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2

3 **Title:** Mixed evidence on the relationship between socioeconomic position and atopic
4 dermatitis: a systematic review

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53 **Capsule summary [Word count: 50 Limit: 50]**

54 • A number of studies and a prior systematic review reported a positive association
55 between atopic dermatitis and socioeconomic position, but the reason for this
56 relationship remains unclear

57 • This updated systematic review found that a majority (58%) of studies did not
58 find a positive association between atopic dermatitis and socioeconomic position

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60 **Key words:** atopic, dermatitis, eczema, socioeconomic position, socioeconomic status

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68 **Abstract**

69 **Background:** Lower socioeconomic position usually portends worse health outcomes,
70 but multiple studies have found that atopic dermatitis is associated with higher
71 socioeconomic position, but the nature of this relationship remains unclear.

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73 **Objective:** To systematically review the literature on socioeconomic position and atopic
74 dermatitis and determine if the association varies by patient or study characteristics.

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76 **Methods:** A literature search was conducted in the PubMed and Embase databases.
77 Individual-level studies addressing the association between all measures of
78 socioeconomic position and the prevalence or incidence of atopic dermatitis were eligible
79 for inclusion. Two independent reviewers screened all texts and extracted all data for
80 qualitative synthesis.

81

82 **Results:** 88 studies met inclusion criteria. Overall, 42% (37/88) of studies found atopic
83 dermatitis to be positively associated with socioeconomic position, 15% (13/88) found a
84 negative association, and 43% (38/88) found a null or inconsistent association. Studies
85 conducted in Europe, among children, and based on self-report of eczema were more
86 likely to find a positive association with socioeconomic position.

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88 **Limitations:** Studies varied both in terms of measurement of socioeconomic position and
89 definition of atopic dermatitis, limiting quantitative synthesis.

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91 **Conclusion:** There is not consistent evidence of a positive association between atopic
92 dermatitis and socioeconomic position.

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106 **Introduction**

107 Atopic dermatitis (also known as atopic eczema, or eczema) is the most common chronic
108 inflammatory skin condition, affecting up to 15-30% of children and 10-15% of adults
109 worldwide, conferring a significant burden of disease (1)(2)(3)(4). Lower socioeconomic
110 position (SEP), based on estimates of income, educational attainment, occupational
111 prestige, or subjective perceptions of social class and social status, is associated with
112 poorer health outcomes for almost every disease studied (5). In contrast, numerous
113 studies suggest that SEP may be positively associated with atopic dermatitis and other
114 atopic diseases, possibly due to differences in the exposure to microorganisms important
115 to immune system development and function (6)(7).

116

117 A 2015 systematic review examining the relationship between SEP and allergic diseases
118 concluded that there was a positive association between SEP and atopic dermatitis, with
119 pooled estimates for the odds ratio of disease for the lowest compared with the highest
120 SEP of 0.72, 95% CI 0.61-0.83 (8). However, results from individual studies varied, with
121 only ten of the nineteen studies on atopic dermatitis finding prevalence to be positively
122 associated with SEP. The review had a broad focus on allergic disease and did not
123 differentiate between participant characteristics or measures of SEP. These factors are
124 important, however, because they could indicate different underlying mechanisms among
125 different patient populations. For example, the relationship between parental educational
126 attainment and childhood atopic dermatitis likely reflects a different set of factors than an
127 individual's own educational attainment and atopic dermatitis during adulthood.

128

129 Multiple studies have found that social and environmental factors are strong predictors of
130 atopic dermatitis, even in comparison to genetic factors (9)(10). A closer inspection of
131 the relationship between SEP and atopic dermatitis is warranted due to the wide spectrum
132 of SEP measures and the heterogenous nature of atopic dermatitis, which varies in
133 severity and chronicity in both children and adults (11). In addition, a re-examination of
134 the relationship is necessitated due to increasing atopic dermatitis research in recent
135 years, with new data highlighting increased prevalence in the adult patient population and
136 in non-Europeans (4)(9).

137

138 Studying the relationship between SEP and atopic dermatitis is important for health
139 policy planning and may help to elucidate a better understanding of the mechanisms
140 driving atopic dermatitis presentation and persistence across the lifespan (5). The
141 objective of this study was to systematically examine the published literature on the
142 association between SEP and atopic dermatitis, and to assess whether the association
143 differs by study characteristics, age category of participants, or the measure of SEP used.

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152 **Methods**

153 We conducted a systematic review in accordance with the PRISMA (Preferred Reporting
154 Items for Systematic Reviews and Meta-Analyses) and MOOSE (Meta-analysis Of
155 Observational Studies in Epidemiology) recommendations (12)(13). The review protocol
156 can be accessed at PROSPERO (www.crd.york.ac.uk/PROSPERO, reference number
157 #161081).

158

159 *Eligibility criteria*

160 Published, full-text studies of individual-level epidemiologic design addressing the
161 association between SEP and the prevalence or incidence of atopic dermatitis were
162 eligible for inclusion, with no restrictions on participant age, sex, or race/ethnicity. Given
163 the nature of the exposure (SEP), all studies were observational. Studies assessing only
164 participants with atopic dermatitis and lacking designated comparison group were
165 excluded. Studies of localized eczema, such as hand eczema, or studies focused on other
166 types of dermatitis, such as seborrheic or contact dermatitis, were not eligible for
167 inclusion.

168

169 *Information sources and search strategy*

170 We searched the literature using the PubMed and Embase databases for articles published
171 through July 4, 2021. The search strategy was developed in collaboration with a medical
172 librarian and included MeSH (Medical Subject Headings) terms for both SEP and atopic
173 dermatitis. The MeSH term “Socioeconomic Factors” includes terms related to education,
174 social class, income, and occupation, as well as terms on family characteristics, social

175 conditions, and social change. Sample search strategies can be found in the supplemental
176 files folder at <https://data.mendeley.com/datasets/syk2bcz8jg/2>.

177

178 We did not restrict the search by language or timeframe. A cross-check through the
179 bibliography of previous reviews was completed to ensure our search strategy included
180 all relevant studies. We used Google Translate to review non-English language texts;
181 none met final eligibility criteria requiring data extraction.

182

183 *Study selection, data extraction, and quality assessment*

184 Titles and abstracts were screened by two co-authors (HB and MB) independently using
185 the web-based systematic review management platform Covidence (14). Full texts of the
186 remaining articles were also assessed for final inclusion in Covidence by two independent
187 reviewers. All conflicts were resolved by a third co-author (KA).

188

189 Extraction of study design, publication date, sample size, study population, measure of
190 SEP, atopic dermatitis diagnosis method, and effect estimates by socioeconomic group
191 was completed by two independent reviewers. Any discrepancies in extracted data were
192 discussed and resolved through group consensus with a third co-author (KA).

193

194 *Synthesis methods*

195 To synthesize the results for the association between SEP and atopic dermatitis, we
196 categorized each study into one of four mutually exclusive categories: atopic dermatitis
197 positively associated with SEP, atopic dermatitis negatively associated with SEP, atopic

198 dermatitis not significantly associated with SEP, or inconclusive results on the
199 association between SEP and atopic dermatitis. Studies categorized as inconclusive
200 reported multiple SEP-atopic dermatitis associations, one for each method of SEP
201 assessment, that were not consistent.

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221 **Results**

222 A total of 519 studies met inclusion criteria after removal of duplicates, 151 passed
223 title/abstract screening, and 88 were included after full text review (Figure 1).

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225 *Overview of included studies*

226 The majority of included studies focused on children (78%, 68/88) (Table 1). Europe and
227 Asia were well-represented (74%, 65/88) while the Americas, Africa and the Middle
228 East, and Oceania were less represented. Out of 22 studies from Asia, 21 were from East
229 Asia (China, Taiwan, Korea, Japan). Only three studies originated from Africa (Nigeria,
230 South Africa). Most studies were relatively large in size, ranging from 105 participants to
231 4,000,739 participants. 29 studies had less than 2500 participants, 30 studies had between
232 2500 and 20000 participants, and 29 studies had more than 20000 participants.

233

234 Most studies were cross-sectional in design (67%, 59/88) and utilized self-reported
235 outcome data (76%, 67/88), predominantly based on the ISAAC (The International Study
236 of Asthma and Allergies in Children) questionnaire (15). SEP was based on self-reported
237 information for all studies, however some studies treated SEP as a continuous variable
238 while others treated it as categorical. For the studies that created SEP categories, many
239 reported binary comparisons, with fewer reporting three, four, or five categories. As
240 shown in Table 3, the most common measures of SEP were income and education. Social
241 class was the next most commonly used SEP proxy variable, with the majority of studies
242 defining it as a measure of occupational skill (16). Eight studies created a composite SEP
243 metric which varied between studies, all of which consisted of some combination of

244 income, education, occupation, and social class. Housing characteristics, which was
245 defined as place of residency (e.g. apartment, house, or shanty) was the least frequently
246 used measure of SEP (n = 3 studies).

247

248 *Association between Socioeconomic Position and Atopic Dermatitis*

249 Study conclusions were inconsistent: 42% (37/88) of studies found atopic dermatitis to be
250 positively associated with SEP, 15% (13/88) found a negative association, and 43%
251 (38/88) found a null or inconclusive association (Table 2). Differences were observed
252 through comparison of studies with varying characteristics: studies of children and those
253 based in Europe were most likely to find positive associations between SEP and atopic
254 dermatitis, while smaller studies and studies using dedicated participant skin
255 examinations or review of participant medical records were more likely to report no
256 association between SEP and atopic dermatitis compared to studies that relied on patient
257 self-reporting of atopic dermatitis.

258

259 The most commonly used measure of SEP for adult studies was income, followed by
260 education (Table 3). Seven out of the nine studies on adults that used income as a
261 measure of SEP found no association with atopic dermatitis or that lower income was
262 associated with higher rates of atopic dermatitis. In contrast, six out of the seven studies
263 on adults that used education as a measure of SEP found a positive association. All four
264 studies involving adults that used class/occupation as a measure of SEP found no
265 association with atopic dermatitis.

266

267 For studies that included children, the most commonly used measure of SEP was parental
268 education, followed by household income and class (Table 3). The educational categories
269 and cut-offs (i.e. graduate/professional school vs high school education) varied by study.
270 The majority of studies using parental education (61%, 27/44) found a positive
271 association between SEP and atopic dermatitis. In contrast, a minority of studies using
272 household income (33%, 13/39) and class (40%, 6/15) found a positive association.

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290 **Discussion**

291 In contrast to prior reports, our systematic review of the literature on SEP and atopic
292 dermatitis found that a minority of studies (42%, 37/88) reported a positive association
293 between high SEP and atopic dermatitis. The majority of studies found either no
294 association between SEP and atopic dermatitis, an inconclusive association between SEP
295 and atopic dermatitis based on multiple measures of SEP used in a study, or atopic
296 dermatitis associated with low SEP. Studies from Europe and studies of children were
297 most common and were more likely to report a positive association as compared to
298 studies among adults and in other geographic settings. Smaller studies were more likely
299 to report no association between SEP and atopic dermatitis, possibly due to lower
300 statistical power.

301

302 A previous systematic review reported a significant positive association between SEP and
303 atopic dermatitis, with pooled crude estimate for the odds ratio of disease for the lowest
304 compared with the highest SEP of 0.72 (95% CI 0.61-0.83) (8). The authors of this study
305 didn't address how differing measures of socioeconomic position or atopic dermatitis
306 were analyzed, which from a methodologic standpoint warrants consideration. Part of the
307 discrepancy in results with our study may be due to our review containing many more
308 studies (n = 88 versus n = 19). The additional studies in our review were published more
309 recently, included more locations outside of Europe, and included more adults.

310

311 The conclusions from individual studies have varied in their explanations for reported
312 associations. Studies finding a positive association between SEP and atopic dermatitis

313 have discussed their results in the context of decreased immune system challenges from
314 early life exposures or increased awareness of disease among higher SEP individuals.
315 Other proposed mechanisms included differential exposure to tobacco smoke, pollutants
316 or toxins.

317

318 Our results challenge prior literature suggesting that atopic dermatitis is a unique
319 exception to the typical association between high SEP and better health outcomes (5)(8),
320 and clinicians should be aware that patients from diverse backgrounds may be at equal
321 risk. The decades-old “hygiene hypothesis” posited that individuals of higher SEP may
322 be less likely to have environmental exposures important for reduction of allergic disease
323 (17). More recent research has highlighted the importance of early life microbial
324 exposures for immune system priming (7)(18). Our findings support the need for
325 additional research on how different measures of SEP relate to microbial exposures,
326 immune tolerance, and subsequent allergic disease over time, and atopic dermatitis
327 provides a useful model for studying these dynamics (19).

328

329 Limitations of our study warrant discussion: the definition of both exposure (SEP) and
330 outcome (atopic dermatitis) varied across studies, precluding quantitative meta-analysis
331 of all studies. Moreover, both were largely self-reported, though most relied on a
332 standardized questionnaire and self-report of atopic dermatitis has been shown to
333 reasonably approximate physician assessment in both children and adults. (20)(21)(22)
334 We focused on disease prevalence but were unable to analyze how SEP might affect
335 disease severity or activity over time because there were not sufficient numbers of studies

336 with consistent measures. Some data suggest that patients with lower SEP may
337 experience more severe disease, therefore this is an important area for future research
338 (11). This review highlights the importance of clear reporting and standardized
339 measurement of SEP and atopic dermatitis. Because atopic dermatitis waxes and wanes
340 over time and affects individuals of all ages, it is important to differentiate between the
341 lifetime prevalence and period prevalence, and for future studies to examine longitudinal
342 trends.

343

344 *Conclusion*

345 Many studies have examined the association between SEP and atopic dermatitis, however
346 there is significant heterogeneity between the measures of SEP and measurement of
347 atopic dermatitis, and clear conclusions on the directionality of association did not
348 emerge. Given that atopic dermatitis affects up to one in five children worldwide, these
349 results highlight the importance of additional research into social influences and
350 disparities on atopic dermatitis disease severity and activity across the lifespan.

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359 **Figure 1: PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-**
360 **Analyses) flowchart**

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382 **Table 1: Characteristics of included studies (total n = 88)**

Study Characteristics	Number of Studies	Percent of Studies
Region		
Africa and the Middle East	12	14%
Asia	22	25%
Europe	43	49%
The Americas	10	11%
Oceania	1	1%
Study Design		
Case-control	7	8%
Cohort	22	25%
Cross-sectional	59	67%
Age Group		
Adults	10	11%
Both	10	11%
Children	68	78%
Method of Atopic Dermatitis Assessment		
Exam	9	10%
Self-report	67	76%
Medical records	12	14%
Study Size		
n < 2500	29	33%
2499 < n < 20000	30	34%
19999 < n	29	33%
Publication Date		
1975-1989	7	8%
1990-1999	8	9%
2000-2009	24	27%
2010-2021	49	56%

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398 **Table 2: SEP-atopic dermatitis associations by study characteristic**

	Positive Association	Negative Association	No Association	Inconclusive Results	Total
	37 (42%)	13 (15%)	23 (26%)	15 (17%)	88
Region					
Africa/Middle East	3 (25%)	2 (17%)	3 (25%)	4 (33%)	12
Asia	10 (45%)	5 (23%)	4 (18%)	3 (14%)	22
Europe	22 (51%)	2 (5%)	14 (32%)	5 (12%)	43
Americas	2 (20%)	4 (40%)	1 (10%)	3 (30%)	10
Oceania	0	0	1 (100%)	0	1
Study Design					
Case-Control	3 (43%)	1 (14%)	2 (29%)	1 (14%)	7
Cohort	9 (41%)	3 (14%)	8 (36%)	2 (9%)	22
Cross-Sectional	25 (43%)	9 (15%)	13 (22%)	12 (20%)	59
Age Group					
Adults	3 (30%)	1 (10%)	3 (30%)	3 (30%)	10
Both	3 (30%)	3 (30%)	3 (30%)	1 (10%)	10
Children	31 (46%)	9 (13%)	17 (25%)	11 (16%)	68
Method of Atopic Dermatitis Assessment					
Exam	2 (22%)	1 (11%)	4 (45%)	2 (22%)	9
Self-Report	31 (46%)	9 (14%)	15 (22%)	12 (18%)	67
Medical Record	4 (33%)	3 (25%)	4 (33%)	1 (9%)	12
Sample Size					
20000+	14 (46%)	6 (19%)	3 (12%)	6 (23%)	29
2500-19999	15 (50%)	2 (7%)	9 (30%)	4 (13%)	30
105-2499	8 (28%)	5 (17%)	11 (38%)	5 (17%)	29
Publication Date					
1975-1989	3 (43%)	0	0	4 (57%)	7
1990-1999	7 (88%)	0	0	1 (12%)	8
2000-2009	11 (46%)	2 (8%)	4 (17%)	7 (29%)	24
2010-2019	16 (33%)	14 (29%)	10 (20%)	9 (18%)	49

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409 **Table 3: Evidence on the associations between SEP and atopic dermatitis by**
 410 **measure of SEP**

Children				
	Positive Association	Negative Association	No association	Total
Measure of SEP				
Class/Occupation	6 (40%)	1 (7%)	8 (53%)	15
Income	13 (33%)	7 (18%)	19 (49%)	39
Family Size	1 (20%)	2 (40%)	2 (40%)	5
Housing Characteristics	1 (50%)	1 (50%)		2
Parental* Education	27 (61%)	3 (7%)	14 (32%)	44
Adults				
	Positive Association	Negative Association	No association	Total
Measure of SEP				
Class/Occupation			4 (100%)	4
Income	2 (23%)	4 (44%)	3 (33%)	9
Family Size	1 (50%)	1 (50%)		2
Housing Characteristics	1 (100%)			1
Participant Education	6 (86%)		1 (14%)	7
Parental* Education			1 (100%)	1**

411 *Maternal or paternal

412 **Study population of university students

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