

The Global Burden of Atopic Dermatitis in Children and Adolescents, and Projections to 2036: Findings from the Global Burden of Disease Study, 1990-2021

Jiahui Qi

Guangdong Medical University

Qian Liu

Guangdong Medical University

Xitong Xu

Guangdong Medical University

Lingyu Liu

Guangdong Medical University

Yihan Wang

Guangdong Medical University

Qianfan Jiang

Guangdong Medical University

Yijin Pan

Guangdong Medical University

Haipeng Wang

Guangdong Medical University

Yiyan Li

Guangdong Medical University

Yuqing He

yuqing.he@gdmu.edu.cn

Guangdong Medical University

Research Article

Keywords: Atopic dermatitis, Children and adolescents, Age-period-cohort model, Global burden of disease

Posted Date: June 14th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10000952/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.
[Read Full License](#)

Additional Declarations: The authors declare no competing interests.

1 **The Global Burden of Atopic Dermatitis in Children and Adolescents, and Projections to**
2 **2036: Findings from the Global Burden of Disease Study, 1990-2021**

3 Jiahui Qi¹, Qian Liu^{1#}, Xitong Xu², Lingyu Liu¹, Yihan Wang¹, Qianfan Jiang¹, Yijin Pan¹,
4 Haipeng Wang¹, Yiyan Li¹, Yuqing He^{1,3*}

5

6 ¹Department of Epidemiology and Medical Statistics, Institute of Medical Systems Biology,
7 Guangdong Medical University, Dongguan, Guangdong, 523808, China.

8 ²School of Nursing, Guangdong Medical University, Dongguan, Guangdong, 523808 China.

9 ³Dongguan Liaobu Hospital, Dongguan, Guangdong, 523400, China.

10 [#]These authors contributed equally to this work and are the co-first authors

11

12 **Corresponding author**

13 Yuqing He, yuqing.he@gdmu.edu.cn.

14 Department of Epidemiology and Medical Statistics, Institute of Medical Systems Biology,
15 Guangdong Medical University, Dongguan, Guangdong, 523808, China.

16

17 **Abstract**

18 **Background:** Atopic Dermatitis (AD) is a chronic inflammatory skin disease that has a long-
19 term negative impact on the health and quality of life of children and adolescents, and this study
20 aims to understand the burden of AD in children and adolescents in different regions of the
21 world over the period 1990-2021.

22 **Methods:** Data related to AD in children and adolescents globally from 1990-2021 were
23 obtained from the Global Burden of Disease (GBD) 2021 and analyzed for trends in age-
24 standardized rates (ASR), stratified by sex, age, and socio-demographic index (SDI). The trends
25 of AD burden were analyzed by Joinpoint regression and the age-period-cohort model, and the
26 Bayesian age-period-cohort (BAPC) model was used to predict the trend from 2022 to 2036.

27 **Results:** Among children and adolescents with AD globally, the burden is concentrated in those
28 under 10 years of age and the High SDI region, with the burden for females being about 21%
29 higher than for males. The rate of decline in AD risk was flat and stable across the periods,
30 whereas the 2017-2021 cohort may have been affected by the COVID-19 pandemic, with an
31 increased relative risk of prevalence. A declining trend in the number of cases is projected over
32 the next 15 years, with a potential impact of COVID-19 on the trend.

33 **Conclusions:** Geographic imbalances in the burden of AD and different disease patterns in
34 different regions of the world over the 1990s require effective prevention. Interventions to
35 protect specific age groups need to be developed, and the potential impact of the COVID-19
36 pandemic on AD needs long-term observation.

37 **Keywords:** Atopic dermatitis; Children and adolescents; Age-period-cohort model; Global
38 burden of disease

Introduction

AD is a chronic inflammatory skin disease caused by a variety of complex factors, such as skin barrier dysfunction, immune dysregulation, and flora disorders. It is characterized by itchy skin and easy to recur, and its pathogenesis is influenced by genetic and environmental factors [1,2]. As a disease of socioeconomic importance, the relapsing course and economic burden of AD reduces the quality of life of patients and their families, the burden of AD cannot be ignored[3–6].

The majority of AD onset begins early in life, with approximately 85% of patients diagnosed at the age of 5 years and the remainder having an adult onset [7,8]. Children and adolescents are at an important stage of growth and education, and the progression of AD can have a long-term negative impact on the quality of life of patients and caregivers at this time [9], such as causing allergies, asthma, and other complications [10], affect the health of children and adolescents through problems such as mental fragility, sleep disorders, anxiety and depression [1], and their guardians are correspondingly burdened with caregiving responsibilities and economic pressures on their lives. In summary, to understand the global burden of AD in children and adolescents, this study limited the age range of the study population to less than 20 years.

For age-specific populations, two GBD 2019 studies have been conducted analyzing global populations <14 years of age as well as children and adolescents in China[11,12], to explore the current status and burden of age-specific patients with AD. Based on the latest data of GBD 2021, there is no systematic study to explore the disease burden of AD on children and adolescents in different regions of the world. In this regard, the present study analyses the trend

of the disease burden of AD in children and adolescents globally and the age-period-cohort effect in the 1990-2021 period and predicts the development trend in the 2022-2036 period, providing new insights into AD prevention and intervention.

Materials and Methods

Data sources

GBD 2021 provides prevalence, incidence, disability-adjusted life years (DALYs), and corresponding numbers for AD by age and sex globally including 7 super-regions, 21 regions, and 204 countries and territories, updated to include the impact of the COVID-19 pandemic through various mechanisms[13–15]. GBD2021 defines AD according to the International Classification of Diseases (ICD), 9th and 10th editions, with codes L20-L20.9 for AD in ICD-10 and 691-691.8 in ICD-9.

Socio-demographic index (SDI)

SDI is an evaluation index calculated based on a combination of per capita lagged distribution income, average years of schooling, and total fertility rate under 25 years of age, and the SDI value ranges from 0 to 1, with higher values indicating higher socio-economic status, and combining the SDI to assess the burden of AD is conducive to research exploring the relationship between the level of regional social development and the burden of disease[16,17].

Joinpoint regression analysis

This study analyzed the global as well as the temporal trend of AD burden in different regions by using Joinpoint software (version 5.1.0.0), average annual percent change (AAPC)

and annual percent change (APC) were used to evaluate the trend of AD burden. APC is calculated as a geometrically weighted average of the annual percentage change values, whereas AAPC is a summary measure of the trend over a pre-specified fixed interval that can describe the average APC over a multi-year period. APC or AAPC and its lower limit of 95% confidence intervals (CI) are greater than zero indicating that the burden is an upward trend within the specified interval, and comparatively, its upper limit is less than zero indicating a downward trend, which, when containing zero, indicates that the trend remains stable[18,19].

Age-period-cohort (APC) model

The APC model is a statistical tool for analyzing the impact of three different factors (age, period, and birth cohort) on a particular outcome or trend[20]. The results of age, period, and cohort effects are obtained through the establishment of the APC model, which allows the observation of disease patterns in different age groups as well as the impact of socio-economic factors on the period or birth cohort, which can help health workers to target prevention and treatment management policies.

Bayesian age-period-cohort (BAPC) model

The study used GBD 2021 data and population projections provided by the Institute for Health Metrics and Evaluation (IHME) to construct a BAPC model to project the burden of disease for 2022-2036 using the “BAPC” R package. The BAPC model, with its comprehensive coverage and ability to capture temporal trends, is widely used in studies involving age, population, and complex cohort effects to predict the burden of disease over time, and the model takes into account the complex interactions of age, period, and birth cohort effects[21].

Statistical analysis

The burden of AD was evaluated in the study by the number of AD incidence and prevalence cases, DALYs, and the respective ASRs in children and adolescents from 1990-2021, which can more accurately describe trends in the burden of disease in the population. ASR was calculated according to public announcements[22–25]. (A: number of age groups, w_i : number of people in the corresponding age group i in the standard population, a_i : age-specific rate for age group i):

$$ASR = \frac{\sum_{i=1}^A a_i w_i}{\sum_{i=1}^A w_i}$$

The 95% uncertainty intervals (UI) are composed of the 2.5th and 97.5th percentiles of the distribution of estimates generated by taking 1000 calculations. Children and adolescents with AD in the study were divided into four age subgroups (<5, 5 to 9, 10 to 14, 15 to 19) and three gender subgroups (both, female and male) to look at the distribution of the burden of disease between different age groups as well as between different gender groups. All graphs were completed by R 4.3.2, and $P < 0.05$ was considered statistically significant.

Results

Global trends in children and adolescents, 1990-2021

Between 1990 and 2021, the prevalence cases of AD in children and adolescents increased globally from 77.16 million to 83.02 million (Additional file 1: Supplementary Table 1), while ASIR and ASPR showed a decreasing trend, with AAPC of -0.33 and -0.26 respectively, ASIR decreased from 169.14 (95% UI: 158.29, 180.72) to 152.47 (95% UI: 142.39, 162.99) and ASPR decreased from 1263.51 (95% UI: 1197.13, 1333.16) to 1164.91 (95% UI: 1105.94, 1229.16). Comparing the burden of AD across gender subgroups, trends for males and females

were consistent with global levels, but ASIR, ASPR, and ASDR were significantly higher for females than for males, about 21% higher than males (Figure 1, Table 1).

Analyzing the burden of AD in the four age subgroups separately, ASIR was significantly higher in children <5 years of age, which showed a decreasing trend from 111.16 (95% *UI*: 103.29, 119.62) to 105.4 (95% *UI*: 97.69, 113.34) (Additional file 1: Supplementary Table 2). The results for ASPR and ASDR showed the burden was mainly concentrated in children <10 years of age, with the highest being 5-9 years of age (Figure 1).

In the regions by SDI quintiles, the global burden of AD for both children and adolescents is concentrated in the High SDI region. The most significant fluctuations in change are in the High-middle SDI region, which shows a downward and upward and then downward trend. In particular, AD affects the High SDI region much more than other areas at all times (Figure 1).

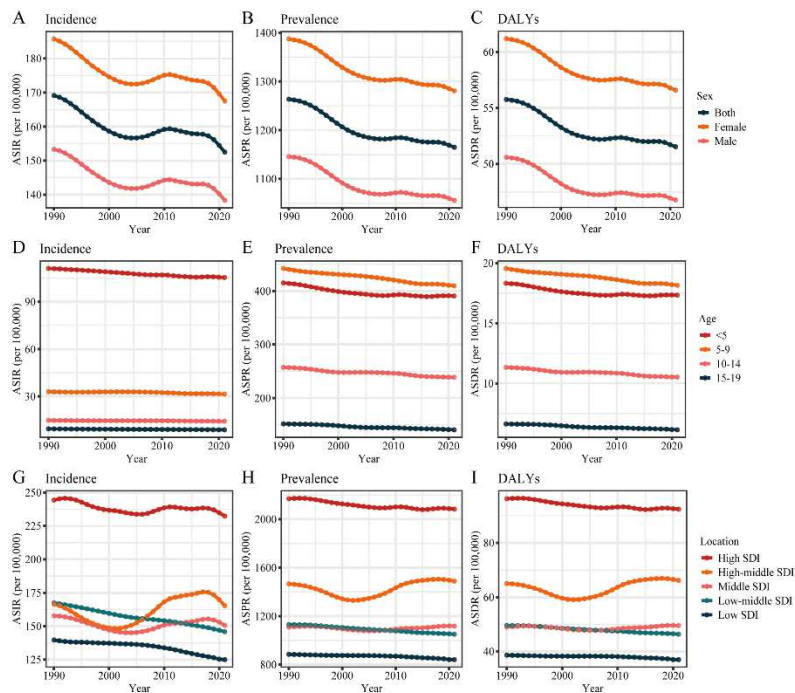


Figure 1. Trends in global and the region by SDI quintiles from 1990 to 2021, in children and adolescents. (A, B, C) Global trends in sex subgroups.(D, E, F) Global trends in four age subgroups.(G, H, I) Trends in the region by SDI quintiles.

Analyzing the distribution of disease burden across 204 countries globally in 2021, the five countries with the highest AD burden are Uzbekistan, Mongolia, Tajikistan, Kazakhstan, and Kyrgyzstan (Figure 2, Additional file 1: Supplementary Table 3), mainly in Central Asia. Central Asia also ranks 1st among the 21 GBD regions (Table 1).

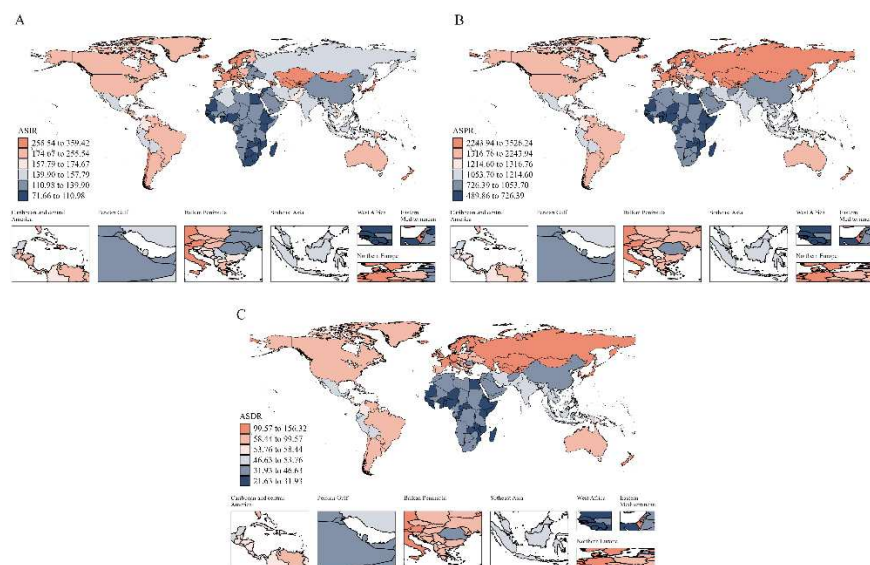


Figure 2. The ASIR, ASPR, and ASDR for children and adolescents in 204 countries in 2021. (A) The ASIR of AD. (B) The ASPR of AD. (C) The ASDR of AD.

Joinpoint regression analysis by regions

Changes in incidence and prevalence in children and adolescents globally and in the regions by SDI quintiles were observed by Joinpoint regression analyses, and the overall trends in ASIR and ASPR were similar in the same regions (Figure 3). The results show an overall decreasing trend in the global change in ASPR from 1990-2021, with only a small peak in 2007-2011 ($APC = 0.09$). The High SDI region shows a fluctuating downward trend, with three peaks in 1990-1993 ($APC = 0.08$), 2007-2011 ($APC = 0.14$), and 2015-2019 ($APC = 0.16$). The High-

middle SDI region as a whole shows an inverted “N” shape, with a minimum in 2000–2003 (APC = -0.32) and a peak in 2012–2017 (APC = 0.43). The trend in the Middle SDI region is similar to that of “M”, with two peaks in 1990–1995 (APC = 0.13) and 2015–2019 (APC = 0.35). The Low-middle and Low SDI regions as a whole show a continuing downward trend (Figure 3). Coincidentally, all regions show a downward trend in ASIR and ASPR from 2019–2021.

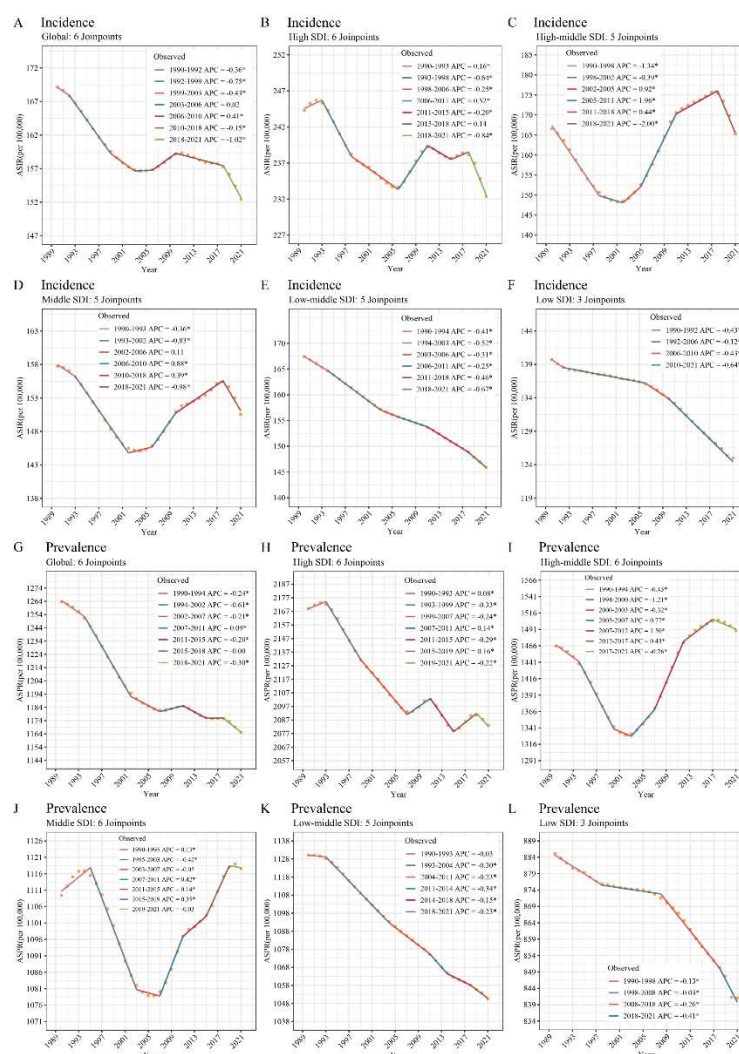


Figure 3. Jointpoint regression analysis of ASIR and ASPR from 1990 to 2021, in children and adolescents. (A, G) Global. (B, H) High SDI region. (C, I) High-middle SDI region. (D, J) Middle SDI region. (E, K) Low-middle SDI region. (F, L) Low SDI region. *denotes statistically significant APC ($P < 0.05$).

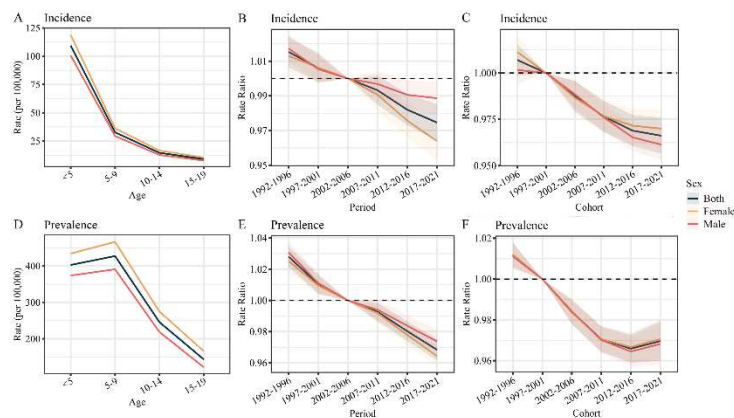
168

169 Age, period, and cohort effects

170 Overall, the age effect showed a similar pattern across gender subgroups, with the highest
171 risk of incidence observed in children <5 years of age, after which the ASIR declined with age
172 (Fig. 3A); the highest ASPR was observed at 5-9 years of age (Figure 4D). The age effect
173 suggests that attention needs to be paid to the burden of AD in people <10 years of age.

174 The period effect suggests a declining incidence and prevalence rate ratio (RR) of AD
175 globally, with the risk of prevalence for different gender subgroups (both, female and male)
176 declining by 5.96%, 6.08%, and 5.69% (Figure 4E).

177 The cohort effect suggests an overall reduction in the RR of incidence, which is not
178 consistent with prevalence. For the RR of prevalence in the different gender subgroups, the
179 2012-2016 cohort showed a decrease of 4.58%, 4.53%, and 4.66% compared to the 1992-1996
180 cohort, after which the 2017-2021 cohort showed a slight upward trend compared to the 2012-
181 2016 cohort, with increases of 0.37%, 0.39% and 0.37% (Figure 4F).



182

183 **Figure 4.** The age, period, and cohort effects in AD from 1990 to 2021, in children and
184 adolescents. (A, D) The age effect of AD. (B, E) The period effect of AD. (C, F) The cohort
185 effect of AD.

BAPC Predictors of 2022-2036

Between 2022 and 2036, the trend in the number of cases of AD is expected to change and show a downward trend (Figure 5). The global ASIR and ASPR of AD in 2036 are projected to be 159.74 (95% *UI*: 107.31, 212.17) and 1197.28 (95% *UI*: 837.82, 1556.74). It is important to note that females continue to have approximately 5 million more cases than males in 2036, with a projected prevalence of 43.52 (95% *UI*: 30.60, 56.44) million and 38.22 (95% *UI*: 26.83, 49.62) million (Additional file 1: Supplementary Table 4). Based on data from the past 32 years and projections for the next 15 years, the global burden of AD among children and adolescents is higher for females than globally, as well as much higher for males.

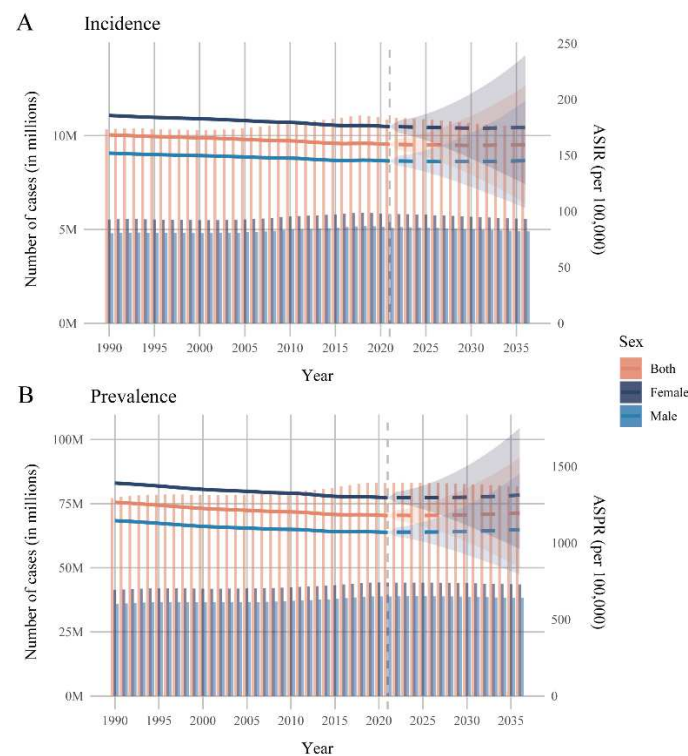


Figure 5. BAPC predictors in AD from 1990 to 2036, in children and adolescents. (A) The ASIR and cases of AD. (B) The ASPR and cases of AD.

Discussion

This study analyzes the current state of the burden of AD in children and adolescents globally. AD usually has an early childhood onset, and the course and severity of the disease, as well as the risk of developing a range of autoimmune disorders such as asthma and allergies, varies widely between patients around the time of puberty[26–28]. Understanding the complex factors and disease trajectories that influence health outcomes in children and adolescents in different contexts enables key points for intervention to be identified [29]. The cases of AD in children and adolescents are increasing with the global population base from 1990-2021, and the increase in patients may be closely related to environmental exposures in the context of genetic susceptibility due to climate as well as air pollution [30,31]. We found that ASIR, ASPR, and ASDR were approximately 1.2-fold higher in females than in males, and previous studies have demonstrated a higher prevalence in females, but in particular, the risk was higher in males up to 1 year of age, and thereafter the risk decreased with age [32,33]. The role of sex hormones on immune homeostasis may modulate the course of AD [34], and is a potential factor in the gender differences, with research studies investigating higher anxiety and depression scores, more common sleep disturbances due to itching, and more pronounced allergic reactions in female AD patients [35,36]. In conclusion, the psychological and health conditions of females with AD in childhood and adolescence need our attention.

The results of the analyses suggest that the burden of AD is predominantly present in the <10 years population. AD appears early in life and there has been much evidence that the prevalence is higher in children[37]. Misdiagnosis and delays in treatment can have an impact on children's health, particularly mental health, and children must be correctly diagnosed as

well as treated early [38,39]. Of course, the situation of people with AD in adolescence, a period of rapid physical, cognitive, and psychosocial growth, cannot be ignored, the WHO appealed for attention, improvement, and maintenance of the healthy development of adolescents. Advancing AD prevention, diagnosis, and breakthroughs in therapeutic management to meet the evolving challenges is the consensus of the 4th Davos Declaration [40,41]. The development of comorbidities with AD is closely related to the severity of the disease, and correct and timely diagnosis and individualized treatment plans are now a pressing clinical need. We need to oppose the “one-size-fits-all” treatment and management plan, which is determined by the complex and heterogeneous characteristics of AD [42–44], and adopt a personalized and precise treatment and management model, give patients educational and psychological support, and carry out psycho-behavioral and exercise interventions, which can help patients cope with comorbidities better, and thus improve the mental health and quality of life of children and adolescents with AD.

The SDI, as a composite indicator, reflects the overall development of a region, and the global burden of AD is concentrated in High SDI regions, with a large gap in burden compared to other regions. Some studies have shown that the incidence pattern of AD varies considerably in different regions, and there is a geographic imbalance with higher drug utilization in countries with high SDI than in countries with low SDI [45–48]. The higher burden of AD in children and adolescents in the High SDI region may be influenced by a variety of factors such as lifestyle, environmental exposures, etc. The High SDI region has advantages in terms of education, healthcare resources, and research innovations, but it also faces challenges such as high morbidity, psychosocial impacts, and healthcare costs. Focusing on spatial and temporal

trends in the burden of AD in different regions, as well as patterns of incidence, can better guide sustainable development related to the health of children and adolescents in regions at different levels of development.

Period effects show a flat and steady rate of RR decline across all periods of AD, with a reduced risk of incidence and prevalence may be related to improvements in medical care and changes in treatment management policies, and subsequent studies could further explore the impact of changes in medical care of treatment management policies. The cohort effect showed a small increase in risk of prevalence in the 2017-2021 cohort, which included people born during the COVID-19 pandemic. Studies have shown an increased risk of AD in people who have been infected with SARS-CoV-2 [49], which may have led to an altered immune pattern in the newborn cohort, where an elevated risk of recurrence after infection may have been responsible for the increased risk of prevalence, whereas the risk of incidence in this cohort remained decreased possibly due to a reduction in allergen exposures during the pandemic, an increase in social distances, and the blocking of public places [50]. During 2019-2021, AD burden shows a declining trend globally and in the regions by SDI quintiles, which is inconsistent with the previous trend of change, and the projected decline in the number of cases of AD may be due to the COVID-19 pandemic that has altered the global demographic pattern. The potential impact of COVID-19 on AD is unclear, but the overburdening of health systems, and the delays in policy revisions and health guidance during pandemics are likely to influence trends in the burden of AD. More data on changing population patterns and disease surveillance are needed to better understand the impact of COVID-19 on AD and to further explore the possibility that changes in data collection during the COVID-19 epidemic led to disparities, as

well as changes in the burden of AD between areas differently hit by COVID. With the end of the pandemic, following the development of trends in AD and analyzing whether the effects of the pandemic are long-lasting or whether there is a return to the pre-pandemic situation [22,51].

Limitations of this study remain. Firstly, the diversity of data sources in the GBD database may lead to bias in estimating the burden of disease [52]. Second, the levels of diagnosis affect the accuracy of the assessment and may lead to an overestimation or underestimation of the burden of AD, especially in poor, remote, regions with low levels of SDI. Last, the impact of COVID-19 on the burden of AD needs to be more accurately assessed with longer-term surveillance data to provide health workers with a more valuable reference for guiding policy development.

Conclusions

In summary, the burden of AD in children and adolescents globally has shown a downward trend since 1990. We need to pay attention to the burden of AD in regions with higher levels of social development, as well as the geographic imbalances and different disease patterns that exist, to develop more effective prevention and intervention measures, protect specific age groups, advance personalized and precision models of care, and improve the burden of AD and the health status of children and adolescents. The potential impact of the COVID-19 pandemic on AD requires a longer-term, in-depth understanding of the disease spectrum, as well as demographic changes.

287 **List of abbreviations**

288 AD, atopic dermatitis;

289 GBD, Global Burden of Diseases;

290 SDI, Social-demographic Index;

291 ASR, age-standardized rate;

292 AAPC, average annual percent change;

293 APC, annual percent change

294 DALYs, disability-adjusted life-years;

295 ASIR, age-standardized incidence rate;

296 ASPR, age-standardized prevalence rate;

297 ASDR, age-standardized disability-adjusted life year;

298 APC, age-period-cohort;

299 BAPC, bayesian age-period-cohort;

300 CI, confidence interval;

301 UI, uncertainty intervals.

302

303 **Declarations**

304 **Ethics approval and consent to participate**

305 Not applicable.

306

307 **Clinical trial number**

308 Not applicable.

309

310 **Consent for publication**

311 Not applicable.

312

313 **Availability of data and materials**

314 Publicly available datasets were analyzed for this study. The GBD Study 2021 data resources

315 are available online through the Global Health Data Exchange (GHDx) query tool

316 (<http://ghdx.healthdata.org/gbd-results-tool>).

317

318 **Competing interests**

319 The authors declare that they have no competing interests.

320

321 **Funding**

322 This work was supported by the National Science Foundation of China (No. 81773312); Social

323 Development Science and Technology Project of Dongguan (No. 20221800906082; No.

324 20231800936282; No. 20221800906092).

325

326 **Authors' contributions**

327 Conception and design: JQ. Data collection and interpretation: JQ, WL, XX, and YP. Statistical
328 analysis: JQ, WL. Writing original draft: JQ, WL, XX, and YP. Writing editing: JQ, WL, XX,
329 YP, LL, YW, QJ, YP, HW and YL. All authors reviewed the manuscript. Supervision: YH. Final
330 approval of manuscript: all authors.

331

332 **Acknowledgements**

333 We appreciate the work of the Global Burden of Disease Collaborators.

334

335 **Authors' information (optional)**

336 Jiahui Qi and Weijia Li have share first authorship.

337

References

1. Hoy SM. Ruxolitinib Cream 1.5%: A Review in Mild to Moderate Atopic Dermatitis. *American Journal of Clinical Dermatology*. 2022;24:143.
2. Langan SM, Irvine AD, Weidinger S. Atopic dermatitis. *The Lancet*. 2020;396:345–60.
3. Sroka-Tomaszewska J, Trzeciak M. Molecular Mechanisms of Atopic Dermatitis Pathogenesis. *International Journal of Molecular Sciences*. 2021;22:4130.
4. Karimkhani C, Dellavalle RP, Coffeng LE, Flohr C, Hay RJ, Langan SM, et al. Global Skin Disease Morbidity and Mortality: An Update From the Global Burden of Disease Study 2013. *JAMA Dermatology*. 2017;153:406.
5. Ramirez FD, Chen S, Langan SM, Prather AA, McCulloch CE, Kidd SA, et al. Association of Atopic Dermatitis With Sleep Quality in Children. *JAMA Pediatrics*. 2019;173:e190025.
6. Wollenberg A, Werfel T, Ring J, Ott H, Gieler U, Weidinger S. Atopic Dermatitis in Children and Adults: Diagnosis and Treatment. *Deutsches Ärzteblatt International*. 2023;120:224.
7. Fishbein AB, Silverberg JI, Wilson EJ, Ong PY. Update on Atopic Dermatitis: Diagnosis, Severity Assessment, and Treatment Selection. *The journal of allergy and clinical immunology In practice*. 2019;8:91.
8. Lee HH, Patel KR, Singam V, Rastogi S, Silverberg JI. A systematic review and meta-analysis of the prevalence and phenotype of adult-onset atopic dermatitis. *Journal of the American Academy of Dermatology*. 2019;80:1526-1532.e7.
9. Benedetto AD, Boguniewicz M, Ong PY, Chu DK, Schneider LC. Atopic Dermatitis (Eczema) Guidelines 2023: Highlights. *The Journal of Allergy and Clinical Immunology: In*

Practice [Internet]. 2024 [cited 2024 Oct 26];0. Available from: [https://www.jaci-inpractice.org/article/S2213-2198\(24\)00885-7/abstract](https://www.jaci-inpractice.org/article/S2213-2198(24)00885-7/abstract)

10. Ochayon DE, DeVore SB, Chang W-C, Krishnamurthy D, Seelamneni H, Grashel B, et al. Progressive accumulation of hyperinflammatory NKG2Dlow NK cells in early childhood severe atopic dermatitis. *Science immunology*. 2024;9:eadd3085.

11. Wang Z, Liang X, Li X, Zhou Z, Zhang Z, Zhao J, et al. Global, regional, and national burdens of atopic dermatitis under 14: a trend analysis and future prediction based on the global burden of disease study 2019. *Arch Dermatol Res*. 2024;316:463.

12. Guo Y, Zhang K-Y, Zou Y-F, Yu B. National situation, trends, and predictions of disease burden of atopic dermatitis in Chinese children and adolescents. *Frontiers in Microbiology*. 2023;14:1161969.

13. Murray CJL. Findings from the Global Burden of Disease Study 2021. *The Lancet*. 2024;403:2259–62.

14. Collaborators G 2021 RF. Global burden and strength of evidence for 88 risk factors in 204 countries and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet (London, England)*. 2024;403:2162.

15. Collaborators G 2021 C of D. Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet (London, England)*. 2024;403:2100.

16. Collaborators G 2021 F. Burden of disease scenarios for 204 countries and territories, 2022–2050: a forecasting analysis for the Global Burden of Disease Study 2021. *Lancet*

(London, England). 2024;403:2204.

17. Feigin VL, Abate MD, Abate YH, ElHafeez SA, Abd-Allah F, Abdelalim A, et al. Global, regional, and national burden of stroke and its risk factors, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *The Lancet Neurology*. 2024;23:973–1003.

18. Liang X, Lyu Y, Li J, Li Y, Chi C. Global, regional, and national burden of preterm birth, 1990–2021: a systematic analysis from the global burden of disease study 2021. *eClinicalMedicine*. 2024;76:102840.

19. Tuo Y, Li Y, Li Y, Ma J, Yang X, Wu S, et al. Global, regional, and national burden of thalassemia, 1990–2021: a systematic analysis for the global burden of disease study 2021. *eClinicalMedicine*. 2024;72:102619.

20. Huang D, Lai H, Shi X, Jiang J, Zhu Z, Peng J, et al. Global temporal trends and projections of acute hepatitis E incidence among women of childbearing age: Age-period-cohort analysis 2021. *Journal of Infection* [Internet]. 2024 [cited 2024 Oct 26];89. Available from: [https://www.journalofinfection.com/article/S0163-4453\(24\)00184-1/fulltext](https://www.journalofinfection.com/article/S0163-4453(24)00184-1/fulltext)

21. Bai Z, Han J, An J, Wang H, Du X, Yang Z, et al. The global, regional, and national patterns of change in the burden of congenital birth defects, 1990–2021: an analysis of the global burden of disease study 2021 and forecast to 2040. *eClinicalMedicine*. 2024;77:102873.

22. Collaborators G 2021 D. Global age-sex-specific mortality, life expectancy, and population estimates in 204 countries and territories and 811 subnational locations, 1950–2021, and the impact of the COVID-19 pandemic: a comprehensive demographic analysis for the Global Burden of Disease Study 2021. *Lancet* (London, England). 2024;403:1989.

404 23. Li J, Jia H, Liu Z, Xu K. Global, regional and national trends in the burden of low bone
 405 mineral density from 1990 to 2030: A Bayesian age-period-cohort modeling study. *Bone*.
 406 2024;189:117253.

407 24. Zhu Z, Zhong X, Luo Z, Liu M, Zhang H, Zheng H, et al. Global, regional and national
 408 burdens of acne vulgaris in adolescents and young adults aged 10–24 years from 1990 to
 409 2021: a trend analysis. *British Journal of Dermatology*. 2024;ljae352.

410 25. Collaborators G 2021 TF. Forecasting the effects of smoking prevalence scenarios on
 411 years of life lost and life expectancy from 2022 to 2050: a systematic analysis for the Global
 412 Burden of Disease Study 2021. *The Lancet Public Health*. 2024;9:e729.

413 26. Kim JH, Lee E, Ha EK, Shin J, Lee GC, Rha YH, et al. Cascade of atopic dermatitis
 414 comorbidities in children after birth for 15 years. *Allergy*. 2024;79:153–63.

415 27. Tanaka A, Morioke S, Ohya Y, Shimojo N, Takahashi M, Tanaka M, et al. Comparison of
 416 the time course of atopic dermatitis from birth to 19 years old among generations of patients
 417 in Japan. *The Journal of Dermatology*. 2021;48:1602–6.

418 28. Thorsteinsdottir S, Stokholm J, Thyssen JP, Nørgaard S, Thorsen J, Chawes BL, et al.
 419 Genetic, Clinical, and Environmental Factors Associated With Persistent Atopic Dermatitis in
 420 Childhood. *JAMA Dermatology*. 2018;155:50.

421 29. Allotey P, MacKenzie E. Introducing the World Health Organization’s Stocktaking
 422 Exercise on Global Adolescent Health. *Journal of Adolescent Health*. 2024;75:S1–2.

423 30. Wang S-P, Stefanovic N, Orfali RL, Aoki V, Brown SJ, Dhar S, et al. Impact of climate
 424 change on atopic dermatitis: A review by the International Eczema Council. *Allergy*.
 425 2024;79:1455–69.

- 426 31. Donald K, Finlay BB. Early-life interactions between the microbiota and immune system:
427 impact on immune system development and atopic disease. *Nat Rev Immunol*. 2023;23:735–
428 48.
- 429 32. Johansson EK, Bergström A, Kull I, Melén E, Jonsson M, Lundin S, et al. Prevalence and
430 characteristics of atopic dermatitis among young adult females and males—report from the
431 Swedish population-based study BAMSE. *Journal of the European Academy of Dermatology*
432 *and Venereology*. 2022;36:698.
- 433 33. Mora T, Sánchez-Collado I, Mullol J, Muñoz-Cano R, Ribó P, Valero A. Prevalence of
434 Atopic Dermatitis in the Adult Population of Catalonia, Spain: A Large-Scale, Retrospective,
435 Population-Based Study. *J Investig Allergol Clin Immunol*. 2024;34:225–32.
- 436 34. Kanda N, Hoashi T, Saeki H. The Roles of Sex Hormones in the Course of Atopic
437 Dermatitis. *International Journal of Molecular Sciences*. 2019;20:4660.
- 438 35. Mina S, Jabeen M, Singh S, Verma R. Gender Differences in Depression and Anxiety
439 Among Atopic Dermatitis Patients. *Indian Journal of Dermatology*. 2015;60:211.
- 440 36. Chen W, Mempel M, Schober W, Behrendt H, Ring J. Gender difference, sex hormones,
441 and immediate type hypersensitivity reactions. *Allergy*. 2008;63:1418–27.
- 442 37. Hadi HA, Tarmizi AI, Khalid KA, Gajdács M, Aslam A, Jamshed S. The Epidemiology
443 and Global Burden of Atopic Dermatitis: A Narrative Review. *Life*. 2021;11:936.
- 444 38. Napolitano M, Fabbrocini G, Martora F, Genco L, Noto M, Patruno C. Children atopic
445 dermatitis: Diagnosis, mimics, overlaps, and therapeutic implication. *Dermatologic Therapy*.
446 2022;35:e15901.
- 447 39. Yamamoto-Hanada K, Kobayashi T, Mikami M, Williams HC, Saito H, Saito-Abe M, et

448 al. Enhanced early skin treatment for atopic dermatitis in infants reduces food allergy. *Journal*
 449 *of Allergy and Clinical Immunology*. 2023;152:126–35.

450 40. Traidl-Hoffmann C, Afghani J, Akdis CA, Akdis M, Aydin H, Bärenfaller K, et al.
 451 Navigating the evolving landscape of atopic dermatitis: Challenges and future opportunities:
 452 The 4th Davos declaration. *Allergy*. 2024;79:2605–24.

453 41. Tsai SY-C, Gaffin JM, Hawryluk EB, Ruran HB, Bartnikas LM, Oyoshi MK, et al.
 454 Evaluation of dupilumab on the disease burden in children and adolescents with atopic
 455 dermatitis: A population-based cohort study. *Allergy*. 2024;79:2748–58.

456 42. Czarnowicki T, He H, Krueger JG, Guttman-Yassky E. Atopic dermatitis endotypes and
 457 implications for targeted therapeutics. *Journal of Allergy and Clinical Immunology*.
 458 2019;143:1–11.

459 43. Yew YW, Thyssen JP, Silverberg JI. A systematic review and meta-analysis of the regional
 460 and age-related differences in atopic dermatitis clinical characteristics. *Journal of the*
 461 *American Academy of Dermatology*. 2019;80:390–401.

462 44. Facheris P, Jeffery J, Duca ED, Guttman-Yassky E. The translational revolution in atopic
 463 dermatitis: the paradigm shift from pathogenesis to treatment. *Cellular and Molecular*
 464 *Immunology*. 2023;20:448.

465 45. Collaborators G 2019 I. Global, regional, and national incidence of six major immune-
 466 mediated inflammatory diseases: findings from the global burden of disease study 2019.
 467 *eClinicalMedicine*. 2023;64:102193.

468 46. Cao X, Wang M, Zhou M, Mi Y, Guo Q, Fan Y, et al. Global, Regional and National
 469 Burden of Paediatric Atopic Dermatitis: A Trend and Geographic Inequalities Analysis.

470 Clinical & Experimental Allergy. 2024;54:747–59.

471 47. Ushcatz I, Zhao HJ, Tadrous M, Aoki V, Chang AY, Dlova N, et al. Association of
472 Countries' Atopic Dermatitis Burden and Sociodemographic Index with Topical Calcineurin
473 Inhibitor Utilization. *Dermatitis®* [Internet]. 2024 [cited 2024 Oct 27]; Available from:
474 <https://www.liebertpub.com/doi/10.1089/derm.2024.0107>

475 48. Shin YH, Hwang J, Kwon R, Lee SW, Kim MS, Collaborators G 2019 AD, et al. Global,
476 regional, and national burden of allergic disorders and their risk factors in 204 countries and
477 territories, from 1990 to 2019: a systematic analysis for the Global Burden of Disease Study
478 2019. *Allergy*. 2023;78:2232.

479 49. Schmitt J, Ehm F, Vivirito A, Wende D, Batram M, Loser F, et al. Large cohort study
480 shows increased risk of developing atopic dermatitis after COVID-19 disease. *Allergy*.
481 2024;79:232–4.

482 50. Kattih M, Lee H, Jo H, Jeong J, Kim H, Park J, et al. National prevalence of atopic
483 dermatitis in Korean adolescents from 2009 to 2022. *Scientific Reports*. 2024;14:12391.

484 51. Collaborators G 2021 D and I. Global incidence, prevalence, years lived with disability
485 (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371
486 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990–
487 2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet* (London,
488 England). 2024;403:2133.

489 52. X W, R X, L G, W S, Y D, W L, et al. Unraveling the global burden of inflammatory
490 bowel disease (1990-2019): A Joinpoint regression analysis of divergent trends in 10-24 and
491 50-69 age cohorts. *Autoimmunity reviews*. 2024;23:103586.

492 **Table 1 should be in the article page 8, line 150.**

493 **Table 1.** The ASIR and ASPR for global in 1990 and 2021, in children and adolescents.

	Incidence (95% UI)			Prevalence (95% UI)		
	ASR in 1990 (per 100, 000)	ASR in 2021 (per 100, 000)	AAPC (95% CI)	ASR in 1990 (per 100, 000)	ASR in 2021 (per 100, 000)	AAPC (95% CI)
Global:						
Both	169.14 (158.29,180.72)	152.47 (142.39,162.99)	-0.33 (-0.36, -0.30)	1263.51 (1197.13,1333.16)	1164.91 (1105.94,1229.16)	-0.26 (-0.28, -0.25)
Male	153.33 (143.44,164.13)	138.33 (128.98,148.34)	-0.33 (-0.37, -0.28)	1145.82 (1089.89,1207.41)	1056.01 (1003.99,1113.47)	-0.26 (-0.28, -0.24)
Female	185.75 (173.28,198.63)	167.51 (156.16,179.02)	-0.33 (-0.35, -0.30)	1387.2 (1313.88,1464.32)	1280.74 (1212.73,1350.97)	-0.26 (-0.27, -0.24)
SDI level:						
High	244.28 (227.78,262.35)	232.33 (216.15,249.87)	-0.16 (-0.19, -0.14)	2169.1 (2058,2286.08)	2082.94 (1976.33,2196.06)	-0.13 (-0.14, -0.12)
High-middle	166.54 (155.12,179.02)	165.24 (153.31,177.72)	-0.03 (-0.12, 0.06)	1465.65 (1389.41,1541.46)	1489.06 (1412.1,1566.93)	0.05 (0.01, 0.09)
Middle	157.76 (147.79,168)	150.57 (140.38,160.91)	-0.14 (-0.19, -0.10)	1109.39 (1049.71,1168.49)	1117.56 (1058.9,1178.79)	0.02 (- 0.01, 0.05)
Low-middle	167.44 (156.49,179.24)	145.89 (136.25,156.19)	-0.44 (-0.45, -0.44)	1130.13 (1070.85,1198.2)	1050.56 (996.13,1113.44)	-0.23 (-0.24, -0.23)
Low	139.71 (130.48,149.7)	125.03 (116.58,133.94)	-0.36 (-0.38, -0.34)	885.04 (837.78,935.32)	841.04 (796.5,888.47)	-0.17 (-0.18, -0.15)
GBD Region:						
Central Asia	357.39 (325.21,391.23)	346.08 (314.18,378.97)	-0.11 (-0.18, -0.04)	3419.26 (3208.28,3635.75)	3411.09 (3195.14,3628.79)	-0.01 (-0.04, 0.02)
South Asia	174.75 (162.79,187.62)	151.72 (141.18,163.38)	-0.46 (-0.46, -0.45)	1167.48 (1103.85,1242.12)	1112.19 (1051.05,1182.03)	-0.16 (-0.17, -0.15)

Southeast Asia	160.46 (148.43,172.51)	154.8 (143.15,166.21)	-0.11 (-0.13, -0.10)	1122.55 (1056.39,1184.69)	1112.5 (1050.65,1173.51)	-0.03 (-0.03, -0.02)
East Asia	136.91 (127.71,146.36)	135.32 (126.61,145.45)	-0.01 (-0.16 - 0.14)	920.73 (868.68,973.44)	963.96 (910.18,1018.21)	0.14 (0.06, 0.23)
High-income Asia Pacific	297.4 (277.21,321.9)	309.06 (288.49,333.58)	0.13 (0.09, 0.16)	3094.21 (2921.23,3282.86)	3182.3 (2999.94,3379.16)	0.10 (0.08, 0.11)
Western Europe	286.91 (263.28,312.16)	287.25 (263.31,312.97)	0.00 (-0.06, 0.07)	2516.32 (2371.45,2671.66)	2548.79 (2396.76,2708.87)	0.04 (0.02, 0.06)
Eastern Europe	145.61 (135.39,156.88)	140 (130.56,150.46)	-0.14 (-0.36 - 0.08)	2201.73 (2109.54,2297.11)	2288.74 (2197.87,2382.95)	0.12 (0.01, 0.23)
Central Europe	163.13 (150.98,177.03)	166.84 (154.63,180.94)	0.09 (-0.00, 0.18)	1359.29 (1284.92,1440.58)	1375.56 (1297.39,1457.8)	0.04 (0.02, 0.06)
High-income North America	211.94 (198.58,225.52)	194.51 (182.3,207.19)	-0.29 (-0.33, -0.24)	1780.81 (1695.01,1864.09)	1723.25 (1636.52,1811.54)	-0.12 (-0.16, -0.07)
Caribbean	186.23 (168.31,205.38)	179.64 (162.06,198.4)	-0.12 (-0.14, -0.10)	1296.59 (1208.04,1384.33)	1295.76 (1206.47,1384.53)	-0.00 (-0.01, 0.00)
Andean Latin America	157.45 (146.04,169.48)	152.29 (141.1,163.76)	-0.10 (-0.13, -0.08)	1118.74 (1057.42,1183.85)	1108.17 (1047.04,1172.24)	-0.03 (-0.05, -0.01)
Tropical Latin America	203.51 (189.52,217.74)	206.48 (192.49,220.45)	0.05 (0.03, 0.07)	1522.93 (1442.75,1612.19)	1500.36 (1423.82,1587.32)	-0.05 (-0.07, -0.02)
Southern Latin America	286.14 (259.59,313.33)	255.54 (230.84,281.02)	-0.36 (-0.43, -0.30)	2235.47 (2092.5,2393.2)	2189.77 (2046.08,2351.5)	-0.06 (-0.08, -0.04)
Central Latin America	184.67 (171.09,200.2)	168.32 (155.23,182.86)	-0.30 (-0.31, -0.29)	1359.29 (1284.92,1440.58)	1225.28 (1150.34,1300.58)	-0.09 (-0.10, -0.08)
Oceania	186.06 (167.33,204.83)	187.63 (168.92,206.45)	0.03 (0.01, 0.05)	1241.01 (1161.23,1333.72)	1241.03 (1161.48,1333.8)	0.00 (-0.01, 0.01)
Australasia	241.25 (221.42,261.97)	240.82 (218.99,262.87)	-0.00 (-0.06, 0.05)	1802.29 (1669.85,1921.71)	1840.32 (1714,1977.59)	0.07 (0.05, 0.09)

Central						
Sub-	123.57	115.61	-0.22	729.8	730.84	0.00 (-
Saharan	(112.31,135.11)	(104.68,126.74)	(-0.23,	(678.65,779.78)	(679.06,780.11)	0.00,
Africa			-0.20)			0.01)
Eastern						
Sub-	114.46	109	-0.15	703.81	711.34	0.04
Saharan	(106.53,122.34)	(100.89,116.65)	(-0.19,	(664.21,742.84)	(671.42,751.01)	(0.01,
Africa			-0.12)			0.07)
Southern						
Sub-	117.1	111.96	-0.14	751.09	746.32	-0.02
Saharan	(108.25,125.42)	(103.2,120.1)	(-0.18,	(708.33,795.1)	(703.17,790.4)	(-0.03,
Africa			-0.11)			-0.01)
Western						
Sub-	114.62	109.01	-0.16	726.28	723.55	-0.01
Saharan	(106.93,122)	(101.76,115.97)	(-0.17,	(689.03,765.8)	(685.83,763.42)	(-0.02,
Africa			-0.15)			-0.01)
North						
Africa and	148.05	134.57	-0.30	1040.52	982.25	-0.18
Middle	(136.14,160.11)	(122.96,145.76)	(-0.34,	(978.65,1104.26)	(918.11,1040.81)	(-0.20,
East			-0.26)			-0.17)

494

495 **Additional material**

496

497 **Additional file 1**

498 **Supplementary table of *The Global Burden of Atopic Dermatitis in Children and***

499 ***Adolescents, and Projections to 2036: Findings from the Global Burden of Disease Study,***

500 ***1990-2021* .pdf**

501 Supplementary Table 1. Cases of incidence and prevalence for global in 1990 and 2021, in

502 children and adolescents.

503 Supplementary Table 2. ASIR, ASPR, and ASDR in four age subgroups of children and

504 adolescents, in 1990 and 2021.

505 Supplementary Table 3. ASIR, ASPR, and ASDR for 204 countries in 2021, in children and

506 adolescents.

507 Supplementary Table 4. Cases and ASR of incidence and prevalence for global in 2022 and

508 2036, in children and adolescents.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Additionalfile1.pdf](#)