eleven interventions, including all the educational and self-management programmes and half the multi-faceted programmes, followed an asthma episode (e.g. hospitaliation, emergency

attendance, recent attack)[27][28][29][30][31][32] [34] [36][37] [39] [43] but the exact timing of the start of the intervention from the episode was not always clear.

Delivery methods/tools

All interventions appeared to use formal or informal discussion and/or questioning in groups or individually, commonly covering experiences with, and problems related to, asthma management. All but one study of a psychosocial intervention[33] incorporated skills training, including demonstration of correct use of inhalers, related equipment and peak flow meters, and training in self-management procedures, relaxation or other psychotherapeutic techniques, trigger management or social skills. Fourteen studies supplemented face-to-face delivery with written information and seven with telephone contact. Seven interventions included a didactic component. All three psychosocial interventions made use of formal psychotherapeutic techniques, two cognitive-behavioural principles[40][41], in delivery. One educational[30] and one multi-faceted intervention[42] also used basic relaxation techniques and cognitive-behavioural principles respectively. Single studies used other delivery methods or tools (e.g. problem-solving, goal-setting, role play, video and audio technology).

There were no clear patterns or differences across intervention types in terms of the delivery methods or tools used except that all psychosocial interventions made use of formal psychotherapeutic techniques. The median number of delivery methods used was estimated at four, ranging from three in educational to 4.5 in self-management interventions.

Content

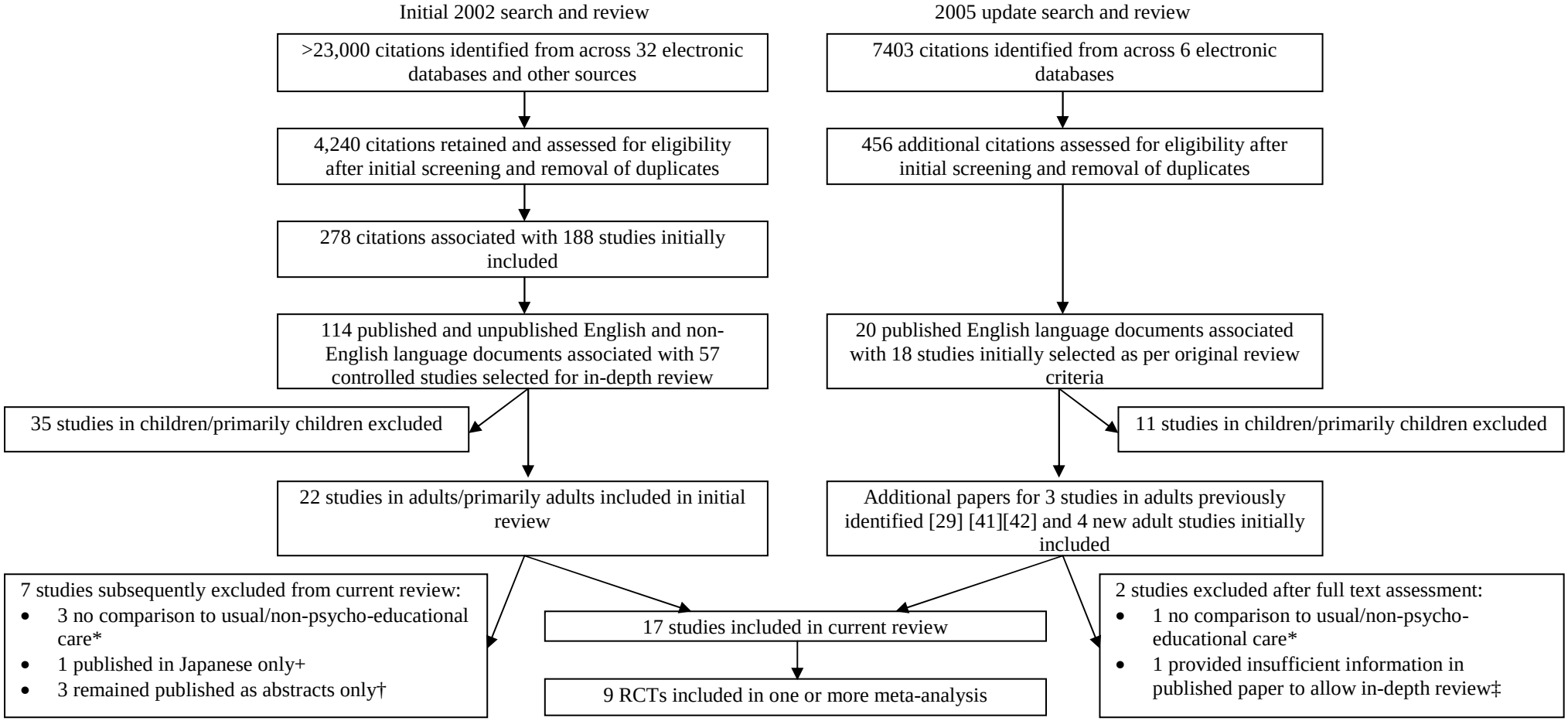
Information on content was particularly sparse for one psychosocial intervention[33]. All interventions appeared to cover asthma medication, and all but one[33] the development of a general understanding of asthma (e.g. its nature, pathophysiology, causes) and aspects of asthma management, most commonly principles of self-management, attack management, and use of a peak flow meter or action plan. Fourteen discussed triggers or trigger avoidance, and seven regular clinic attendance. The median number of asthma-specific topics covered was estimated at 10. Multi-faceted and self-management interventions tended to cover a greater range than educational interventions, and these more than psychosocial interventions. After examining their detailed content, the distinction between educational and self-management programmes appears questionable, since two studies classified as educational interventions included use of formal self-management plans for at least some patients[28] [31].

All but three interventions[28] [36] [39] reported consideration of broader issues indirectly related to asthma and its management. Ten covered psychological issues (e.g. stress, anxiety, fears) and nine social or family issues. Five studies or less covered attitudes and beliefs in relation to asthma and its management, smoking and other health-related behaviours (e.g. exercise, diet) and economic problems. Other issues (e.g. communication with providers, occupational concerns) were addressed by single studies. The median number of broader issues covered was estimated at two. There was little difference in the number or categories of issues addressed across interventions of different types except that psychosocial interventions were most likely to cover psychological issues.

Add-ons

Interventions classified as multi-faceted included non-psycho-educational add-ons, all incorporating enhanced medical care (e.g. optimisation of drug therapy, altered inpatient and follow up treatment, liaison with medical services), two individualised exercise programmes[38] [42], and two referral to other health, psychological or social services[32] [42]. Two educational interventions [30][31] involved referral.

Figure 1 Literature identified, screened, selected and reviewed in depth



*Comprised 4 trials of various psychotherapeutic interventions.
+This retrospective observational study compared patients who had undergone psychosomatic treatment to those who had discontinued treatment, and had not contributed to the syntheses of results in the original review.
†These 3 studies, which included two UK-based RCTs of cognitive-behavioural therapy and a specialist nurse intervention, remained published as abstracts only at the end of 2005 and further information was unavailable or could not be obtained from authors.
‡This retrospective observational study comparing Medicaid patients participating in a US disease management programme to patients who had not participated, provided insufficient information on the intervention in a published paper to allow in-depth review and the study author did not respond to requests for further information.

Table 1 General study characteristics and details of patients, interventions and control groups

Study	Country & setting	Targetting of severe/difficult asthma and sample selection	Intervention	Control group(s)
Blixen et al 2001[27]	USA Tertiary care	**Targetting:** Definite **Inclusion criteria:** African-Americans aged 18-50 years hospitalised overnight with a primary diagnosis of asthma. **Exclusions:** None stated. **Rationale for targetting:** Asthma death rates among African-Americans more than double that in Caucasians, hospitalisation rates also higher amongst inner-city, low-income African-Americans. Group studied representative of those with severe asthma who are at risk.	**Type:** Self-management **Description:** Asthma education programme including self-management **Setting:** Inpatient **Provider(s):** 1 Nurse Educator **Format:** Individual **Structure:** 3 x 1-hour sessions (frequency and total intervention duration not stated) **Timing:** Following admission **Delivery methods/tools*:** L, D, S, W, V (Total 5) **Asthma content†:** 10 topics related to asthma in general, management, medication, triggers **Other content:** Other psychological issues (dealing with stresses common to many African-Americans), social or family issues, other (communication with medical providers, contacts for local support organisations) **Add-ons:** None	Usual care (no description given)
Brewin & Hughes 1995[28]	UK Secondary care	**Targetting:** Likely **Inclusion criteria:** Adults aged 16+ years hospitalised with asthma. **Exclusions:** None stated. **Rationale for targetting:** Patients hospitalised with asthma need opportunity to learn more about asthma so they can be independent and as symptom-free as possible.	**Type:** Educational **Description:** Patient education with some elements of self-management **Setting:** Inpatient **Provider(s):** Respiratory Nurse **Format:** Individual **Structure:** 1+ sessions, with more shorter sessions as needed. Most seen for >30 mins (frequency of sessions and total intervention duration not stated) **Timing:** Immediately following hospital admission **Delivery methods/tools*:** D, S, W (Total 3) **Asthma content†:** 7 topics related to asthma in general, management, medication, triggers **Other content:** None stated **Add-ons:** None	Usual care comprising all other patients admitted with asthma to hospitals in the district, a survey of whom suggested they received minimal education.
Castro et al 2003[29]	USA Secondary care	**Targetting:** Definite **Inclusion criteria:** Adults aged 18-65 years hospitalised for asthma with a physician diagnosis of asthma of at least 12 months, FEV_1 to FVC ratio of <80% and a history of one or more additional hospitalisations or ED	**Type:** Multi-faceted **Description:** Multi-faceted approach to asthma care including education, self-management, psychosocial support, optimization of medications and feedback to physicians **Setting:** Inpatient **Provider(s):** 3 Asthma Nurse Specialists	Usual care comprising normal care provided by the patient's primary care physician, and including asthma education (covering

Study	Country & setting	Targetting of severe/difficult asthma and sample selection	Intervention	Control group(s)
		visits in the previous 12 months. **Exclusions:** Chronic bronchitis, emphysema, congestive heart failure, a terminal condition with estimated survival of <1 year, dementia or serious psychiatric illness (e.g. schizophrenia, personality disorder), planned discharge to long-term care facility, early discharge of <24 hours, refusal to participate by patient or their physician. **Rationale for targetting:** Hospitalisations account for half of healthcare expenditure for asthma, with African-Americans more than three times as likely to be hospitalised. The 20% of the population who have a history of frequent healthcare use consume more than 80% of resources. Sample targetted defined as "high risk".	**Format:** Individual **Structure:** As many sessions as possible before discharge (average of 2, duration not stated) plus follow up phone calls (average of 5.8, range 0-24) and home visits where necessary (average of 0.4, range 0-3) up to 6 months **Timing:** Immediately following admission **Delivery methods/tools*:** D, S, T, W (Total 4) **Asthma content†:** 10 topics related to asthma in general, management, medication, triggers, clinic attendance **Other content:** Other psychological issues (referral to psychiatric nurse where indicated), Social or family issues (social support, referral to social worker or consultation with social services where indicated) **Add-ons:** Medical treatment (optimisation of medical care)	medication dosing, action and side effects, inhaler technique and peak flow monitoring) from the hospital respiratory therapist and nurse and written discharge instructions from the hospital nurse which stated medications and the need for physician follow-up but did not include an action or self-management plan.
Ford et al 1997[30]	USA Secondary care	**Targetting:** Likely **Inclusion criteria:** African-American subgroup (72% of original sample) aged 18-70 years seen in emergency department for asthma. **Exclusions:** Language barriers; psychiatric barriers. **Rationale for targetting:** Re-analysed data from African-American subgroup in previous study since asthma death rates twice as high among African-Americans (acounting for 86% of deaths in one study) and, morbidity and treatment costs also disproportionately high.	**Type:** Educational **Description:** Educational intervention including basic relaxation training **Setting:** A&E **Provider(s):** 2 Nurses **Format:** Medium group (5-15 people) **Structure:** 3 x 1-hour sessions (frequency and total intervention duration not stated) **Timing:** During A&E visit for exacerbation **Delivery methods/tools*:** D, S, P, FT, W, A (Total 6) **Asthma content†:** 8 topics related to asthma in general, management, medication, triggers **Other content:** Smoking, other health-related behaviours, attitudes/beliefs (beliefs in self-care), other psychological issues (stress management), social or family issues, other (physician communication, other medication) **Add-ons:** Referral (to stop-smoking programmes as required)	Usual care comprising admission to and discharge from A&E with usual care and follow up
Garrett et al 1994[31]	New Zealand Community	**Targetting:** Likely **Inclusion criteria:** Patients aged 2-55 years (majority adult and including adult subgroup) with acute asthma diagnosed by a doctor whilst attending the emergency room who lived within a defined geographical area with high A&E use and social depriviation and intended	**Type:** Educational **Description:** Community health care intervention comprising education, link to GP/referral **Setting:** Home, Community, Other (workplace or as according to patients' wishes) **Provider(s):** 4 Nurses & Community health workers **Format:** Individual	Usual care comprising usual management by physicians with referral to hospital asthma clinic for some patients

Study	Country & setting	Targeting of severe/difficult asthma and sample selection	Intervention	Control group(s)
		to reside locally for next 9 months; understood English sufficiently and; could be contacted within 5 days of attending. **Exclusions:** None stated. **Rationale for targetting:** Mortality and admission rates for asthma in Auckland are highest amongst patients attending A&E from within the geographical area of high social and medical needs targetted. This area also has a large immigrant population and rates are up to four times higher in Pacific Islander, ethnic minority and Maori patients due to lack of self management skills, social factors and non-attendance.	**Structure:** Number of sessions as needed (mean 3.7, range 1-10) with duration of sessions dependent on educational needs of patient, and intervention continued until all topics covered **Timing:** Following recent attack **Delivery methods/tools*:** D, S, W (Total 3) **Asthma content†:** 11 topics related to asthma in general, management, medication, triggers, clinic attendance **Other content:** Smoking, attitudes/beliefs, social or family issues, economic issues (assessment of social, financial & cultural beliefs) **Add-ons:** Referral (links with GPs and contact with other health, mental health or social service agencies or support structures as appropriate)	
George et al 1999[32]	USA Secondary care	**Targetting:** Likely **Inclusion criteria:** Adults aged 18-45 years living in area around hospital which predominantly populated by African-Americans who were hospitalised from ED with (uncomplicated) acute exacerbation of asthma. **Exclusions:** Patients admitted to intensive care; inability to speak English; comorbid disease; absence of telephone; pregnancy. **Rationale for targetting:** Disproportionate morbidity and mortality in poor, indigent, inner-city patients due to allergens, smoking and psychosocial factors.	**Type:** Multi-faceted **Description:** Comprehensive inpatient programme including education, self-management, addressing socio-economic barriers via social worker and with additional follow up **Setting:** Inpatient, outpatient **Provider(s):** Asthma Clinical Nurse Specialist **Format:** Individual **Structure:** Number, frequency and duration of sessions not stated. Total duration of intervention dependent on length of stay (mean 2.1 days) with outpatient follow up 7 days after discharge **Timing:** Begun during admission for exacerbation **Delivery methods/tools*:** L, D, S, T (Total 4) **Asthma content†:** 10 topics related to asthma in general, management, medication, clinic attendance **Other content:** Other psychological issues, social or family issues, economic issues (screened for obstacles to care including inability to fill prescriptions, lack of transportation, lack of child care, substance abuse which addressed with social worker) **Add-ons:** Medical treatment (use of bedside spirometry, discharge planning and outpatient follow up which were not provided as part of usual care), Referral (liaison with social workers as needed)	Usual care comprising inpatient treatment including nebulised albuterol and intravenous methylprednisolone sodium; education, peak flow measurement as needed.
Groen & Pelser 1960[33]	The Netherlands Setting unclear	**Targetting:** Definite **Inclusion criteria:** Appear to be adults (although not explicitly stated) hospitalised at least once for severe status asthmaticus, most	**Type:** Psychosocial **Description:** Psychotherapy **Setting:** Not stated **Provider(s):** 2 Physicians with no specific training in psychiatry but	1. Enhanced medical care comprising patients treated with symptomatic therapy

Study	Country & setting	Targetting of severe/difficult asthma and sample selection	Intervention	Control group(s)
		with many hospitalisations and very severe asthma. **Exclusions:** None stated. **Rationale for targetting:** No explicit discussion of at-risk status.	experience with individual psycho-therapeutic techniques; support from Psychiatrist, Psychosomatic Researchers **Format:** Group (size not stated) **Structure:** Twice weekly sessions planned as 1 hour, actually up to 75 mins, provided over several years **Timing:** No specific timing to asthma episode **Delivery methods/tools*:** D, R, FT (Total 3) **Asthma content†:** 1 topic related to medication **Other content:** Other psychological issues, social or family issues (little detail provided) **Add-ons:** None	and, from 3 months to 4 years, preventive therapy. 2. Usual care comprising patients treated with symptomatic therapy only
Kelso et al 1995[34]	USA Secondary care	**Targetting:** Definite **Inclusion criteria:** African-Americans aged 18+ years with a diagnosis of moderate-severe asthma (as per American Thoracic Society criteria) admitted to ED with acute asthma, who had 5+ ED visits in the last 2 years, 3+ ED visits in the last year, 2+ hospitalisations in the last 2 years OR an intensive care admission in the last 2 years. **Exclusions:** Patients with chronic bronchitis, emphysema, other chronic pulmonary disease, significant cardiac disease, psychosis or substance abuse, who were pregnant or unable to use a peak flow meter or metered dose inhaler with spacer correctly. **Rationale for targetting:** African-Americans have three times the mortality rate for asthma, similar to other ethnic minorities, and use the ED as their main source of care.	**Type:** Multi-faceted **Description:** Education and long-term therapeutic intervention including education, self-management, medical treatment **Setting:** A&E, outpatient **Provider(s):** Study investigators **Format:** Individual **Structure:** 1 x 1-hour session during average 4.4- hour stay in ED with follow up at clinic after 1 week then every 2 weeks to 6 months for 1 year **Timing:** Immediately following emergency department treatment **Delivery methods/tools*:** L, D, S, T, W (Total 5) **Asthma content†:** 12 topics related to asthma in general, management, medication, triggers, clinic attendance **Other content:** Other health-related behaviours **Add-ons:** Medical treatment (prescriptions for inhaled steroids, beta-agonists, emergency prednisolone and other medications as necessary).	Usual care comprising patients meeting same inclusion criteria admitted or treated in ED during same time period as intervention group in other local hospitals.
Kelso et al 1996[35]	USA Secondary care	**Targetting:** Definite **Inclusion criteria:** African-Americans (but not explicitly stated in inclusion criteria) aged 18+ years meeting US National Asthma Education & Prevention Programme criteria for moderate-severe asthma and with 5+ ED visits in last 2 years, 3+ ED visits in last year, 2+ hospitalisations in last 2 years OR an intensive care admission in last 2 years.	**Type:** Multi-faceted **Description:** Educational intervention with long-term management programme including education, self-management, medical treatment **Setting:** Outpatient **Provider(s):** Doctor, Pharmacist **Format:** Individual **Structure:** 1 x 1-hour initial visit followed by unstated number of follow up contacts provided monthly initially, then 2-3 monthly thereafter based on need (total intervention duration not stated)	Usual care comprising retrospective group of patients, 14 out of 18 of whom saw primary care physician, 4 of whom saw a pulmonologist/ allergist. Frequency of office visits for control patients could not be

Study	Country & setting	Targeting of severe/difficult asthma and sample selection	Intervention	Control group(s)
		Exclusions: COPD; clinically significant cardiac disease; psychosis, substance abuse; pregnancy; inability to use peak flow meter or inhaler with spacer correctly. **Rationale:** Asthma morbidity and mortality higher in African-Americans.	**Timing:** None **Delivery methods/tools*:** D, S, T, W (Total 4) **Asthma content†:** 14 topics related to asthma in general, management, medication, triggers, clinic attendance **Other content:** Attitudes/beliefs **Add-ons:** Medical treatment (optimisation of therapy and linking this to use of a self-management plan).	determined.
Mayo et al 1990[36]	USA Secondary care	**Targetting:** Definite **Inclusion criteria:** Adults aged 18+ years with a primary diagnosis of acute asthma exacerbation as per American Thoracic Society definition and >4 ER visits in last 12 months or >1 hospitalisation in last 24 months. **Exclusions:** Mild asthma; remote residence or in prison, deaf mute; intravenous drug abusers; overt central nervous system/mental illness; severe alcoholism; private follow up; discharged before evaluation in hospital. **Rationale for targetting:** Local area (Lower East Side of New York) densely populated, socio-economically depressed, where asthma common cause for admission (670/year) and certain patients, labelled as "difficult", have frequent admissions.	**Type:** Multi-faceted **Description:** Specialist clinic programme comprising education, self-management, open-door policy, medical treatment **Setting:** Outpatient **Provider(s):** 1 Respiratory Nurse Specialist, 1 Respiratory Doctor **Format:** Individual **Structure:** Initial session of >1 hour, followed by further >30 min sessions as needed, ranging from once a week to 1 every 6 months plus phone contact between for a maximum period of 8 months **Timing:** Patients recruited following admission, unclear how long after intervention began **Delivery methods/tools*:** D, S, T (Total 3) **Asthma content†:** 8 topics related to asthma in general, management, medication, clinic attendance **Other content:** None stated **Add-ons:** Medical treatment (reduction in or minimal use of medications required to control symptoms)	Usual care comprising regular outpatient care in chest or medical clinic at local hospital, neighbourhood clinics or local physicians.
Morice & Wrench 2001[37]	UK Secondary care	**Targetting:** Likely **Inclusion criteria:** Patients aged 16-72 years hospitalised with a primary diagnosis of acute asthma. **Exclusions:** Unable or unwilling to complete follow up questionnaires; underlying COPD; previous participation in an educational programme from a hospital-based asthma nurse. **Rationale for targetting:** Inadequate self-management contributes to mortality and morbidity. Written management plans are a postive step but their usefulness is dependent upon identifying and targetting those asthmatics most at risk.	**Type:** Self-management **Description:** Education programme including self-management **Setting:** Inpatient **Provider(s):** 1 Asthma Nurse **Format:** Individual **Structure:** Minimum of 2 sessions, average 30 mins duration, delivered on consecutive days, plus one prior to discharge where possible**,** with total duration of intervention being 2+ days, dependent on length of admission **Timing:** Initial assessment within 48 hours of admission **Delivery methods/tools*:** L, D, S, W (Total 4) **Asthma content†:** 11 topics related to asthma in general, management, medication, triggers **Other content:** Other psychological issues (fears & anxieties related to home management), social or family issues (relatives involved at patient's request), other (influence of lifestyle activities e.g. leisure & occupation)	Usual care comprising routine care from medical and nursing staff

Study	Country & setting	Targetting of severe/difficult asthma and sample selection	Intervention	Control group(s)
			Add-ons: None	
Nathell 2005[38]	Sweden Tertiary care	**Targetting:** Likely **Inclusion criteria:** Adults born after 1941 (i.e. aged <55 years at time of identification) in a compulsory sick leave scheme primarily for manual workers who had been on sick leave from private sector work for more than 2 weeks in 2 years due to respiratory symptoms and in whom a diagnosis of asthma was made as per American Thoracic Society criteria via interview and clinical examination. **Exclusions:** None stated. **Rationale for targetting:** Major proportion of the costs of asthma attributable to productivity losses and societal costs in relation to sick leave compensation, therefore important to reduce sick leave for asthma.	**Type:** Multi-faceted **Description:** Rehabilitation programme comprising education, self-management, optimization of medications, physical training, and coping skills acquisition **Setting:** Inpatient **Provider(s):** Physician, Nurse, Physiotherapist, Psychologist, Dietician, Vocational Therapist, Lab technician **Format:** Not stated **Structure:** 4 week programme (number, frequency & duration of contacts not stated) plus follow up by post/email/phone for one year **Timing:** No specific timing to asthma episode **Delivery methods/tools*:** L, D, S, T, W (Total 5) **Asthma content†:** 6 topics related to asthma in general, management, medication, triggers **Other content:** Other health-related behaviour (weight reduction or maintenance), Other psychological issues (coping with asthma, treatment and consequences) **Add-ons:** Medical care (optimisation of drug therapy), Exercise (personal physical training programme)	Usual care in which patients advised to see their regular doctor as usual
Osman et al 2002[39]	UK Secondary care	**Targetting:** Likely **Inclusion criteria:** Patients aged 14-60 years with a confirmed diagnosis and hospitalised with acute asthma. **Exclusions:** None stated. **Rationale for targetting:** After acute asthma admissions there is a high rate of readmission with 1 in 5 patients being re-admitted.	**Type:** Self-management **Description:** Self-management education programme **Setting:** Inpatient **Provider(s):** 1 Respiratory Nurse **Format:** Individual **Structure:** 2 x 30 min sessions (frequency and total intervention duration not stated) **Timing:** Following admission **Delivery methods/tools*:** D, S, W (Total 3) **Asthma content†:** 11 topics related to asthma in general, management, medication, triggers **Other content:** None stated **Add-ons:** None	Usual care comprising standard care by more than 40 general medical and respiratory physicians, usually including follow up in an outpatient clinic at discretion of physician as per British Thoracic Society guidelines and local practice. Could include education or use of management plans.
Put et al 2003[40]	Belgium Secondary care	**Targetting:** Likely **Inclusion criteria:** Adults aged 18-65 years with a diagnosis of asthma according to American Thoracic Society criteria, and symptoms during the last 6 months (stated that	**Type:** Psychosocial **Description:** Education and cognitive-behavioural intervention **Setting:** Outpatient **Provider(s):** 2 researchers **Format:** Individual	Usual care comprising waiting list control group (no description given)

Study	Country & setting	Targetting of severe/difficult asthma and sample selection	Intervention	Control group(s)
		those reporting symptomology and impairment despite adequate medical treatment targetted but unclear from criteria how this was done). **Exclusions:** Occupational asthma, nicotine, drug or alcohol abuse, brittle asthma, previous participation in an educational or other asthma programme. **Rationale for targetting:** Patients reporting symptomology and impairment despite adequate medical treatment represent a challenge in clinical practice and cause frustration to clinicians	**Structure:** 6 x 1-hour sessions (frequency and total intervention duration not stated) **Timing:** No specific timing to asthma episode **Delivery methods/tools*:** D, S, FT, W (Total 4) **Asthma content†:** 5 topics related to asthma in general, management, medication, triggers. **Other content:** Attitudes/beliefs (negative and irrational illness and medication perceptions and beliefs), Other psychological issues (problem areas as indicated e.g. anxiety) **Add-ons:** None	
Ross et al 2005[41]	Canada Research facility	**Targetting:** Likely **Inclusion criteria:** Women (due to higher rates of panic disorder) aged 18-65 years with a physician diagnosis of asthma who had been referred to a pulmonary specialist or attended the ED for an acute asthma episode AND were identified as having a primary diagnosis of panic disorder (with no, mild or moderate agrophobic avoidance and at least 3 panic attacks in the last 3 weeks) following a DSM-IV structured diagnotic interview and expert discussion. **Exclusions:** Recent change in psychotrophic medication or dose, other medical condition contraindicating participation (e.g. emphysema, organic brain syndrome), bipolar disorder, schizophrenia, obsessive-compulsive disorder, alcohol or drug dependence. **Rationale for targetting:** Higher than normal rates of panic disorder in asthma patients. Combination of panic and asthma attacks leads to mental, emotional and physical anguish, increased health service use and increased asthma morbidity and mortality.	**Type:** Psychosocial **Description:** Cognitive-behavioural treatment and asthma education programme including self-managmenent **Setting:** Not stated **Provider(s):** 2 nurse clinicians (one trained in asthma, one in psychiatry) **Format:** Small group (<5 people) **Structure:** 12 x 90 min sessions, 8 conducted twice weekly for 4 weeks, 4 conducted weekly for 4 weeks making 8 week intervention in total. **Timing:** No specific timing to asthma episode **Delivery methods/tools*:** L, D, S, FT, W (Total 5) **Asthma content†:** 10 topics related to asthma in general, management, medication, triggers **Other content:** Attitudes/beliefs (addressing faulty cognitive appraisals contributing to anxiety and panic), other psychological issues (general information on anxiety & panic, training in slow diaphragmatic breathing to reduce symptoms triggering panic attacks, addressing fear of bodily sensations associated with anxiety and panic) **Add-ons:** None	Usual care comprising a waiting list (delayed treatment) control (no description given)
Smith et al 2005[42]	UK Secondary care	**Targetting:** Definite **Inclusion criteria:** Adults (attending adult clinic) with a confirmed diagnosis and severe	**Type:** Multi-faceted **Description:** Psycho-educational programme comprising education, self-management, psychological supervision and referral where indicated	Usual care comprising routine asthma care provided by primary

Study	Country & setting	Targeting of severe/difficult asthma and sample selection	Intervention	Control group(s)
		asthma indicated by British Thoracic Society Step 4 or 5 treatment AND/OR one or more previous hospitalisations for asthma, who had failed to attend 2 or more routine asthma clinic appointments in close succession AND/OR were judged to be poorly adherent with other aspects of recommended management (e.g. poorly compliant with medication, not monitoring asthma as agreed). **Exclusions:** None stated. **Rationale for targetting:** Adverse psychosocial factors, including poor adherence, particularly in combination with severe asthma put patients at high risk of experiencing fatal and near-fatal attacks and hospitalisations for asthma.	**Setting:** Home **Provider(s):** 1 Respiratory Nurse Specialist with supervision from a Health Psychologist & GP Liaison Psychiatrist **Format:** Individual **Structure:** 4 visits of around 1-hour provided fortnightly for 2 months with phone calls between visits followed by monthly phone calls for 4 months thereafter, making 6 month intervention in total **Timing:** No specific timing to asthma episode **Delivery methods/tools*:** D, S, P, G, R, FT, T, W (Total 8) **Asthma content†:** 14 topics related to asthma in general, management, medication, triggers, clinic attendance **Other content:** Smoking, other health-related behaviours, attitudes/beliefs, other psychological issues, social or family issues, economic issues (topics and issues addressed according to individual needs) **Add-ons:** Medical treatment (liaison with medical services, additional testing and recommendations for adjustment of medication where necessary), Exercise (provision of programme as required on an individual basis), Referral (to medical, psychological and social services as necessary)	and secondary health services according to local arrangements, generally comprising scheduled reviews at hospital and/or general practice-based asthma clinics every 3-6 months, and use of emergency and inpatient services as needed.
Yoon et al 1993[43]	Australia Secondary care	**Targetting:** Likely **Inclusion criteria:** Patients aged 16-65 years with a diagnosis confirmed by history and reversibility of airflow obstruction who were hospitalised with a severe exacerbation, able to attend the education centre and literate in English**.** **Exclusions:** Signs of irreversible airways obstruction e.g. due to smoking; significant concurrent disease. **Rationale for targetting:** No explicit discussion of at-risk status.	**Type:** Self-management **Description:** Education programme including self-management **Setting:** Outpatient **Provider(s):** Not stated **Format:** Medium group (5-15) **Structure:** 1 x 2.5-3 hour session **Timing:** Following hospital admission, no details on exact timing **Delivery methods/tools*:** L, D, S, W, V (Total 5) **Asthma content†:** 11 topics related to asthma in general, management, medication, triggers **Other content:** Social or family issues (encouraged to involve spouses or other key people) **Add-ons:** None	Usual care comprising waiting list control with 88% of all patients receiving specialist follow up care and most receiving some education including instruction in medication by clinical pharmacist before discharge, instruction in use of peak flow meter and chart for recording

***Delivery methods/tools:** L = Lecture/didactic teaching, D = Discussion, S = Skills training, P = Problem-solving, G = Goal-setting, R = Role play, FT = Formal therapeutic techniques (e.g. cognitive-behavioural therapy), T = Telephone, W = Written information, V = Video, A = Audio.

†Asthma-specific topics assessed: Asthma general (e.g. causes, pathophysiology); Asthma management (symptom recognition, self-management principles, attack management, symptom monitoring, peak expiratory flow meter use/monitoring, action plan); Medications (general, inhaler use, compliance, side effects); Triggers (general, avoidance); clinic attendance.

Table 2 Methodological quality characteristics, follow ups reported, outcomes assessed and summary findings in individual studies

Study	Design	Methodological details & quality assessment				Follow-ups†	Outcomes assessed‡ and summary findings (including relative risks (RR) and standardised mean differences (SMD), 95% confidence intervals where able to be calculated)
		Randomisation/ selection of controls*	Outcome assessment*	Sample & attrition*	Analysis & reporting*		
Blixen et al 2001[27]	RCT	A) Not stated B) No C) N/A	D) Yes E) No F) Yes - 6 mths pre-specified	G) 28 H) Yes I) Yes J) 70% K) No L) Yes - minor differences M) 43% N) No	O) Yes P) No Q) Yes	ST (3 mths) MT (6 mths)	**Ad, A&E:** comments on non-sig. ST and MT effects but no data presented **Sym:** not reported **HS:** SMDs (0.11, -0.74 to 0.97; 0.10, -0.99 to 1.19) calculated from mean overall asthma-specific quality of life scores suggest non-sig. ST and MT effects (p=0.8, p=0.86 respectively); no data presented from generic scale **Psy:** SMDs (-0.01, -0.86 to 0.85; 0.22, -0.87 to 1.32) calculated from mean depression scores suggest non-sig. ST and MT effects (p=0.99, p=0.69 respectively) **SA:** comments on non-sig. ST and MT effects but no data presented **SM:** comments on non-sig. ST and MT effects across variety of areas related to adherence, use of action plan, monitoring, attendance but no data presented
Brewin & Hughes 1995[28]	CPOS	Concurrent comparison group selected from patients admitted to other hospitals in district	D) Yes E) No F) Yes - one only	G) 45 H) Yes I) No J) 100% K) N/A L) No M) 70% N) No	O) No P) No Q) No	ST (3-5 mths)	**Sym:** comments on non-sig. effects on scores from composite symptom measure presented in various ways (no p values reported) **TL:** non-sig. effects on % having time off (no p value reported) **Kn:** perceived knowledge scores sig. higher in control (p<0.000001) and actual knowledge scores sig. higher in intervention group (p=0.000029)

Study	Design	Methodological details & quality assessment				Follow-ups†	Outcomes assessed‡ and summary findings (including relative risks (RR) and standardised mean differences (SMD), 95% confidence intervals where able to be calculated)
		Randomisation/ selection of controls*	**Outcome assessment***	**Sample & attrition***	**Analysis & reporting***		
Castro et al 2003[29]	RCT	A) Not stated B) Yes C) Sealed envelopes	D) No E) Yes - admissions pre-specified F) Yes - 12 mths pre-specified	G) 96 H) Yes I) No J) 100% K) N/A L) Yes - minor differences M) 69% N) No	O) Yes P) Yes Q) Yes	MT (6 mths) LT (12 mths)	**Ad:** sig. LT effects on total numbers (p=0.04) and hospital days due to asthma (p=0.04), overall numbers (p=0.04) and hospital days from any cause (p=0.04), and on multiple readmissions (p=0.03) **A&E:** non-sig. LT effects on total numbers (p=0.52) **HS:** SMD (0.07, -0.41 to 0.55) calculated from mean overall asthma-specific quality of life scores suggests non-sig. MT effects (p=0.77); also reports non-sig. MT effects on mean subscale scores (all p>0.49) **SA:** non-sig. LT effects on total numbers of healthcare provider visits (p=0.82)
Ford et al 1997[30]	RCT	A) Not stated B) No C) N/A	D) Yes E) Yes – A&E visits pre-specified F) Yes – 12 mths in results	G) 163 H) Yes I) Yes J) 42% K) Yes - similar L) Yes - similar M) 100% N) No	O) Yes P) Yes Q) Yes	ST (4 mths) MT (8 mths) LT (12 mths)	**Ad, OU, SA, Ex:** Not reported for subgroup of interest **A&E:** sig. LT effects on monthly average attendance in total sample (p<0.0005) with no differential effect in the ethnic minority (p=0.6) subgroup of interest, but effects primarily seen during initial 4 months (p=0.003) rather than last 4 months (p=0.42) **HS:** sig. LT effects on monthly average number of limited activity days in total sample (p=0.04) with no differential effect in the ethnic minority (p=0.43) subgroup of interest, but effects primarily seen in initial 4 months (p=0.03) rather than last 4 months (p=0.65) **Kn, Bel**: effects on overall sample not formally assessed but reported that no differential effects by race (p=0.51 for interaction)

Study	Design	Methodological details & quality assessment				Follow-ups†	Outcomes assessed‡ and summary findings (including relative risks (RR) and standardised mean differences (SMD), 95% confidence intervals where able to be calculated)
		Randomisation/ selection of controls*	**Outcome assessment***	**Sample & attrition***	**Analysis & reporting***		
Garrett et al 1994[31]	RCT	A) Not stated B) No C) N/A	D) Yes E) No F) Yes - one only	G) 500 H) Yes I) Yes J) 51% K) Yes - non-participants younger, admission rates similar L) Yes - similar M) >90% N) Yes – similar	O) Yes P) Yes - for some outcomes Q) No	MT (9 mths)	**Ad**: RR (0.79, 0.45 to 1.39, p=0.42) calculated from % of total sample admitted suggests non-sig. effects favouring intervention **AE**: RR (1.03, 0.80 to 1.32, p=0.83), calculated from % of total sample attending suggests non-sig. effects **Sym:** sig. effects on % total sample waking at night (p=0.02), coughing (p=0.05) and experiencing breathlessness (p=0.05); comments on non-sig. effects on other symptom measures but no data reported **HS**: comments on non-sig. effects but no data reported **OU**: RR (0.78, 0.53 to 1.14) calculated from % adults attending for urgent GP care suggests non-sig. effects favouring intervention **Psy:** non-sig. effects on % adults with anxiety/panic at time of attack (p=0.25) **Med:** sig. effects on use of preventive medication in adults (p<0.0005) but data on this and other aspects of medication use not reported **SA**: comments on non-sig. effects but no data reported **RF**: non-sig. effects on % total sample in different categories of peak flow variability (p=0.08) **Sev**: sig. effects on % total sample reporting perceived improvement in severity (p=0.0005) **TL**: non-sig. effects on % total sample with days absent (p=0.3) **SM**: sig. effects on % adults with an action plan (p<0.01), having and using peak flow meter correctly (p<0.005) and adequately managing slow (p<0.005) and fast-onset (p<0.01) attacks; non-sig. effects on inhaler technique (p>0.01); comments on non-sig. effects on smoking and adherence but no data reported **SS**: sig. effects on % adults having someone to help with an asthma attacks (p<0.05)

Study	Design	Methodological details & quality assessment				Follow-ups†	Outcomes assessed‡ and summary findings (including relative risks (RR) and standardised mean differences (SMD), 95% confidence intervals where able to be calculated)
		Randomisation/ selection of controls*	**Outcome assessment***	**Sample & attrition***	**Analysis & reporting***		
George et al 1999[32]	RCT	A) Random number table B) No C) N/A	D) No E) No F) Yes - one only for main outcomes	G) 77 H) Yes I) No J) 88% K) No L) Yes - similar M) 65% N) No	O) Yes P) Yes - f or some outcomes Q) No	ST (1 mth) MT (6 mths)	**Ad:** sig. MT effects on total number (p=0.04) but non-sig. effects on mean length of stay (p=0.12) **A&E:** sig. MT effects on total number (p=0.04) **SA:** sig. ST effects on attendance at outpatient appointments (p=0.01)
Groen & Pelser 1960[33]	CROS	Retrospective identification of groups receiving different treatments at same centre	D) No E) Yes - severity only F) Yes - one only	G) 162 H) Yes I) No J) 100% K) N/A L) Yes - age differences adjusted for M) 91% N) No	O) Yes P) N/A Q) Yes	LT (1+ yr)	**D:** sig. effect on number dead (p=0.0004) but sig. lost when adjusted for age (p=0.14) **Sev:** sig. effect on number improved (p=0.0004), maintained after adjustment for age (p=0.00005)
Kelso et al 1995[34]	CPOS	Control group meeting same criteria and treated at same time, retrospectively identified from other hospitals in area serving similar population (low-income, African-Americans)	D) No E) No F) Yes - one only	G) 52 H) Yes I) No J) Not stated K) No L) Yes - differences in age & adult-onset asthma adjusted for M) Not stated N) No	O) No P) No - but actually done Q) Yes	LT (12 mths)	**Ad:** non-sig. effects on average number of admissions (p=0.37) **A&E:** sig. effects on average number of attendances (p<0.01) **Med, SM, Kn:** reported for intervention group only
Kelso et al 1996[35]	CPOS	Control group retrospectively identified via chart review	D) No E) No F) No	G) 39 H) Yes I) No J) Not stated K) No L) Yes - similar M) Not stated N) No	O) Yes P) No Q) Yes	LT (1 yr & 2 yrs)	**Ad:** sig. effects on mean number of admissions (p<0.05 at 1 and 2 years) **A&E:** sig. effects on mean number of attendances (p<0.05 at 1 and 2 years) **HS, Med, Kn:** reported for intervention group only **Sym:** No outcome data reported **D:** 1 in intervention group **ITU:** 1 in intervention (later died), 2 in control group

Study	Design	Methodological details & quality assessment				Follow-ups†	Outcomes assessed‡ and summary findings (including relative risks (RR) and standardised mean differences (SMD), 95% confidence intervals where able to be calculated)
		Randomisation/ selection of controls*	**Outcome assessment***	**Sample & attrition***	**Analysis & reporting***		
Mayo et al 1990[36]	RCT	A) Patient record number B) No C) N/A	D) No E) Yes - admissions in results F) Yes - one only	G) 104 H) Yes I) No J) 100% K) N/A L) Yes - similar M) 100% N) No	O) Yes P) No - but actually done Q) No	MT (max. 8 mths)	**Ad:** sig. effects on number ($p<0.004$) and days per patient ($p<0.02$) **Med:** reported for intervention group only **D:** 1 death in control group
Morice & Wrench 2001[37]	RCT	A) Not stated B) No C) N/A	D) No E) No F) No	G) 80 H) Yes I) No J) Not stated K) No L) Yes - minor differences M) 75% N) No	O) Yes P) No - but actually done for some outcomes Q) No	ST (6 wks) MT (6 mths) LT (18 mths)	**Ad:** RR (0.91, 0.44 to 1.90, $p=0.80$) calculated from number of patients admitted suggested non-sig. LT effects favouring intervention **A&E:** RR (5.00, 0.25 to 100.97, $p=0.29$) calculated from number of patients attending suggests non-sig. LT effects favouring control **OU:** RR (0.93, 0.50 to 1.72) calculated from number of patients having urgent GP visits/call-outs suggests non-sig. MT effects favouring intervention **Med:** sig. MT effects on beta-agonist use ($p<0.01$) (selective reporting) **SM:** sig. ST and MT effects on % with written management plan ($p<0.001$, $p<0.001$), sig. ST effects on use of peak flow meter ($p<0.005$) and knowledge of peak flow ($p<0.01$), sig. MT effects on % performing various appropriate actions ($p<0.01$) (but data on these not formally reported)
Nathell 2005[38]	RCT	A) Computerised list B) Yes C) Conducted by independent researcher	D) No E) Yes – sick leave pre-specified F) No	G) 197 H) Yes I) No J) 83% K) Yes - similar L) Yes - similar M) 89% N) No	O) Yes P) Yes Q) Yes	LT (1, 2 & 3 yrs)	**TL:** non-sig. effects on overall median sick leave days at 1 ($p=0.47$), 2 ($p=0.18$) and 3 years ($p=0.12$), but sig. effects at 3 years on subgroup with previous physician diagnosis of asthma and non-smokers (both $p=0.02$) **Med:** sig. effects on % using of inhaled steroids at 1 ($p=0.03$) but not 2 ($p=0.13$) or 3 years ($p=0.88$) **SM:** non-sig. effects on % smoking at 1 ($p=0.45$), 2 ($p=0.87$) or 3 years ($p=0.88$)

Study	Design	Methodological details & quality assessment				Follow-ups†	Outcomes assessed‡ and summary findings (including relative risks (RR) and standardised mean differences (SMD), 95% confidence intervals where able to be calculated)
		Randomisation/ selection of controls*	**Outcome assessment***	**Sample & attrition***	**Analysis & reporting***		
Osman et al 2002[39]	RCT	A) Random number table B) Yes C) Serially numbered envelopes	D) Yes E) Yes - admissions pre-specified F) Yes – 12 mths pre-specified	G) 280 H) Yes I) Yes J) 60% K) No L) Yes - differences in gender adjusted for M) 95% N) No	O) Yes P) No Q) Yes	ST (1 mth) LT (12 mths)	**Ad:** RRs calculated from number of patients admitted suggests non-sig. ST effect favouring intervention (0.27, 0.03 to 2.41, p=0.24), sig. LT effect favouring intervention (0.62, 0.39 to 0.99, p=0.04) which non-sig. when analysis confined to subgroup with previous admissions (0.88, 0.54 to 1.44, p=0.62) **Sym:** sig. ST effects on % experiencing day and night-time symptoms (both p=0.01), non-sig. effects on % experiencing restrictions to activity (p=0.12), but non-sig. effects when analysis confined to subgroup with previous admissions (p=0.70, 0.33, 0.17 respectively) **Sat:** sig. ST effects on % in total sample and subgroup with previous admissions satisfied with care (p<0.001)
Put et al 2003[40]	RCT	A) Drawing envelope B) Yes C) Sealed, non-transparent envelopes	D) Yes E) No F) No	G) 25 H) No I) No J) 51% K) No L) Yes – controls prescribed more anticholinergics, otherwise similar M) 39% N) No	O) Yes P) No Q) Yes	ST (1. post-treatment (actual timepoint not stated) for intervention & 3 mths for control. 2. 3 mths for intervention & 6 mths for control)	**Sym:** sig. effects on mean obstruction (p=0.04), fatigue (p=0.001) and irritation (p=0.03) but not dyspnoea, hyperventilation or anxiety subscale scores (p values for latter not reported) **RF:** sig. effects on mean day (p=0.03) and night-time (p=0.04) peak flow rates **HS:** SMD (1.18, 0.28 to 2.08) calculated from mean overall asthma-specific quality of life scores suggests sig. effect (p=0.01); also reports sig. effects on mean activity limitation (p<0.0001), symptom (p<0.0001) and emotion (p=0.003) (p<0.0001), but not environment subscale scores (p value not reported) **Psy:** SMD (-1.23, -2.14 to -0.32) calculated from mean negative emotionality scores suggests sig. effect (p=0.008) **SM:** sig. effects on mean adherence scores (p=0.002) **SE, Bel, Kn:** sig. effects on mean self-efficacy (p=0.008), attitude (p<0.0001) and knowledge (p<0.0001) subscale scores of asthma-specific questionnaire

Study	Design	Methodological details & quality assessment				Follow-ups†	Outcomes assessed‡ and summary findings (including relative risks (RR) and standardised mean differences (SMD), 95% confidence intervals where able to be calculated)
		Randomisation/ selection of controls*	**Outcome assessment***	**Sample & attrition***	**Analysis & reporting***		
Ross et al 2005[41]	RCT	A) Not stated B) No C) N/A	D) No E) No F) No	G) 34 H) Yes I) No J) 71% K) Yes - similar L) Yes – intervention group more severe asthma, otherwise similar M) 74% N) Yes – similar	O) Yes P) No Q) Yes	ST (8 wks), MT (6 mths for intervention only)	**Psy:** SMD (-0.52, -1.36 to 0.32) calculated from mean depressive symptoms scores suggests non-sig. effect favouring intervention (p=0.23); also reports sig. ST effects on total number of panic attacks (p=0.03), mean total scores on scales assessing intensity of anxiety symptoms (p<0.01) and fear of anxiety-related bodily sensations (p<0.01) which remained apparent to 6 months, but non-sig. ST effects on mean scores of agrophobic avoidance (p=0.2) **RF:** sig. ST effects on mean morning peak flow rate (p<0.05) but non-sig. effects on peak flow variability (p=0.14) **Sym:** SMD (-0.19, -1.07 to 0.69) calculated from mean days with symptoms suggests non-sig. ST effect favouring intervention (p=0.68). **HS:** SMD (0.67, -0.18 to 1.53) calculated from mean overall asthma-specific quality of life scores suggests non-sig. ST effect favouring intervention (p=0.12).

Study	Design	Methodological details & quality assessment				Follow-ups†	Outcomes assessed‡ and summary findings (including relative risks (RR) and standardised mean differences (SMD), 95% confidence intervals where able to be calculated)
		Randomisation/ selection of controls*	**Outcome assessment***	**Sample & attrition***	**Analysis & reporting***		
Smith et al 2005[42]	RCT	A) Computer generated list B) No C) N/A	D) No E) Yes - symptoms pre-specified F) Yes – 6 mths pre-specified	G) 92 H) Yes I) Yes J) 51% K) Yes - non-participants more likely male and non-attenders at clinic L) Yes - differences in gender & education adjusted for M) 83% N) Yes – similar	O) Yes P) Yes Q) Yes	ST (2 mths) MT (6 mths) LT (12 mths)	**Ad:** RRs calculated from number of patients admitted suggests non-sig. MT (1.55, 0.72 to 3.32, p=0.26) and LT effects (1.26, 0.67 to 2.37, p=0.48) favouring control (additional data provided by authors) **A&E:** RRs calculated from number of patients attending suggests non-sig. MT (1.59, 0.64 to 3.95, p=0.32) and LT effects (1.16, 0.65 to 2.15, p=0.62) favouring control (additional data provided by authors) **Med:** sig. ST effects on beta-agonist use (p=0.04), not maintained in MT (p=0.2) **Sym:** SMD calculated from mean scores on composite symptom scale suggest non-sig. ST effects favouring intervention (-0.22, -0.65 to 0.21, p=0.31) and non-sig. MT (0.06, -0.36 to 0.49, p=0.77) and LT effects (-0.04, -0.46 to 0.39, p=0.87). **HS:** sig. ST (p=0.01), MT (p=0.01) and LT effects (p=0.03) on mean asthma-specific quality of life scores seen only from fully adjusted analyses, otherwise non-sig. effects (all p>0.56); non-sig. ST (p=0.78, p=0.60), MT (p=0.67, p=0.94) and LT effects (p=0.80, p=0.56) respectively on mean physical function and mental health subscale scores from generic questionnaire **Psy:** SMDs (0.10, -0.33 to 0.53; 0.27, -0.16 to 0.70; 0.02, -0.41 to 0.44) calculated from mean depression scores suggest non-sig. ST, MT and LT effects (p=0.66; p=0.22; p=0.94 respectively); also reports no clear effects on mean anxiety or general psychological morbidity scores, formal analyses not undertaken **SM :** no clear ST, MT or LT effects on mean adherence scores, % smoking or identifying additional triggers, formal analyses not undertaken **SE:** no clear ST, MT or LT effects on mean perceived control of asthma scores, formal analyses not undertaken

Study	Design	Methodological details & quality assessment				Follow-ups†	Outcomes assessed‡ and summary findings (including relative risks (RR) and standardised mean differences (SMD), 95% confidence intervals where able to be calculated)
		Randomisation/ selection of controls*	Outcome assessment*	Sample & attrition*	Analysis & reporting*		
Yoon et al 1993[43]	RCT	A) Not stated B) No C) N/A	D) Yes E) No F) Yes - 10 months in results	G) 76 H) Yes I) No J) 41% K) Yes - women, non-smokers, those with physician more likely to participate L) Yes - similar M) 74% N) No	O) Yes P) No Q) Yes	ST (5 mths) MT (10 mths)	**Ad:** RR (0.15, 0.02 to 1.17, p=0.07) calculated from number of patients admitted suggests non-sig. MT effect favouring intervention **A&E:** RR (0.45, 0.13 to 1.62, p=0.22) calculated from number of patients admitted suggests non-sig. MT effects favouring intervention **RF:** sig. effects on prevention of declines in mean FEV_1 and FVC in ST (p=0.01, p<0.05 respectively) but not MT (no p values reported); comments on little effect on mean peak flow variability (no p values reported) **Sev:** non-sig. MT effects on mean perceived severity scores (p=0.85) **Sym:** SMD (-0.10, -0.62 to 0.42, p=0.71) calculated from mean scores on composite symptom scale suggest non-sig. MT effects favouring intervention **TL:** non-sig. MT effects on % absent for >2 weeks (p value not reported) **Psy:** SMD (0.01, -0.51 to 0.53) calculated from mean scores for psychosocial disturbance due to asthma suggests non-sig. MT effects (p=0.97) **SM:** sig. MT effects on mean scores for use of an action plan (p<0.001) and differentiation of mild from severe attacks (p=0.005) **Kn:** sig. MT effects on mean scores for knowledge of asthma (p<0.07) and medications (p<0.05) **Bel:** sig. MT effects on mean scores for appropriate health beliefs (p<0.001)

***Methodological details and quality criteria assessed:** A) Randomisation method, B) Concealed allocation?, C) Concealment method, D) Blinded outcome assessment? E) Single primary outcome specified/reported? F) Single primary endpoint specified? G) Total sample size, H) Clear selection criteria?, I) Power calculation?, J) Participation rate, K) Comparability of non-participants checked?, L) Baseline comparability of groups checked?, M) Minimum follow-up, N) Comparability of withdrawals checked? O) Provided details of analysis? P) Specified ITT analysis? Q) Adequate outcome reporting (numerator and denominator for binary outcomes, point estimates plus measures of variability for continuous data)?

†Follow-up: This was standardised, as far as possible, to represent follow up from the start of the intervention or baseline assessment (assumed to be close together) and taken as the average duration or mid-point of a range where length of follow up varied across individual patients within studies, and was categorised into short-term (ST) = 0 to <6 months; medium-term (MT) = 6 to <12 months; and long-term (LT) = 12+ months

‡Outcome categories: Ad = hospital admissions/re-admissions, A&E = A&E/ED attendances, OU = Other unscheduled healthcare attendances, SA = scheduled healthcare attendances, Med = medication use, Ex = exacerbations, TL = time lost from work, Sym = symptoms/asthma control, Sev = severity, RF = respiratory function, HS = health status/quality of life, Psy = psychological morbidity, SM = self-management behaviour, SE = self-efficacy/perceived control, Bel = beliefs/attitudes, Kn = knowledge, SS = social support

Table 3 Numbers of studies assessing and reporting adequate data for different categories of outcomes and syntheses of findings from these in short- (ST), medium- (MT) and long-term (LT) (where 0 = non-significant effects; + = significant effects of psycho-educational intervention compared to usual care)

Type of outcome	Number of studies reporting assessment of outcome		Number of studies not reporting comparative numerical data for outcome		Number of and findings from studies reporting adequate comparative numerical outcome data from which meaningful summary statistics for meta-analysis could not be calculated		Number of and findings from RCTs reporting data suitable for inclusion in meta-analyses	Summary findings, including pooled estimates (RR/SMD, 95% confidence intervals) from meta-analyses and any subgroup and sensitivity analyses where able to be undertaken
	COSs	**RCTs**	**COSs**	**RCTs**	**COSs**	**RCTs**	**RCTs**	
Admission/re-admission	2	10	0	2[27,30]	2 **LT:** **0**,+[34,35]	3 **MT:** +,+[32,36] **LT:** +[29]	5 **ST:** **0**[39] **MT:** **0,0,0**[31,42,43] **LT:** **0,0,**+[37,42,39]	**ST:** Only one study examining effects. **MT:** 5 individual studies show conflicting findings, pooled estimate across 3 studies (RR=0.83, 0.35 to 1.94) suggests a small and non-sig. effect (p=0.67). **LT:** 6 individual studies show conflicting findings with only clearly sig. effects from an RCT confined to single study of a multi-faceted intervention. Pooled estimate across 3 studies (RR=0.85, 0.55 to 1.32,) suggests a small and non-sig. effect (p=0.47), which eliminated when data from a higher risk subgroup in one study were used in analysis (RR=0.99, 0.70 to 1.39, p=0.94). **Overall** (min. follow up = 6 months): 10 individual studies show conflicting findings. Pooled estimate across 5 studies (RR=0.79, 0.55 to 1.14) suggests a small and non-sig. effect (p=0.21) (Figure 2). However this was of borderline significance when a fixed effects model (RR=0.75, 0.56 to 0.99, p=0.04) or odds-ratio statistic was used (OR=0.70, 0.49 to 0.99, p=0.04). Pooled estimate (RR=0.70, 0.50 to 0.97) from subgroup analysis in which 4 studies with likely targetting were considered separately from only study with definite targetting showed sig. effect (p=0.03). Subgroup analysis of higher risk patients in one individual study and this sensitivity analysis suggest that any positive effects on admissions in those with severe asthma may not extend to patients with multiple risk factors.

Type of outcome	Number of studies reporting assessment of outcome		Number of studies not reporting comparative numerical data for outcome		Number of and findings from studies reporting adequate comparative numerical outcome data from which meaningful summary statistics for meta-analysis could not be calculated		Number of and findings from RCTs reporting data suitable for inclusion in meta-analyses	Summary findings, including pooled estimates (RR/SMD, 95% confidence intervals) from meta-analyses and any subgroup and sensitivity analyses where able to be undertaken
	COSs	RCTs	COSs	RCTs	COSs	RCTs	RCTs	
A&E/ED attendance	2	8	0	1[27]	2 **LT:** **+,+**[34,35]	3 **MT:** **+**[32] **LT:** **0,+**[29,30]	4 **MT:** **0,0,0**[31,42,43] **LT:** **0,0**[37,42]	**ST:** No data. **MT:** Data from 4 individual studies and pooled estimate across 3 studies (RR=1.03, CI=0.69-1.51, p=0.9) suggest a lack of positive effects. **LT:** 6 individual studies show conflicting findings, pooled estimate across 2 studies (RR=1.22, 0.69 to 2.15) suggests a small and non-sig. effect (p=0.50) favouring usual care. **Overall** (min. follow up = 6 months): 9 individual studies show conflicting findings, pooled estimate across 4 studies (RR=1.03, 0.82 to 1.29) suggests no overall effect (p=0.8) which was not greatly altered by using a fixed effects method, odds-ratio statistic or a subgroup analysis in the 3 studies with likely targetting.
Symptoms/asthma control	2	7	1[35]]	1[27]	1 **ST:** **0**[28]	3 **ST:** **+,+** (0 for higher risk subgroup[40,39] **MT:** **+**[31]	3 **ST:** **0,0**[41,42] **MT:** **0,0**[42,43] **LT:** **0**[42]	**ST:** 5 individual studies show conflicting findings. Pooled estimate across 2 studies reporting composite symptom scores (SMD=-0.22, -0.60 to 0.17) suggests a small and non-sig. effect (p=0.27). **MT:** 3 individual studies show conflicting findings. Pooled estimate across 2 studies reporting composite symptom scores (SMD=0.00, -0.33 to 0.33) suggests no overall effect (p=0.99). **LT:** Only one study examining effects. **Overall** (min. follow up = 1 month): 7 individual studies show conflicting findings. Pooled estimate across 3 studies reporting composite symptom scores (SMD=-0.08, -0.39 to 0.23) suggests a small and non-sig. effect (p=0.63) which not altered by use of a fixed effects model. Subgroup analysis of higher risk patients in one individual study suggests that any positive effects on symptoms in those with severe asthma may not extend to patients at higher risk.

Type of outcome	Number of studies reporting assessment of outcome		Number of studies not reporting comparative numerical data for outcome		Number of and findings from studies reporting adequate comparative numerical outcome data from which meaningful summary statistics for meta-analysis could not be calculated		Number of and findings from RCTs reporting data suitable for inclusion in meta-analyses	Summary findings, including pooled estimates (RR/SMD, 95% confidence intervals) from meta-analyses and any subgroup and sensitivity analyses where able to be undertaken
	COSs	RCTs	COSs	RCTs	COSs	RCTs	RCTs	
Health status/quality of life	1	7	1[35]	1[31]	0	2 **ST:** **0**[42] **MT:** **0**[42] **LT:** **0,+**[42,30]	4 **ST:** **0**,**0**,+[27,41,40] **MT:** **0**,**0**[27,29]	**ST:** 4 individual studies mainly show a lack of positive effects, pooled estimate across 3 studies reporting overall scores on asthma-specific quality of life scale (SMD=0.64, 0.05 to 1.24,) suggests a sig. effect (p=0.03). **MT:** 3 individual studies show a lack of positive effects, pooled estimate across 2 studies reporting overall scores on asthma-specific quality of life scale (SMD=0.08, -0.37 to 0.52) suggests a small and non-sig. effect (p=0.74). **LT:** 2 individual studies show conflicting findings. **Overall** (min. follow up = 8 wks): 6 individual studies show mainly non-sig. effects, with clear positive effects seen only in studies of 2 psychosocial interventions in short-term. Pooled estimate across 4 studies reporting overall scores on asthma-specific quality of life scale (SMD=0.45, -0.07 to 0.98) suggests a small and non-sig. effect (p=0.09) (Figure 3), which was of borderline sig. when a fixed effects model was used (SMD=0.36, 0.00 to 0.72, p=0.05). When studies were divided into subgroups according to their degree of targetting, sig. pooled effects across the 2 with likely targetting (SMD=0.91, 0.29 to 1.53, p=0.004) did not extend to the 2 with definite targetting (SMD=0.08, -0.37 to 0.52, p=0.74).
Psychological morbidity	0	6	0	0	0	1 **MT:** **0**[31]	5 **ST:** **0,0,+,+**[27,42,40,41] **MT:** **0,0,+**[27,42,43] **LT:** **0**[42]	**ST:** 4 individual studies show conflicting findings, pooled estimate across 4 studies reporting scores of negative mood (SMD=-0.34, -0.92 to 0.24) suggests a small and non-sig. effect (p=0.25). **MT:** 4 individual studies mainly suggest a lack of positive effects, pooled estimate across 3 studies reporting scores of negative mood (SMD=0.17, -0.15 to 0.49) suggests a small and non-sig. effect (p=0.30)

Type of outcome	Number of studies reporting assessment of outcome		Number of studies not reporting comparative numerical data for outcome		Number of and findings from studies reporting adequate comparative numerical outcome data from which meaningful summary statistics for meta-analysis could not be calculated		Number of and findings from RCTs reporting data suitable for inclusion in meta-analyses	Summary findings, including pooled estimates (RR/SMD, 95% confidence intervals) from meta-analyses and any subgroup and sensitivity analyses where able to be undertaken
	COSs	RCTs	COSs	RCTs	COSs	RCTs	RCTs	
								favouring usual care. **LT:** Only one study examining effects. **Overall** (min. follow-up = 8 wks): 6 individual studies mainly suggest a lack of positive effects with clear effects primarily confined to studies of psychosocial interventions in the short-term. Pooled estimate across 5 studies reporting scores for various negative mood states (SMD=-0.23, -0.66 to 0.19) suggests a small and non-sig. effect (p=0.28) (Figure 4), which not greatly altered by use of a fixed effects model. When studies were divided into subgroups according to their degree of targetting, small but non-sig. pooled effects across the 2 with likely targetting (SMD=-0.51, -1.23 to 0.22, p=0.17) did not extend to the 2 with definite targetting (SMD=0.04, -0.36 to 0.44, p=0.83).
Self-management behaviour	1	7	1[34]	1[27]	0	6 **ST:** **+,+,+**[37,40,42] **MT:** **0,+,+,+**[42,31,37,43] **LT:** **0,0**[38,42]	N/A No summary statistics calculated as different aspects assessed and reported in different ways	**Overall** (min. follow up = 3 mths): 6 individual studies showed mainly positive ST and MT effects with respect to various aspects of self-management including use of action plans, use of peak flow meters, recognition and management of attacks. However, 2 studies suggest these may not be maintained in the longer-term and several that effects may not extend to other aspects of self-management (e.g. smoking).
Medication use	2	5	2[34][35]	2[31][36]	0	3 **ST:** **+**[42] **MT:** **0,+** [42,37] **LT:** **0,+**	N/A No summary statistics calculated as different aspects assessed and reported in different ways	**Overall** (min. follow up = 6 mths): 3 individual studies showed mainly positive effects, 2 with respect to reductions in beta-agonist use and 1 with respect to proportions using preventive medication, although in one effects were confined to the short-term.

Type of outcome	Number of studies reporting assessment of outcome		Number of studies not reporting comparative numerical data for outcome		Number of and findings from studies reporting adequate comparative numerical outcome data from which meaningful summary statistics for meta-analysis could not be calculated		Number of and findings from RCTs reporting data suitable for inclusion in meta-analyses	Summary findings, including pooled estimates (RR/SMD, 95% confidence intervals) from meta-analyses and any subgroup and sensitivity analyses where able to be undertaken
	COSs	RCTs	COSs	RCTs	COSs	RCTs	RCTs	
						[42,38]		
Knowledge	3	4	2[34][35]	1[30]	1 **ST:** +[28]	2 **ST:** +[40] **MT:** +[43]	N/A No summary statistics calculated as different aspects assessed and reported in different ways	**Overall** (min. follow up = 3 mths): 3 individual studies, 2 of self-management and 1 of a psychosocial intervention, all showed positive effects on various combined measures of knowledge in relation to asthma, medications and self-management.
Scheduled health care attendances	0	5	0	3[27,30, 31]	0	1 **ST:** +[32] **LT:** **0**[29]	N/A No summary statistics calculated as both reported in different ways	**Overall** (min. follow up = 1 mth): 2 individual studies showed conflicting findings, with clear positive effects seen only in the short-term following a multi-faceted intervention.
Respiratory function	0	4	0	0	0	4 **ST:** **+,+,+** [40,41,43] **MT:** **0,0**[31,43]	N/A No summary statistics calculated as different aspects assessed and reported in different ways	**Overall** (min. follow up = 8 wks): 3 individual studies showed mainly positive ST effects, 2 of psychosocial interventions with respect to peak flow rates, and 1 of a self-management intervention with respect to FEV_1 and FVC, but data from 2 studies suggest these may not be maintained in the medium-term.
Time lost from work	1	3	0	0	1 **ST:** **0**[28]	3 **MT:** **0,0**[31,43] **LT:** **0** (+ in lower risk subgroup)[38]	N/A No summary statistics calculated as all reported in different ways	**Overall** (min. follow up = 3 mths): 4 individual studies showed non-sig. effects, except when long-term analysis in one study was confined to a lower risk group of non-smokers.

Figure 2 Forest plot showing meta-analysis, divided by asthma subgroups (likely and definite targetting), of relative risks ratios (RR) calculated from proportions of adults admitted for asthma at latest follow up reported by studies

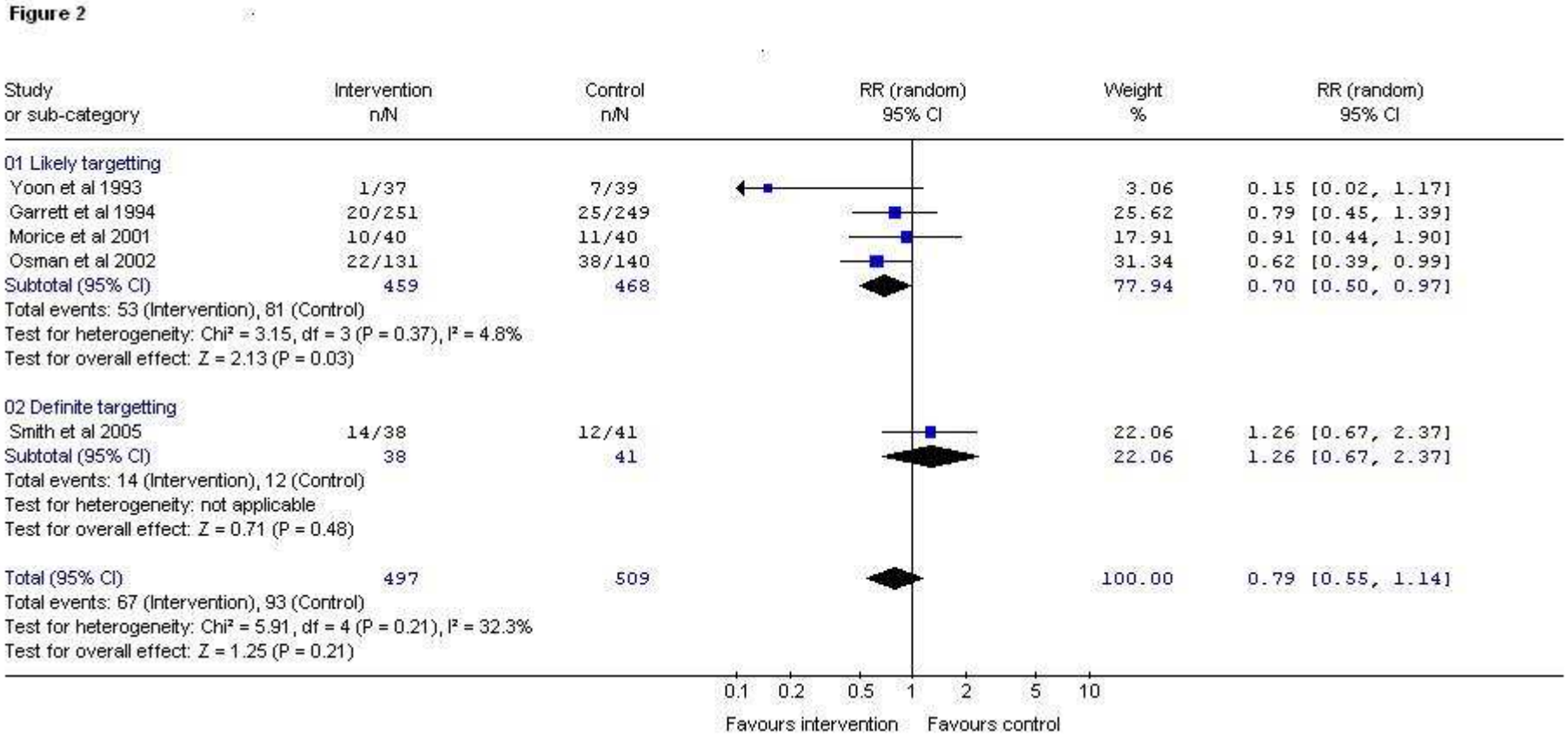


Figure 3 Forest plot showing meta-analysis, divided by asthma subgroups (likely and definite targetting), of standardised mean differences (SMD) calculated from asthma-specific quality of life scores (where higher scores = better quality of life) at latest follow up reported by studies

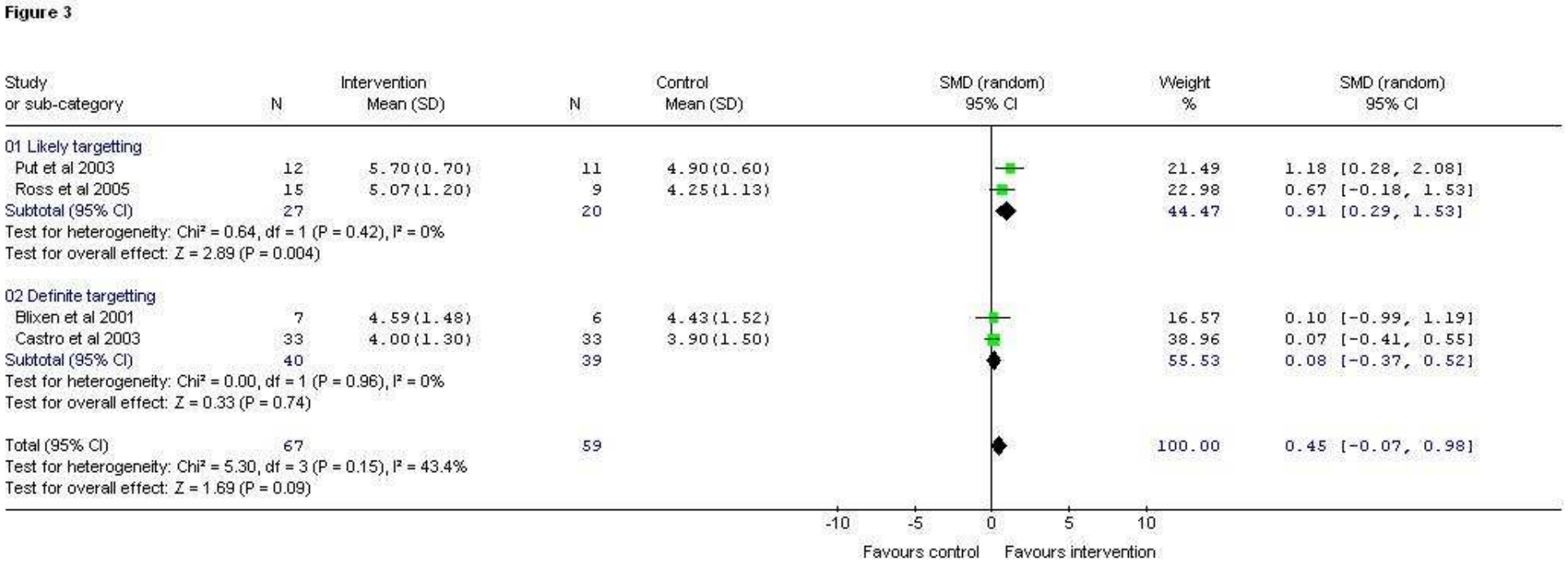


Figure 4 Forest plot showing meta-analysis, divided by asthma subgroups (likely and definite targetting), of standardised mean differences (SMD) calculated from psychological morbidity scores (where higher scores = greater morbidity) at latest follow up reported by studies