Received: 30 May 2024 | Accepted: 5 August 2024

DOI: 10.1002/jvc2.526

JEADV CLINICAL PRACTICE
OPEN ACCESS JOURNAL OF THE EUROPEAN ACADEMY OF DERMATOLOGY & VENEREOLOGY

SYSTEMATIC REVIEW

The global epidemiology of vitiligo: A systematic review and meta-analysis of the incidence and prevalence

Morten Bahrt Haulrig[1,2,3] | **Rownaq Al-Sofi**[1,3] | **Subisan Baskaran**[1,3] | **Mie Siewertsen Bergmann**[1,3] | **Marianne Løvendorf**[1,4] | **Beatrice Dyring-Andersen**[1,4,5] | **Lone Skov**[1,2,3] | **Nikolai Loft**[1,3]

[1]Department of Dermatology and Allergy, Herlev and Gentofte Hospital, Hellerup, Denmark

[2]Department of Clinical Medicine, University of Copenhagen, Copenhagen, Denmark

[3]Copenhagen Research Group for Inflammatory Skin, Herlev and Gentofte Hospital, Hellerup, Denmark

[4]Leo Foundation Skin Immunology Research Center, Faculty of Health and Medical Sciences, University of Copenhagen, Kobenhavn, Denmark

[5]Novo Nordisk Foundation Center for Protein Research, Faculty of Health and Medical Sciences, University of Copenhagen, Kobenhavn, Denmark

Correspondence
Morten Bahrt Haulrig, Department of Dermatology and Allergy, Herlev and Gentofte Hospital, Gentofte Hospitalsvej 15, DK-2900, Denmark.
Email: Morten.bahrt.haulrig@regionh.dk

Funding information
Novo Nordisk Fonden, Grant/Award Number: NNF21OC0066694; Kongelig Hofbuntmager Aage Bangs Fond; Carl and Ellen Hertz' granto to Medical and Natural Sciences; Herlev and Gentofte Hospital Research Council

Abstract

Vitiligo is described with a prevalence of 0.5%−1%. Recent studies suggest an increasing prevalence, but there is a scarcity of studies that have systematically evaluated the global incidence and prevalence. We examined the incidence and the global, regional, and country-specific prevalence of vitiligo in the general population (PROSPERO: CRD42021261643). We systematically searched PubMed, EMBASE, and Web of Science. Each study was categorised in subgroups. The overall analysis comprised all studies, except for studies only examining children and adolescents. Pooled proportions were calculated with the DerSimonian-Laird method for random-effects models with 95% confidence intervals (CI). Of the 7,838 identified studies, 171 were eligible for analysis (participants $n = 572{,}334{,}973$). The overall incidence was 1.59 per 10,000 person-years (95% CI: 0.70−2.83). The overall prevalence was 0.40% (95% CI: 0.37−0.44); no difference was observed between females (0.50%, 95% CI: 0.36−0.66) and males (0.49%, 95% CI: 0.35−0.65). West Asia showed the highest prevalence (0.77%, 95% CI: 0.44−1.10) and East Asia the lowest (0.12%, 95% CI: 0.10−0.14). The highest country-specific prevalence was reported in Jordan (1.34%, 95% CI: 0.12−3.87) and the lowest in Sweden (0.19%, 95% CI: 0.08−0.34). Children and adolescents showed a lower prevalence (0.27%, 95% CI: 0.24−0.31) compared to adults (0.70%, 95% CI: 0.59−0.81). Questionnaire-based studies showed a higher prevalence (0.73%, 95% CI: 0.52−0.98) compared to examination-based studies (0.59%, 95% CI: 0.46−0.73) and register-based studies (0.13%, 95% CI: 0.10−0.17). The prevalence in examination-based studies increased from 0.40% (95% CI: 0.17−0.73) between 1943 and 1979 to 0.89% (95% CI: 0.68−1.13) between 2020 and 2023. Questionnaire-based studies also showed an increasing prevalence, while in register-based studies, the prevalence was continuously

low. This study shows the global impact of vitiligo and how subgroup analyses influence the prevalence. The overall prevalence of vitiligo is lower than previously assumed; females and males are equally affected, and vitiligo is more common in adults.

KEYWORDS
country-specific, epidemiology, global, regional, vitiligo

INTRODUCTION

Vitiligo is an acquired, immune-mediated skin disease. The primary feature is the destruction of melanocytes, resulting in milky-white skin lesions with well-defined borders. Vitiligo has often a progressive and unpredictable disease course, and it can lead to a decline in quality of life, self-esteem, and amplify social stigma.[1–3] Individuals affected by vitiligo have an increased risk of other autoimmune comorbidities, including thyroid diseases, alopecia areata, and diabetes mellitus.[4] Two distinct forms of vitiligo have been described: non-segmental vitiligo, commonly referred to as vitiligo, characterised by symmetrical lesions, and segmental vitiligo, presenting with unilateral lesions.[5] The pathophysiology is complex and only partly characterised, and it involves a combination of genetic susceptibility, autoimmune dysregulation, and environmental triggers.[6]

The treatment options have been limited to treatments with poor efficacy until 2022, when the first treatment for vitiligo was approved by the US Food and Drug Administration.[7–9] This increased focus on vitiligo has given rise to several published epidemiological studies, suggestive of an increase in prevalence.[10–12] Vitiligo is commonly described as a widespread disease with an estimated prevalence ranging from 0.5% to 1%, equally affecting individuals across all age groups, regardless of sex, skin type, or ethnicity.[5] However, supporting evidence remains limited, as few studies have assessed the global prevalence and incidence of vitiligo.[13–15] Furthermore, no research has yet presented data on the changes in prevalence since the earliest published studies, nor how different study types may influence the prevalence.

Therefore, we conducted a systematic review and meta-analysis to examine the epidemiology of vitiligo.

We investigated the incidence and the global, regional, and country-specific prevalence of vitiligo. Additionally, we investigated the prevalence through subgroup analyses based on age, sex, study type, sample size, study quality and publication year.

METHODS

Search strategy and selection criteria

A study protocol was developed before the study start and was registered online at PROSPERO (ID CRD42021261643). The systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (Figure 1; Supporting Information S3). We searched the databases PubMed, EMBASE, and Web of Science from their inception date to August 2023. The following medical subject heading (MeSH) terms were used in the respective databases: ('Vitiligo' or 'pigmentary' or 'leukoderma') and ('prevalence' or 'incidence' or 'epidemiology'). References of each included study and other published reviews were assessed for additional studies.

We included studies that reported on the prevalence and/or incidence of vitiligo in a general population.

Studies that examined selected populations were excluded, such as studies conducted in dermatological departments or in populations with autoimmune diseases.[4] Conference abstracts and articles written in languages other than English were excluded.

Four authors (M. H., N. L., R. A. and S. B.) independently screened and reviewed titles and abstracts from the included databases before reading full-text articles. In cases of duplicate studies examining the same populations, we prioritised either (a) the study with the most comprehensive data or (b) the most recent publication, in the specified order. Duplicate studies were only considered if they examined different subgroups from the same population, that could be analysed independently in the subsequent meta-analysis. For studies reporting on multiple point prevalence estimates in the same populations, we only included the most recent data.

Each study was critically assessed for the overall quality and risk of bias. Two commonly used tools for critical appraisal of studies were used: the Appraisal tool for Cross-Sectional studies (AXIS),[16] and the Newcastle-Ottawa Scale (NOS)[17,18] for cohort and case-control studies. The AXIS tool comprises 20 items that systematically appraise the methods, results, discussion

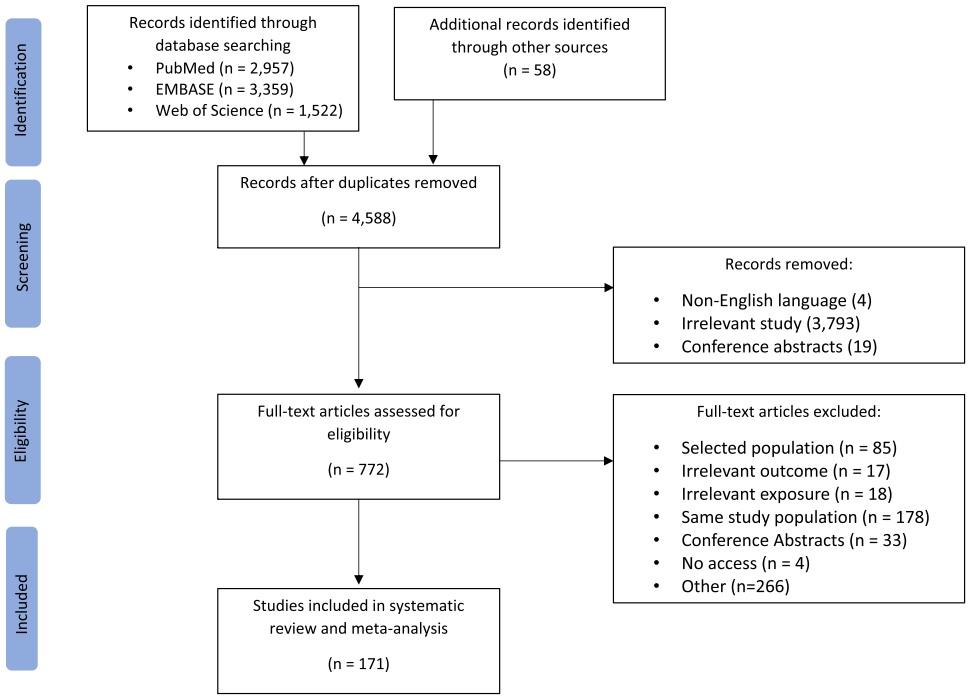

FIGURE 1 PRISMA flowchart showing the screening and reasons for exclusion of studies. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-analyses.

sections, and the risk of bias in cross-sectional studies (Supporting Information S2: Table 1). Since there are no published cut-off scores for the risk of bias in the AXIS-tool, a quartile system was implemented. Each study was classified as having low risk (≥16), moderate risk (11−15), high risk (6−10), or very high risk (≤5) based on the number of AXIS items met.[19,20] The NOS comprises nine items that systematically assesses the selection and comparability of the study groups, and the outcome or exposure of interest for cohort- and case-control studies, respectively (Supporting Information S2: Table 2 and 3). The risk of bias in each study was classified as low (7−9), moderate (4−6), or high (0−3), based on the number of NOS items met.[17,18]

Each study was categorised into predefined subgroups. We categorised each study by age. Children and adolescents were defined as having a maximum age range of 19 years (according to the WHO definition),[21] while adults were defined as populations with a minimum age range of 18 years. Populations aged exactly 18 years were defined as children and adolescents. The other predefined subgroups were sex, study type (examination-, questionnaire-, or register-based), study quality (low risk of bias), sample size (≥5000 participants), and publication year. The overall population analysis included studies with populations of all ages, except for studies that only examined children and adolescents.

Data analysis

We performed the statistical analysis in StatsDirect version 3.1.4 (StatsDirect Ltd.). Because we expected high between-study heterogeneity among the included studies, we used an inverse variance method with random-effects models using the DerSimonian-Laird method to calculate pooled estimates with 95% confidence intervals (CI) for incidence and prevalence, and for the overall population and subgroup analyses. Heterogeneity was determined using the Cochran Q test and the I^2 statistic, wherein the I^2 value represents the approximate proportion of total between-study variation that can be attributed to heterogeneity. A minimum of two studies in each subgroup was required to conduct the meta-analysis.

RESULTS

We identified 7838 studies in the database search (Figure 1). After screening the title and abstract of each study, 772 studies were eligible for full-text assessment. We found 171 studies reporting on the incidence or prevalence of vitiligo: 8 on incidence, 159 on prevalence, and 4 on both. The overall population analysis included 112 prevalence studies and 11 incidence studies. Most of the studies showed a low or moderate risk of bias (Supporting Information S2: Table 4, 5 and 6).

Incidence of vitiligo

In total, 11 studies reported an incidence of vitiligo in the overall population, comprising 470,280,903 person-years (participants $n = 198,492,688$, Supporting Information S2: Table 7). The incidence of vitiligo was 1.59 events per 10,000 person-years (95% CI: 0.70−2.83). Most studies were conducted in North America and Europe. Only one study reported on the incidence in children. No regional or country-specific analysis could be conducted due to the limited number of studies.

Prevalence of vitiligo

A total of 112 studies reported on the prevalence of vitiligo in the overall population (participants $n = 373,842,285$, Supporting Information S2: Table 8). The global prevalence was 0.40% (95% CI: 0.37−0.44, Table 1). Most of the studies were conducted in Europe ($n = 47$) and North America ($n = 22$), whereas no studies were conducted in Central- or Southeast Asia (Figure 2). West Asia showed the highest prevalence (0.77%, 95% CI: 0.58−1.00) and East Asia the lowest (0.12%, 95% CI: 0.10−0.14, Table 1 and Supporting Information S1: Figure 1). Twenty-one studies were not included in the country-specific meta-analysis as they were the only studies conducted within their respective countries, and a minimum of two studies in each country was required to conduct the analysis (Supporting Information S2: Table 11). There was a considerable variation in the reported prevalence of vitiligo by country, with the highest prevalence reported in Jordan (1.34%, 95% CI: 0.12−3.87) and the lowest in Sweden (0.19%, 95% CI: 0.08−0.34). See Figure 3 for all prevalence estimates categorised by country.

The overall prevalence categorised by sex was reported in 34 studies for females ($n = 37,755,696$) and 33 studies for males ($n = 52,298,396$, Supporting Information S2: Table 8). The overall prevalence of vitiligo in females was 0.50% (95% CI: 0.36−0.66) and in males 0.49% (95% CI: 0.35−0.65, Table 1); the prevalence differences in the regional analysis were marginal (Supporting Information S1: Figure 7).

There were 58 studies on the prevalence of vitiligo conducted in children and adolescents ($n = 42,123,177$, Supporting Information S2: Table 10); the overall prevalence was 0.27% (95% CI: 0.24−0.31, Table 1). Across all regions, the prevalence ranged from 0.17% to 0.22%, except for South Asia, where the prevalence was highest (0.70%, 95% CI: 0.42−1.05, Supporting Information S1: Figure 5 and Supporting Information S2: Table 6 and 12). The subgroup analysis categorised by sex in children and adolescents comprised 68,645 females and 117,902 males; the prevalence was 0.42% and 0.32%, respectively (females 95% CI: 0.20−0.72, males 95% CI: 0.20−0.48, Supporting Information S2: Table 12). The prevalence of vitiligo in adults was reported in 51 studies ($n = 111,215,697$, Supporting Information S2: Table 9) and was 0.70% (95% CI: 0.59−0.81, Supporting Information S2: Table 6 and 12). The prevalence among adults was slightly higher in males (0.63%, 95% CI: 0.33−1.02) than in females (0.48%, 95% CI: 0.15−0.98).

The subgroup analysis categorised by study type comprised 31 questionnaire-based, 49 examination-based, and 27 register-based studies, along with five chart review studies that were not categorised. The prevalence of vitiligo was 0.73% (95% CI: 0.52−0.98), 0.59% (95% CI: 0.46−0.73), and 0.13% (95% CI: 0.10−0.17) for questionnaire-, examination-, and register studies, respectively (Table 1, Supporting Information S1: Figure 2, 3, and 4). The subgroup analysis categorised by publication year examined the variations in prevalence over the past 80 years. The overall prevalence was 0.40% (95% CI: 0.17−0.73) in the earliest published studies and 0.41% (95% CI: 0.36−0.48) in studies published after 2020 (Table 1, Figure 4). When categorised by study type, questionnaire-based studies showed an increasing prevalence from 0.57% (95% CI: 0.46−0.68) to 1.28% (95% CI: 0.90−1.73). The prevalence also increased in examination-based studies from 0.40% (95% CI: 0.17−0.73) to 0.89% (95% CI: 0.68−1.13), while the prevalence in register-based studies was continuously low, ranging from 0.11% (95% CI: 0.07−0.15) to 0.15% (95% CI: 0.11−0.20). There were 54 studies included in the subgroup analysis of studies with at least 5000 participants ($n = 373,722,024$, Supporting Information S2: Table 12). Here, the overall prevalence was 0.32% (95% CI: 0.28−0.36). South Asia showed the highest prevalence (0.83%, 95% CI: 0.25−1.76), and East Asia had the lowest (0.07%, 95% CI: 0.06−0.07). For studies with a low risk of bias ($n = 52,314,200,147$ participants) the prevalence was 0.27% (95% CI: 0.22−0.31) and the prevalence was similar in females and males at 0.39% (females 95% CI: 0.25−0.56, males 95% CI: 0.25−0.56, Supporting Information S2: Table 12).

DISCUSSION

This study assessed the global prevalence and incidence of vitiligo, and 171 studies were included in the systematic review and meta-analysis. The overall incidence of vitiligo was 1.59 events per 10,000 person-years based on 11 studies and 470,280,903 person-years. The overall prevalence of vitiligo was 0.40% based on 112 studies comprising 373,842,285 participants; no difference in prevalence was observed between females and males. The prevalence was 0.27% among children and adolescents, and 0.70% among adults.

TABLE 1 The prevalence of vitiligo in the overall population and categorised by study type.

	Overall			Examination-based studies			Questionnaire-based studies			Register-based studies		
Variable	Total number of studies, *n* (*n* individuals)	Prevalence, % (95% CI)	I^2, %	Total number of studies, *n* (*n* individuals)	Prevalence, % (95% CI)	I^2, %	Total number of studies, *n* (*n* individuals)	Prevalence, % (95% CI)	I^2, %	Total number of studies, *n* (*n* individuals)	Prevalence, % (95% CI)	I^2, %
Global	112 (373,842,285)	0.40 (0.37-0.44)	99.9	49 (479,908)	0.59 (0.46-0.73)	96.6	31 (402,360)	0.73 (0.52-0.98)	98.4	27 (372,895,857)	0.13 (0.10-0.17)	100
Sex												
Female	34 (37,755,696)	0.50 (0.36-0.66)	99.7	20 (172,483)	0.69 (0.47-0.94)	96.0	8 (208,716)	0.50 (0.20-0.93)	99.0	6 (37,374,497)	0.14 (0.03-0.30)	99.9
Male	33 (52,298,396)	0.49 (0.35-0.65)	99.6	20 (229,324	0.63 (0.40-0.90)	97.7	7 (52,829)	0.75 (0.46-1.12)	91.9	6 (52,016,243)	0.10 (0.02-0.23)	99.8
Age group												
Children and adolescents	58 (42,123,177)	0.27 (0.24-0.31)	98.4	51 (246,286)	0.32 (0.23-0.44)	94.4	3 (9,817)	2.42 (0.87-4.71)	87.0	4 (41,868,922)	0.05 (0.03-0.07)	99.7
Adults	51 (111,215,697)	0.70 (0.59-0.81)	99.3	24 (97,792)	0.88 (0.62-1.18)	93.4	20 (338,258)	0.88 (0.58-1.25)	98.8	7 (110,779,647)	0.10 (0.07-0.14)	98.8
Region												
South Asia	13 (51,518)	0.73 (0.44-1.10)	94.4	12 (48,506)	0.62 (0.39-0.91)	91,5	-	-	-	-	-	-
West Asia	10 (4,623,612)	0.77 (0.58-1.00)	94.9	6 (72,414)	0.83 (0.38-1.45)	95.1	3 (10,430)	0.90 (0.17-2.18)	93.2	-	-	-
East Asia	6 (74,899,030)	0.12 (0.10-0.14)	99.1	4 (70,298)	0.40 (0.06-1.01)	98.6	-	-	-	2 (74,828,732)	0.07 (0.06-0.07)	99.1
Africa	4 (10,700)	0.48 (0.08-1.23)	90.3	3 (9,634)	0.66 (0.16-1.49)	86.0	-	-	-	-	-	-
South America	4 (98,252)	0.30 (0.10-0.60)	97.4	2 (20,835)	0.30 (0.00-1.25)	95.4	-	-	-	-	-	-
North America	22 (230,641,179)	0.24 (0.18-0.30)	100	4 (67,827)	0.22 (0.04-0.54)	97.5	8 (196,911)	0.59 (0.21-1.14)	99.2	9 (230,374,014)	0.13 (0.08-0.20)	100
Europe	47 (63,453,690)	0.33 (0.28-0.39)	99.9	14 (185,375)	0.79 (0.52-1.13)	94.9	14 (114,038)	0.61 (0.39-0.88)	98.4	15 (63,152,343)	0.12 (0.08-0.17)	100
Publication year												
1943-1979	8 (134,250)	0.40 (0.17-0.73)	98.2	8 (134,250)	0.40 (0.17-0.73)	98.2	-	-	-	-	-	-
1980-1989	7 (43,260)	0.49 (0.39-0.60)	43.9	5 (25,256)	0.46 (0.33-0.61)	47.2	2 (18,004)	0.57 (0.46-0.68)	0.0	-	-	-
1990-1999	6 (4,133)	0.37 (0.21-0.58)	0.0	6 (4,133)	0.37 (0.21-0.58)	0.0	-	-	-	-	-	-
2000-2009	20 (338,040)	0.44 (0.29-0.62)	97.2	9 (119,413)	0.58 (0.28-0.99)	97.6	8 (31,103)	0.40 (0.22-0.64)	80.2	3 (187,524)	0.11 (0.07-0.15)	73.0
2010-2019	43 (130,930,885)	0.39 (0.33-0.46)	99.9	16 (64,153)	0.68 (0.38-1.07)	95.4	12 (142,533)	0.67 (0.32-1.16)	98.3	10 (130,660,039)	0.09 (0.05-0.15)	100
2020-	28 (242,391,717)	0.41 (0.36-0.48)	100	5 (132,703)	0.89 (0.68-1.13)	63.6	9 (210,720)	1.28 (0.90-1.73)	98.2	14 (242,048,294)	0.15 (0.11-0.20)	100
Sample size, n ≥5000	54 (373,722,024)	0.32 (0.28-0.36)	100	17 (500,617)	0.43 (0.27-0.62)	98.8	13 (377,647)	0.76 (0.46-1.13)	99.3	24 (372,820,147)	0.13 (0.09-0.16)	100
Low risk of bias	52 (314,200,147)	0.27 (0.22-0.31)	100	22 (345,581)	0.56 (0.38-0.78)	97.8	6 (58,900)	0.86 (0.50-1.32)	92.8	25 (313,795,666)	0.13 (0.09-0.17)	100

Abbreviations: 95% CI, 95% confidence intervals; n, number.

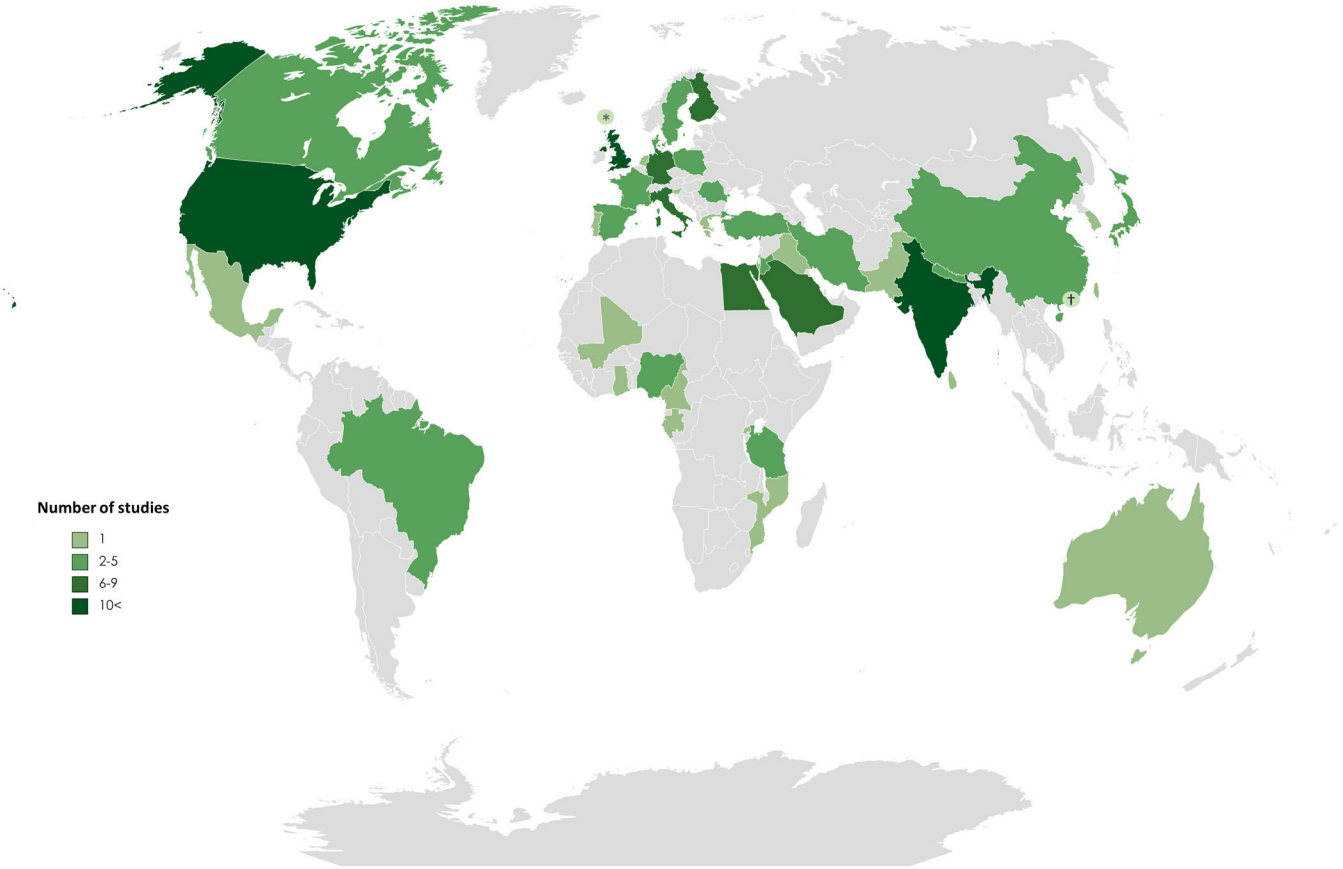

FIGURE 2 Distibution of studies on the prevalence of vitiligo conducted in each country. *Faroe Islands. †Hong Kong. Countries with no observed prevalence studies are light grey.

Our findings revealed a lower overall prevalence compared to the commonly accepted estimate of 0.5% −1%. The lower prevalence could be caused by the inclusion of participants from all age groups in the overall analysis (except for studies that specifically examined children and adolescents), as the adult prevalence of 0.70% corresponded to the accepted estimate. Since vitiligo can debut at any age and seldom goes into complete remission, the prevalence increases with age, thus possibly explaining the higher prevalence found in adults compared to children and adolescents.

The overall prevalence was comparable to the prevalence reported in a very recent meta-analysis (0.36% based on 71 studies),[13] but higher than the prevalence reported in a 2016 meta-analysis (0.20% based on 82 studies).[15] The latter study also showed a higher prevalence among females (0.50%) than males (0.20%), and included studies that specifically examined children and adolescents in the overall analysis, which could explain our diverging results. In another study by Krüger et al.[14] from 2012, the prevalence in adults ranged from 0.06% to 2.28% across 30 studies, which was comparable to the prevalence range among adults in this study.

We observed a substantial variation in the prevalence of vitiligo, both regionally and within specific countries. West Asia and East Asia showed the highest and lowest regional prevalence, while the highest and lowest country-specific prevalence was reported in Jordan and Sweden. Furthermore, we noticed variation within countries, as documented in a United Kingdom-based study,[22] wherein individuals of South Asian descent had a significantly higher prevalence compared to individuals of white ethnicity.

The high prevalence reported in West Asia and Jordan could be explained by social and cultural stigma being more common, or because the populations have darker skin, which causes increased visibility of vitiligo lesions and earlier healthcare-seeking behaviour.[23] Areas and populations with a low prevalence could be attributed to limited awareness by healthcare providers dismissing vitiligo as a cosmetic concern instead of an autoimmune disease.[24,25]

Differences in study types contributed to the variation in the observed prevalence.[26] The subgroup analyses revealed a prevalence of 0.73% in questionnaire studies, 0.59% in examination-based studies, and 0.13%

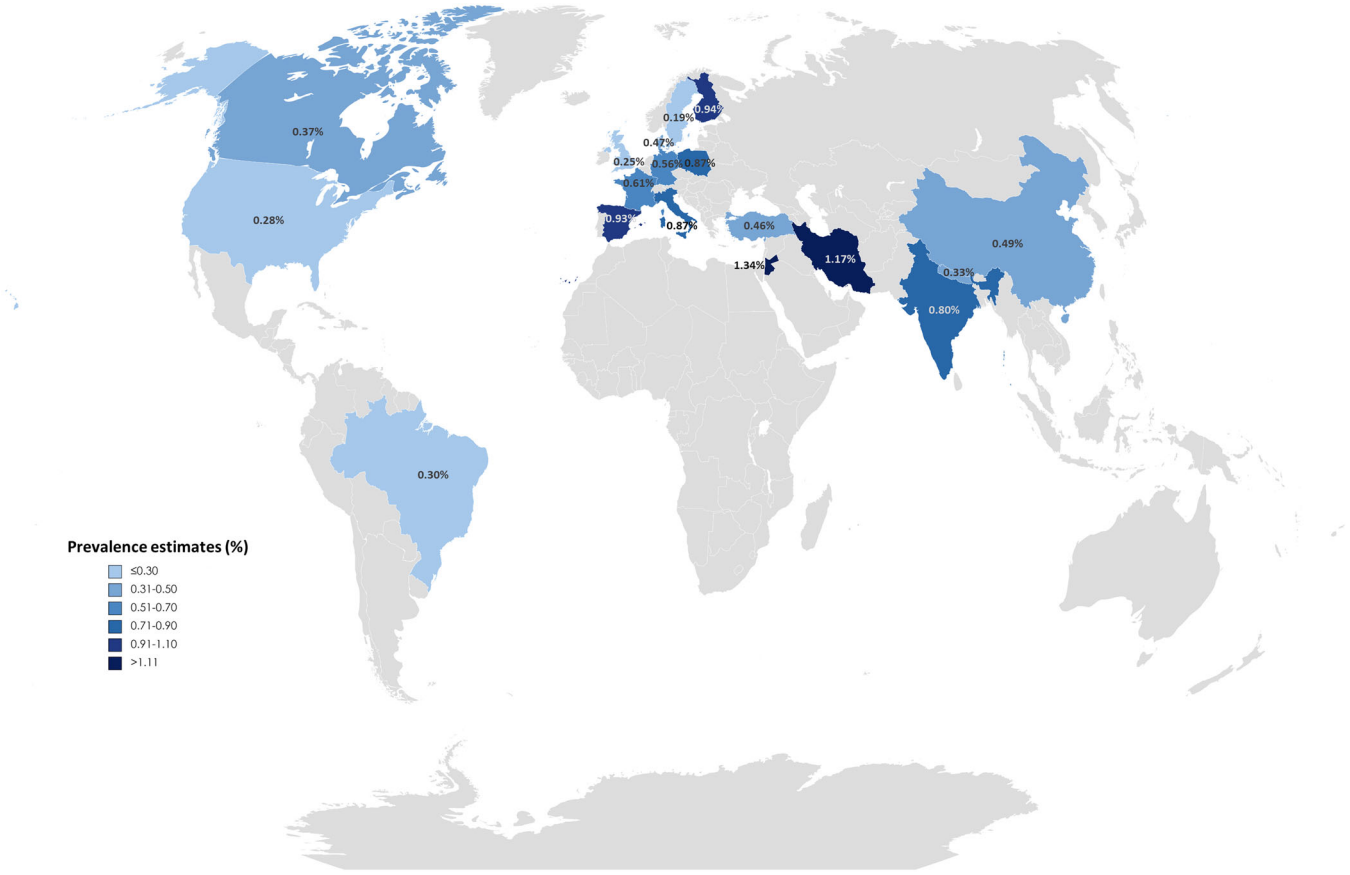

FIGURE 3 The overall prevalence of vitiligo categorised by countries. The prevalence estimates are based on the overall meta-analysis, which included all studies, except for studies only examining children and adolescents. A minimum of two studies in each country was required to conduct the meta-analysis. Countries with no observed data are light grey.

in register-based studies. These differences emphasise the challenges in presenting accurate prevalence estimates. Several questionnaire studies included non-random sampling and self-report, which may have caused an overestimation due to misdiagnosis. Register-based studies are prone to nonattendance bias, since individuals affected by vitiligo may not commonly seek medical attention,[27–29] which could cause an underestimation of the prevalence of vitiligo. Examination-based studies can effectively determine prevalence provided that random sampling methods are implemented, and the outcome is consistently evaluated.[30] However, we observed considerable variation in the study designs; some studies were conducted by trained dermatologists and others by investigators with limited training, which could have caused overestimation. Further, vitiligo is more commonly diagnosed in the summer, and seasonal variation could therefore have influenced the outcomes in some studies, possibly because of an increased contrast between affected and unaffected skin.[11] The outcomes could also have been influenced by sampling populations with darker skin, where vitiligo lesions are more apparent, and in cultures with high stigma, where healthcare-seeking behaviour is more common.[23]

The prevalence categorised by publication date showed a stable trend in the overall population analysis, suggesting no change in the prevalence over the past 80 years (Figure 4). Interestingly, the prevalence of examination-based and questionnaire-based studies showed a gradual increase over time, while there was consistently low prevalence in register-based studies. Our findings suggest that prevalence derived from registers and questionnaires may lead to either an underestimation or overestimation when compared to examination-based studies. The findings presented here support the conclusions reached in the dual-based research conducted by Mohr et al.[31] which reported a higher prevalence in adults in the examination-based study relative to the register-based study of 0.77% and 0.17%. In the subgroup analyses categorised by a minimum of 5000 participants or low risk of bias, the prevalence was 0.32% and 0.27%. The findings showed that excluding biased studies reduced the prevalence compared to the overall analysis, potentially providing a more representative reflection of the general population.

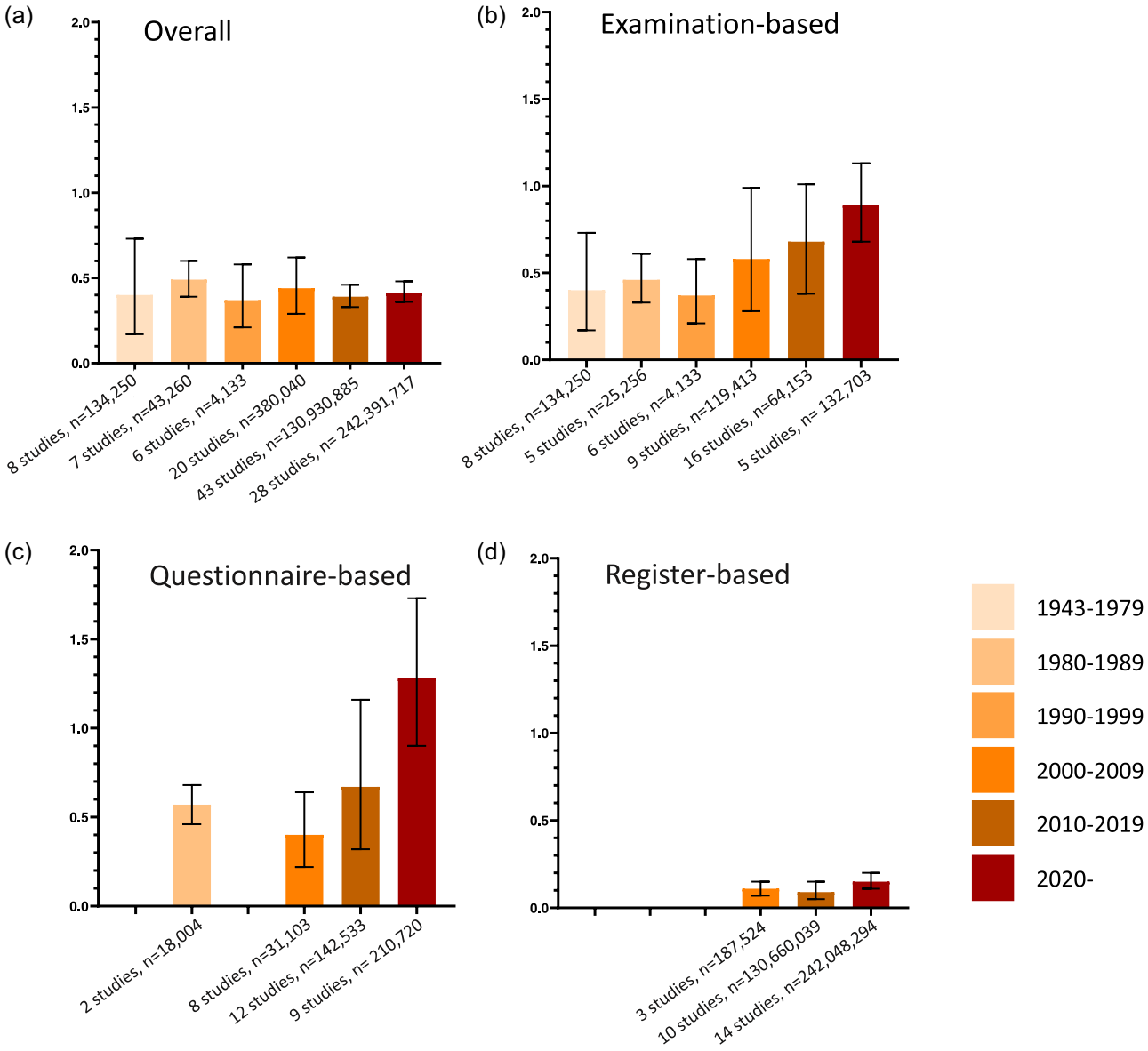

FIGURE 4 The prevalence of vitiligo categorized by publication year in (a) the overall population, (b) examination-based studies, (c) questionnaire-based studies, (d) register-based studies. *n*, number of participants.

Strengths and limitations

The study had limitations, including the classification of vitiligo as a single entity. However, only a minority of the included studies differentiated between vitiligo subtypes. The included studies rarely reported a prevalence of zero. Since negative results might not be documented, there is a potential risk of studies that found no cases did not report their findings, resulting in an overestimation of the overall prevalence. However, we reduced the risk of overestimation through subgroup analyses of studies with at least 5000 participants. The overall analysis generally showed a high level of heterogeneity, but we used subgroup analyses to address the most prominent differences and observed a substantial variance in the prevalence. Since we only included studies written in the English language, we may have excluded relevant studies. Still, we included studies from multiple global regions and only four studies were excluded because of non-English language (Figure 1). Most of the regional studies were conducted in Europe and North America, whereas studies conducted in South America, Africa, Central Asia, and Oceania were limited or lacking. Several regions showed an uneven distribution of countries included, and the prevalence in these regions might reflect within-country variations rather than serving as a regional representation.[32] This study also had its strengths. The literature search was performed by a team of four researchers and encompassed multiple databases. Furthermore, the references of each study meeting the

inclusion criteria were thoroughly reviewed. This allowed us to include relevant studies from all publication dates, even those without searchable MeSH terms or a digital object identifier.

CONCLUSION

The overall prevalence of vitiligo was 0.40% with a similar prevalence among females and males. The highest prevalence was reported in Jordan and the lowest in Sweden. There was a higher prevalence among adults compared to children and adolescents. The subgroup analysis categorised by study types influenced the prevalence. There is a lack of incidence studies and prevalence studies conducted in South America, Africa, Central Asia, and Oceania.

AUTHOR CONTRIBUTIONS

Morten Bahrt Haulrig, contributed to the study design, data collection, drafting of the paper, and interpretation of the work. Nikolai Loft contributed to supervision, the study design, data collection, analysis, critical revision, and interpretation of the work. Rownaq Al-Sofi, Subisan Baskaran, Mie Siewertsen Bergmann contributed to the data collection, critical revision, and interpretation of the work. Lone Skov contributed to the study design, critical revision, and interpretation of the work. Marianne Løvendorf and Beatrice Dyring-Andersen contributed to critical revision and interpretation of the work. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

ACKNOWLEDGEMENTS

Herlev and Gentofte Hospital Research Council, Aage Bang Foundation, Carl and Ellen Hertz' grant to Medical and Natural Sciences, and The Novo Nordisk Foundation (NNF21OC0066694). The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

CONFLICT OF INTEREST STATEMENT

Lone Skov has been an advisor, investigator, and speaker for Abbvie, Eli Lilly, Novartis, Sanofi, LEO Pharma, BMS, UCB, Incyte, Stada, Takeda, Pfizer and Almirall, outside the submitted work. Lone Skov reports nonfinancial support from grants from Almirall, Novartis, Janssen, BMS, and Sanofi. Nikolai Loft has been a speaker for Eli Lilly, Janssen Cilag, and Sandoz. The remaining authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article.

ETHICS STATEMENT

Not applicable.

ORCID

Morten Bahrt Haulrig http://orcid.org/0000-0002-5553-3213
Rownaq Al-Sofi http://orcid.org/0009-0000-6411-6393
Subisan Baskaran http://orcid.org/0009-0001-2813-4946
Mie Siewertsen Bergmann http://orcid.org/0000-0002-8913-9644
Marianne Løvendorf http://orcid.org/0000-0002-7361-5845
Beatrice Dyring-Andersen http://orcid.org/0000-0002-3012-2645
Lone Skov http://orcid.org/0000-0002-4784-9680
Nikolai Loft http://orcid.org/0000-0002-2950-3280

REFERENCES

1. Morrison B, Burden-Teh E, Batchelor JM, Mead E, Grindlay D, Ratib S. Quality of life in people with vitiligo: a systematic review and meta-analysis. Br J Dermatol. 2017;177(6):e338–9.
2. Ezzedine K, Eleftheriadou V, Jones H, Bibeau K, Kuo FI, Sturm D, et al. Psychosocial effects of vitiligo: a systematic literature review. Am J Clin Dermatol. 2021;22(6):757–74. https://doi.org/10.1007/s40257-021-00631-6
3. Ezzedine K, Eleftheriadou V, Whitton M, Van Geel N. Vitiligo. Lancet. 2015;386(9988):74–84.
4. Dahir AM, Thomsen SF. Comorbidities in vitiligo: comprehensive review. Int J Dermatol. 2018;57(10):1157–64.
5. Ezzedine K, Lim HW, Suzuki T, Katayama I, Hamzavi I, Lan CCE, et al. Revised classification/nomenclature of vitiligo and related issues: the vitiligo global issues consensus conference. Pigm Cell Melanoma Res. 2012;25(3):E1–13. https://doi.orrg/10.1111/j.1755-148X.2012.00997.x
6. Frisoli ML, Essien K, Harris JE. Vitiligo: mechanisms of pathogenesis and treatment. Annu Rev Immunol. 2020;38:621–48.
7. Gellatly KJ, Strassner JP, Essien K, Refat MA, Murphy RL, Coffin-Schmitt A, et al. scRNA-seq of human vitiligo reveals complex networks of subclinical immune activation and a role for CCR5 in treg function. Sci Transl Med. 2021;13(610):1–14.
8. Wang XX, Wang QQ, Wu JQ, Jiang M, Chen L, Zhang CF, et al. Increased expression of CXCR3 and its ligands in patients with vitiligo and CXCL10 as a potential clinical marker for vitiligo. Br J Dermatol. 2016;174(6):1318–26.
9. Rashighi M, Agarwal P, Richmond JM, Harris TH, Dresser K, Su MW, et al. CXCL10 is critical for the progression and maintenance of depigmentation in a mouse model of vitiligo. Sci Transl Med. 2014;6(223):223ra23. https://doi.org/10.1126/scitranslmed.3007811
10. Ray M, Gandhi K, Maughn K, Pandya AG. Diagnosed prevalence and incidence of vitiligo in the United States: analysis

of employer-sponsored insurance claims. JID Innovat. 2023; 3(4):100199.
11. Conrad N, Misra S, Verbakel JY, Verbeke G, Molenberghs G, Taylor PN, et al. Incidence, prevalence, and co-occurrence of autoimmune disorders over time and by age, sex, and socioeconomic status: a population-based cohort study of 22 million individuals in the UK. Lancet. 2023;401(10391):1878–90. https://doi.org/10.1016/S0140-6736(23)00457-9
12. Lee YB, Kim S, Kim HS. The incidence, prevalence, and mortality of vitiligo in korea: A nationwide Population-Based cohort study. J Cutan Med Surg. 2023;27(2):166–7.
13. Akl J, Lee S, Ju HJ, Parisi R, Kim JY, Jeon JJ, et al. Estimating the burden of vitiligo: a systematic review and modelling study. Lancet Public Heal. 2024;9(6):e386–96. https://doi.org/10.1016/S2468-2667(24)00026-4
14. Krüger C, Schallreuter KU. A review of the worldwide prevalence of vitiligo in children/adolescents and adults. Int J Dermatol. 2012;51(10):1206–12.
15. Zhang Y, Cai Y, Shi M, Jiang S, Cui S, Wu Y, et al. The prevalence of vitiligo: a meta-analysis. PLoS One. 2016;11(9): e0163806.
16. Downes MJ, Brennan ML, Williams HC, Dean RS. Development of a critical appraisal tool to assess the quality of cross-sectional studies (AXIS). BMJ Open. 2016;6(12):e011458.
17. Wells G, Shea B, O'Connel D, Peterson J, Welch V, Losos M, et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Ottawa Hosp Res Inst. 2020.
18. Pedisic Z, Shrestha N, Kovalchik S, Stamatakis E, Liangruenrom N, Grgic J, et al. Is running associated with a lower risk of all-cause, cardiovascular and cancer mortality, and is the more the better? A systematic review and meta-analysis. Br J Sports Med. 2020;54(15):898–905.
19. Bull C, Byrnes J, Hettiarachchi R, Downes M. A systematic review of the validity and reliability of patient-reported experience measures. Health Serv Res. 2019;54(5):1023–35.
20. Fisher G, Quel de Oliveira C, Verhagen A, Gandevia S, Kennedy D. Proprioceptive impairment in unilateral neglect after stroke: a systematic review. SAGE Open Med. 2020;8:205031212095107.
21. WHO. Adolescent health [Internet]. Accessed November 6, 2023. https://www.who.int/health-topics/adolescent-health#tab=tab_1
22. Subramanian A, Adderley NJ, Gkoutos GV, Gokhale KM, Nirantharakumar K, Krishna MT. Ethnicity-based differences in the incident risk of allergic diseases and autoimmune disorders: a UK-based retrospective cohort study of 4.4 million participants. Clin Experime Aller. 2021;51(1):144–7.
23. Sehgal V, Srivastava G. Vitiligo: compendium of clinico-epidemiological features. Indian J Dermatol Venereol Leprol. 2007;73(3):149–56.
24. Teasdale E, Muller I, Abdullah Sani A, Thomas KS, Stuart B, Santer M. Views and experiences of seeking information and help for vitiligo: a qualitative study of written accounts. BMJ Open. 2018;8(1):e018652.
25. Ezzedine K, Sheth V, Rodrigues M, Eleftheriadou V, Harris JE, Hamzavi IH, et al. Vitiligo is not a cosmetic disease. J Am Acad Dermatol. 2015;73(5):883–5. https://doi.org/10.1016/j.jaad.2015.07.039
26. Higgins JPT. Measuring inconsistency in meta-analyses. BMJ. 2003;327(7414):557–60.
27. Migayron L, Boniface K, Seneschal J. Vitiligo, from physiopathology to emerging treatments: a review. Dermatol Ther. 2020;10(6):1185–98. https://doi.org/10.1007/s13555-020-00447-y
28. Thygesen LC, Ersbøll AK. When the entire population is the sample: strengths and limitations in register-based epidemiology. Eur J Epidemiol. 2014;29(8):551–8.
29. Radtke MA, Schäfer I, Gajur AI, Augustin M. Clinical features and treatment outcomes of vitiligo from the patients' perspective: results of a national survey in Germany. Dermatology. 2010;220(3):194–200.
30. Mann CJ. Observational research methods. Research design II: Emerg Med J. 2003;20(1):54–60. https://doi.org/10.1136/emj.20.1.54
31. Mohr N, Petersen J, Kirsten N, Augustin M. Epidemiology of vitiligo – a dual population-based approach. Clin Epidemiol. 2021;13:373–82.
32. Imrey PB. Limitations of meta-analyses of studies with high heterogeneity. JAMA Network Open. 2020;3(1):e1919325.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Haulrig MB, Al-Sofi R, Baskaran S, Bergmann MS, Løvendorf M, Dyring-Andersen B, et al. The global epidemiology of vitiligo: a systematic review and meta-analysis of the incidence and prevalence. JEADV Clin Pract. 2024;1–10. https://doi.org/10.1002/jvc2.526