Parasitology Research (2020) 119:3125–3143
https://doi.org/10.1007/s00436-020-06847-5

ARTHROPODS AND MEDICAL ENTOMOLOGY - REVIEW

Pediculosis capitis among school-age students worldwide as an emerging public health concern: a systematic review and meta-analysis of past five decades

Kareem Hatam-Nahavandi[1,2] · Ehsan Ahmadpour[3,4] · Fariba Pashazadeh[5] · Asiyeh Dezhkam[1] · Mehdi Zarean[6] · Raheleh Rafiei-Sefiddashti[7] · Alireza Salimi-Khorashad[8] · Saeed Hosseini-Teshnizi[9] · Teimour Hazratian[4,10] · Domenico Otranto[11]

Received: 14 May 2020 / Accepted: 7 August 2020 / Published online: 15 August 2020

Abstract

Pediculosis by *Pediculus humanus capitis* is still an important health issue in school-age students worldwide. Although pediculicidal agents effectively kill head lice, the re-infestation rate is still high. This study was conducted to provide a summary of evidence about the prevalence of pediculosis capitis among school-age students worldwide. Different databases including MEDLINE/PubMed, Scopus, and Web of Science were searched for publications related to pediculosis capitis in school-age students from 1977 to 2020. All peer-reviewed original research articles describing pediculosis capitis among school-age students were included. Statistical heterogeneity of the different years among studies was assessed using the standard chi squared and I^2 tests. Due to the significant heterogeneity, a random effect model was adopted to estimate the pooled, continent, and gender-specific prevalence of pediculosis. Two hundred and one papers met the inclusion criteria of this review and entered into the meta-analysis including 1,218,351 individuals. Through a random effect model, the prevalence of pediculosis capitis among school students was estimated as 19% (CI 95% = 0.18–0.20%, I^2 = 99.89%). The prevalence of pediculosis capitis among boys was 7% (CI 95% = 0.05–0.10) compared to 19% (CI 95% = 0.15–0.24) in girls. The highest prevalence was in Central and South America (33%, CI 95% = 0.22–0.44, I^2 = 99.81%) and the lowest was in Europe (5%, CI 95% = 4–6, I^2 = 99.28%). Relatively high pediculosis capitis prevalence among school-age students observed in this study emphasizes the need for implementing screening and prophylaxis tailored to the local context.

Keywords Pediculosis capitis · School-age students · Worldwide

Handling Editor: Una Ryan

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00436-020-06847-5) contains supplementary material, which is available to authorized users.

✉ Ehsan Ahmadpour
ehsanahmadpour@gmail.com

[1] School of Medicine, Iranshahr University of Medical Sciences, Iranshahr, Iran

[2] Research Center for Contagious Diseases and Tropical Infections, Iranshahr University of Medical Sciences, Iranshahr, Iran

[3] Infectious and Tropical Diseases Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

[4] Department of Parasitology and Mycology, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

[5] Research Center for Evidence Based Medicine (RCEBM), Tabriz University of Medical Sciences, Tabriz, Iran

[6] Department of Parasitology and Mycology, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

[7] Department of Parasitology and Mycology, Iran University of Medical Sciences, Tehran, Iran

[8] Department of Parasitology and Mycology, Zahedan University of Medical Sciences, Zahedan, Iran

[9] Food Health Research Center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

[10] Immunology Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

[11] Department of Veterinary Medicine, Università degli Studi di Bari, Valenzano, Bari, Italy

Introduction

Head lice infestation or pediculosis capitis, initiated by *Pediculus humanus capitis*, is an important public health problem, which is widespread around the world and more common in developing countries, among school-age students (Yingklang et al. 2018). Pediculosis capitis is restricted to the scalp and can result in scalp pruritus which is a common and distressing symptom. Depression, insomnia, allergies, and hair loss may also occur (Nutanson et al. 2008; Oh et al. 2010; Moosazadeh et al. 2015; Galassi et al. 2018). Although pediculicidal agents effectively kill head lice, the re-infestation rate is still high (Yingklang et al. 2018). Epidemiological studies have found local prevalence rates to range from zero to over 80% (Shakkoury and Abu-Wandy 1999; Saddozai and Kakarsulemankhel 2008; Rassami and Soonwera 2012). To date, various studies have been performed to evaluate the pediculosis capitis prevalence between school-age students worldwide. There are substantial differences in the results of these studies which restrict their use in public health policy making. A systematic review previously assessed the prevalence of pediculosis capitis and its associated factors among primary school students in Iran (Moosazadeh et al. 2015). Despite combining data from across the world and over half a century in a meta-analysis, improved decision and policy making for dealing with pediculosis capitis was not evident. Therefore, the current systematic review was conducted and combined the available information to provide a general perspective on the overall prevalence of pediculosis capitis for researchers and public health decision-makers. The aim of the current research is to estimate pediculosis capitis prevalence in school children worldwide by meta-analysis.

Methods

The protocol of the present systematic review has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) (https://www.crd.york.ac.uk/PROSPERO), study protocol registration CRD42018103342.

Search strategy

The protocol was followed with no changes, and the review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (Additional file 1) (Moher et al. 2009).

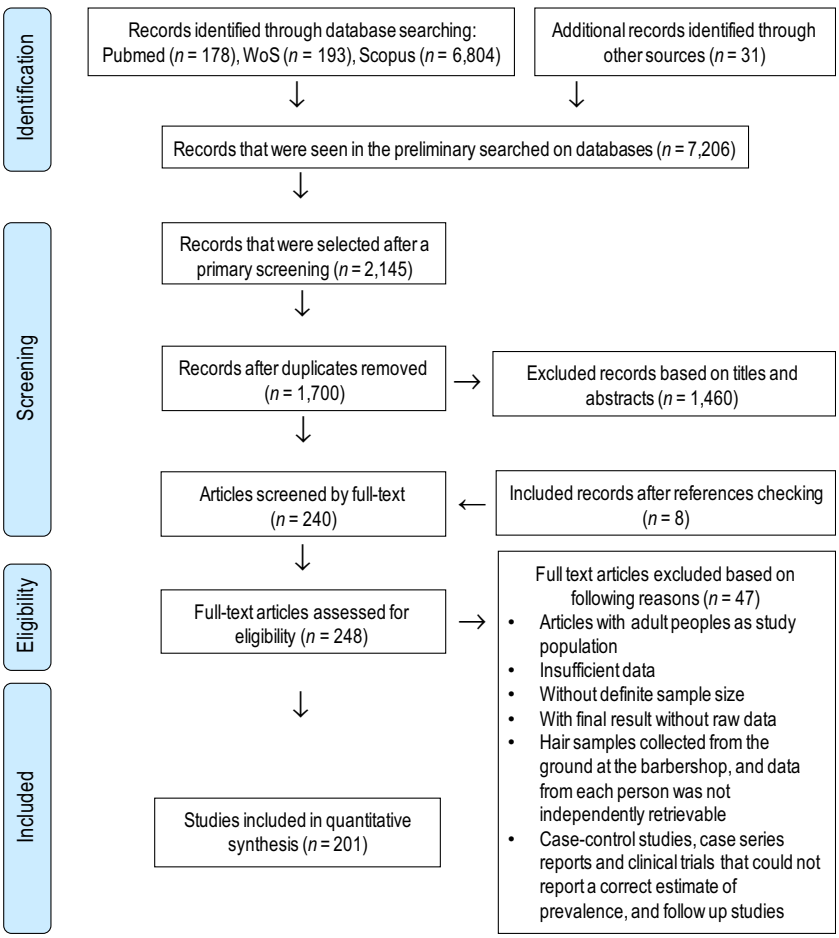

Fig. 1 Flow diagram describing paper selection process according to PRISMA guidelines

Table 1 Demographic data and prevalence of infestation of head lice in school students in developing and developed countries (sorted by publication date)

Location of study	Study year	Sample size			No. positive (%)			Association between prevalence of head lice with variables (*P* value)							Age group	Ref.
		Total	Boy	Girl	Total	Boy	Girl	Hair size	Edu. of mother	Edu. of father	Job of mother	Job of father	Falimy size	Freq. of hair washing		
USA	1974	2283	n.s.	n.s.	53 (2.3)	n.s.	n.s.	> 0.05	-	-	-	-	< 0.05	-	n.s.	Slonka et al. 1976
UK	1975	22,519	11,799	10,720	656 (2.9)	302 (2.5)	354 (3.3)	-	-	-	-	-	-	-	< 16 years	Donaldson 1976
USA	1973	281	n.s.	n.s.	45 (16.0)	n.s.	n.s.	> 0.05	-	-	-	-	-	-	n.s.	Slonka et al. 1977
Nigeria	1976	4242	n.s.	n.s.	746 (17.6)	n.s.	n.s.	-	-	-	-	-	-	-	3–26 years	Iwuala and Onyeka 1977
Holand	1977	5155	n.s.	n.s.	227 (4.4)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Bergink 1979
Holand	1978	4679	n.s.	n.s.	142 (3.0)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Bergink 1979
Italy	1978	1988	n.s.	n.s.	190 (9.6)	n.s.	n.s.	-	-	-	-	-	-	-	3–13 years	Petrelli et al. 1980
Italy	1978–79	3076	n.s.	n.s.	81 (2.6)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Pelissero et al. 1980
Germany	1979	9300	n.s.	n.s.	298 (3.2)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Letz 1980
Brazil	n.s.	9955	n.s.	n.s.	4972 (49.9)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Bechelli et al. 1981
Canada	1978	163	n.s.	n.s.	17 (10.4)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Ewasechko 1981
Malaysia	1979	308,101	n.s.	n.s.	33,000 (10.7)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Sinniah et al. 1981
Taiwan	1979–80	2509	-	2509	998 (39.8)	-	998 (39.8)	-	-	-	-	-	-	-	n.s.	Chao et al. 1981
Ghana	n.s.	319	170	149	158 (49.5)	78 (45.9)	80 (53.7)	-	-	-	-	-	-	-	7–11 years	Kwaku-Kpikpi 1982
Malaysia	1982	4112	n.s.	n.s.	530 (12.9)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Sinniah et al. 1983
Nigeria	1982	2333	n.s.	n.s.	113 (4.8)	n.s.	n.s.	-	-	-	-	-	-	-	5–15 years	Ogunrindae and Oyejide 1984
South Korea	1983	615	n.s.	n.s.	452 (73.5)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Lee et al. 1984
Malaysia	1984	1243	n.s.	n.s.	513 (41.5)	n.s.	n.s.	-	-	-	-	-	-	-	1–15 years	Sinniah et al. 1984
South Korea	1984	5937	n.s.	n.s.	2642 (44.5)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Kim et al. 1984
Nigeria	1983	2704	1364	1340	344 (12.7)	150 (11.0)	194 (14.5)	-	-	-	-	-	-	-	5–11 years	Jinadu 1985
Kenya	1984	1270	n.s.	n.s.	217 (17.1)	n.s.	n.s.	-	-	-	-	-	-	-	3–15 years	Chunge 1986
Saudi Arabia	1983	300	167	133	37 (12.3)	20 (12.0)	17 (12.8)	-	-	-	-	-	-	-	< 10 years	Boyle 1987
South Korea	1985	420	n.s.	n.s.	386 (91.9)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Pai and Huh 1987
Israel	n.s.	1431	n.s.	n.s.	793 (55.4)	n.s.	n.s.	-	-	-	-	-	-	-	6–15 yeas	Sarov et al. 1988
Libya	n.s.	13,734	6276	7458	10,796 (78.6)	4220 (67.2)	6576 (88.1)	-	-	-	-	-	-	-	6–16 years	Bharija et al. 1988
Nigeria	n.s.	1842	n.s.	n.s.	57 (3.1)	n.s.	n.s.	-	-	-	-		-	-	n.s.	Ebomoyi 1988
Pakistan	1986	2287	788	1499	1046 (46.0)	734 (49.0)	312 (40.0)	> 0.05	-	-	-	-	-	-	8–16 years	Suleman and Fatima 1988
Spain	n.s.	23,624	n.s.	n.s.	2219 (9.39)	n.s.	n.s.	-	-	-	-	-	-	-	3–14 years	De Buruaga et al. 1989
South Korea		11,865	n.s.	n.s.	2900 (24.4)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Pai et al. 1989
Israel	1988	3079	n.s.	n.s.	344 (11.2)	n.s.	n.s.	< 0.05	-	-	-	-	-	-	4–17 years	Mumcuoglu et al. 1990
Ethiopia	n.s.	1842	n.s.	n.s.	1020 (55.4)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Dagnew and Erwin 1991
Taiwan	1990	10,562	n.s.	n.s.	1700 (16.0)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Fan et al. 1991
Egypt	n.s.	486	n.s.	n.s.	80 (16.4)	n.s.	n.s.	-	-	-	-	-	-	-	6–12 years	Morsy et al. 1991
Sierra Leone	n.s.	84	n.s.	n.s.	25 (30.0)	n.s.	n.s.	-	-	-	-	-	-	-	5–18 years	Dunne et al. 1991
Sierra Leone	n.s.	1007	n.s.	n.s.	69 (6.8)	n.s.	n.s.	-	-	-	-	-	-	-	6–13 years	Gbakima and Lebbie 1992
South Korea	1990	931	466	465	346 (37.2)	105 (22.5)	241 (51.8)	-	-	-	-	-	-	-	6–12 years	Huh et al. 1993
Nigeria	1987	6822	3749	3133	254 (3.7)	79 (2.1)	175 (5.6)	-	-	-	-	-	-	-	6–15 years	Ebomoyi 1994
Poland	1992	27,800	n.s.	n.s.	881 (3.2)	n.s.	n.s.	-	-	-	-	-	-	-	6–15 years	Wegner et al. 1994
South Korea	1995	1530	768	762	76 (5.0)	4 (0.5)	72 (9.4)	-	-	-	-	-	-	-	6–12 years	Hong et al. 1995
Mali	n.s.	1817	n.s.	n.s.	85 (4.6)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Mahé et al. 1995
Jordan	n.s.	3440	n.s.	n.s.	232 (6.7)	n.s.	n.s.	-	-	-	-		-	-	n.s.	Rabi et al. 1996
Saudi Arabia	n.s.	2788	n.s.	n.s.	307 (11.0)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Zimmo et al. 1996

Table 1 (continued)

Location of study	Study year	Sample size			No. positive (%)			Association between prevalence of head lice with variables (*P* value)							Age group	Ref.
		Total	Boy	Girl	Total	Boy	Girl	Hair size	Edu. of mother	Edu. of father	Job of mother	Job of father	Falimy size	Freq. of hair washing		
Saudi Arabia	n.s.	2376	n.s.	n.s.	19 (0.8)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Abolfotouh et al. 1996
Saudi Arabia	n.s.	467	467	-	45 (9.6)	45 (9.6)	-	-	-	-	-	-	-	-	n.s.	Bahamdan et al. 1996
Ethiopia	1992	112	-	-	65 (58.0)	-	-	-	-	-	-	-	-	-	n.s.	Figueroa et al. 1996
Argentina	n.s.	326	n.s.	n.s.	272 (83.4)	n.s.	n.s.	-	-	-	-	-	-	-	3–15 years	Chouela et al. 1997
Turkey	1993	5347	n.s.	n.s.	225 (4.2)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Ilhan et al. 1997
Argentina	1993	1390	n.s.	n.s.	630 (45.3)	n.s.	n.s.	-	-	-	-	-	-	-	5–14 years	De Doucet et al. 1997
Ethiopia	1995	219	n.s.	n.s.	204 (93.0)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Figueroa et al. 1997
India	1988–89	666	n.s.	n.s.	136 (20.42)	n.s.	n.s.	-	-	-	-	-	-	-	< 14 years	Bhatia and Nayar 1997
United Kingdom	1997	1001	n.s.	n.s.	187 (18.7)	n.s.	n.s.	-	-	-	-	-	-	-	4–11 years	Downs et al. 1999
Taiwan	n.s.	2725	n.s.	n.s.	349 (12.8)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Fan et al. 1999
Australia	1997	456	n.s.	n.s.	102 (22.4)	n.s.	n.s.	-	-	-	-	-	-	-	5–13 years	Speare and Buettner 1999
Jordan	1997	2788	2788	00	307 (11.01)	307 (11.01)	00 (0.0)	-	-	-	-	-	-	-	6–14 years	Shakkoury and Abu-Wandy 1999
Iran	1998	524	276	248	41 (7.8)	00 (0.0)	41 (16.5)	-	-	-	-	-	-	-	7–11 years	Ghavanini 1999
Egypt	n.s.	256	n.s.	n.s.	151 (58.9)	n.s.	n.s.	-	-	-	-	-	-	-	4–6 years	El-Sahn et al. 2000
Egypt	n.s.	510	250	260	276 (54.1)	85 (34.0)	191 (73.4)	-	-	-	-	-	-	-	6–11 years	Omar 2000
Jordan	n.s.	2519	808	1711	338 (13.4)	90 (11.1)	248 (14.5)	-	-	-	-	-	-	-	6–12 years	Amr and Nusier 2000
Belgium	1999	224	n.s.	n.s.	49 (21.9)	n.s.	n.s.	-	-	-		-	-	-	2–5 years	De Maeseneer et al. 2000
South Korea	1999	2288	1242	1046	294 (12.8)	48 (3.9)	246 (23.5)	-	-	-	-	-	-	-	n.s.	Ha et al. 2000
Taiwan	1998	3029	n.s.	n.s.	391 (12.9)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Wu et al. 2000
USA	1998	1729	918	811	91 (5.3)	20 (2.2)	71 (8.7)	-	-	-	-	-	-	-	5–8 years	Williams et al. 2001
Poland	1989	42,759	n.s.	n.s.	682 (1.6)	n.s.	n.s.	-	-	-	-	-	-	-	6–15 years	Buczek et al. 2001
Egypt	n.s.	1772	n.s.	n.s.	384 (21.6)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Morsy et al. 2001
Israel	1998	268	n.s.	n.s.	152 (56.7)	29 (36.7)	123 (65.1)	< 0.05	-	-	-	-	-	-	7–10 years	Mumcuoglu et al. 2001
Brazil	96–2000	884	443	441	309 (35.0)	101 (22.7)	208 (47.1)	-	-	-	-	-	-	-	< 15 years	Borges and Mendes 2002
India	2001	940	n.s.	n.s.	156 (16.6)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Khokhar 2002
Turkey	n.s.	785	n.s.	n.s.	74 (9.4)	n.s.	n.s.	-	-	-	-	-	-	-	6–14 years	Inanir et al. 2002
Turkey	2000–01	2277			321 (14.0)	n.s.	n.s.	-	-	-	-	-	-	-	6–11 years	Aksin et al. 2002
Turkey	1998	20,612	10,367	10,245	701 (3.4)	51 (0.49)	650 (6.34)	-	-	-	-	-	-	-	6–11 years	Tanyuksel et al. 2003
South Africa	2001	175	74	101	15 (8.6)	4 (5.4)	11 (10.9)	-	-	-	-	-	-	-	6–13 years	Govere et al. 2003
South Korea	2001	7495	3908	3587	437 (5.8)	36 (0.9)	401 (11.2)	-	-	-	-	-	-	-	5–12 yeasrs	Sim et al. 2003
Turkey	n.s.	5318	2847	2471	360 (6.8)	32 (1.1)	328 (13.3)	> 0.05	> 0.05	< 0.05	> 0.05	> 0.05	> 0.05	> 0.05	8–16 yeasrs	Kokturk et al. 2003
United Kingdom	n.s.	21,556	n.s.	n.s.	438 (2.03)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Harris et al. 2003
Iran	2002	918	-	918	248 (27.0)	-	248 (27.0)	> 0.05	-	-	-	-	-	-	6–14 years	Alempour Salemi et al. 2003
Iran	2002	2906	1493	1400	129 (4.5)	49 (3.3)	80 (5.7)	-	< 0.05	< 0.05	> 0.05	< 0.05	-	-	6–11 years	Pourbaba et al. 2004
Poland	96–2000	95,153	n.s.	n.s.	1688 (1.77)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Buczek et al. 2004
Australia	2001	1838	893	945	239 (13.0)	74 (8.3)	165 (17.5)	-	-	-	-	-	-	-	8–12 years	Counahan et al. 2004
Pakistan	2002	1516	365	1151	396 (26.0)	58 (15.8)	338 (29.3)	< 0.05	-	-	-	-	-	-	8–16 years	Ali and Ramzan 2004
Nepal	2003	818	n.s.	n.s.	172 (21.0)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Shakya et al. 2004
Thailand	2003	300	123	180	43 (14.2)	00 (0.0)	43 (23.9)	-	-	-	-	-	-	-	8–14 years	Fan et al. 2004

Table 1 (continued)

Location of study	Study year	Sample size			No. positive (%)			Association between prevalence of head lice with variables (*P* value)							Age group	Ref.
		Total	Boy	Girl	Total	Boy	Girl	Hair size	Edu. of mother	Edu. of father	Job of mother	Job of father	Falimy size	Freq. of hair washing		
Iran	2003	1650	-	1650	74 (4.5)	-	74 (4.5)	-	-	-	-	-	-	-	n.s.	Farzinnia et al. 2004
India	n.s.	150	n.s.	n.s.	72 (48.0)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Mallik et al. 2004
Iraq	n.s.	720	364	356	39 (5.4)	9 (2.5)	30 (8.4)	-	-	-	-	-	-	-	6–15 years	Al-Rubaiy et al. 2004
Argentina	n.s.	181	n.s.	n.s.	82 (45.0)	n.s.	n.s.	-	-	-	-	-	-	-	6–11 years	Catala et al. 2004
Argentina	2003	1370	678	692	842 (61.4)	296 (44.0)	546 (79.0)	-	-	-	-	-	-	-	n.s.	Catala et al. 2005
Iran	2003	4244	2115	2129	392 (18.4)	100 (4.7)	292 (13.7)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	7–12 years	Rafinejad et al. 2005
Iran	2003	1200	564	636	45 (3.8)	2 (0.4)	43 (6.8)	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	-	7–12 years	Kamiabi and Nakhaei 2005
Belgium	n.s.	6169	n.s.	n.s.	549 (8.9)	n.s.	n.s.	-	-	-	-	-	-	-	2–12 yeras	Willems et al. 2005
Turkey	n.s.	1569	812	757	260 (16.6)	20 (2.5)	240 (31.8)	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	-	7–14 years	Akisu et al. 2005
Turkey	2003	185	n.s.	n.s.	16 (8.7)	n.s.	n.s.	-	-	-	-	-	-	-	~ 13 years	Serarslan and Savaş 2005
Saudi Arabia	2003	2239	-	2239	117 (5.2)	-	117 (5.2)	-	-	-	-	-	-	-	n.s.	Al-Saeed et al. 2006
Czech Rep.	2004	531	n.s.	n.s.	75 (14.1)	n.s.	n.s.	-	-	-	-	-	-	-	6–15 years	Rupes et al. 2006
Palestine	2004	2408	-	2408	340 (14.1)	-	340 (14.1)	< 0.05	-	-	-	-	-	-	6–14 years	Al-Shawa 2006
Turkey	2004	1134	607	527	14 (1.2)	6 (0.9)	8 (1.5)	-	<0 .05	> 0.05	< 0.05	> 0.05	> 0.05	> 0.05	4–6 years	Ciftci et al. 2006
Turkey	2005	1261	648	613	117 (9.1)	16 (2.1)	101 (16.4)	-	-	-	-	-	-	-	7–12 years	Oguzkaya Artan et al. 2006
Malaysia	2006	463	243	220	162 (34.9)	25 (10.3)	137 (62.3)	< 0.05	-	-	> 0.05	> 0.05	< 0.05	-	7–12 yeras	Bachok et al. 2006
Turkey	n.s.	178	104	74	17 (9.4)	2 (1.9)	15 (20.2)	-	-	-	-	-	-	-	6–14 years	Ozçelik et al. 2006
Turkey	2004	117	n.s.	n.s.	6 (5.1)	n.s.	n.s.	-	-	-	-	-	-	-	6–21 years	Atambay et al. 2007
Egypt	2005	1200	564	636	45 (3.7)	2 (0.4)	43 (6.8)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	6–12 years	El-Enin and Osman 2007
Iran	n.s.	515	246	269	123 (23.9)	27 (11.02)	96 (35.6)	-	< 0.05	< 0.05	< 0.05	> 0.05	-	-	< 10 years	Soleimani et al. 2007
France	n.s.	3345	n.s.	n.s.	112 (3.3)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Durand et al. 2007
Iran	2007	845	440	407	58 (6.8)	3 (0.7)	55 (13.5)	-	< 0.05	< 0.05	-	> 0.05	< 0.05	-	n.s.	Nazari and Saidijam 2006
Venezuela	2003	327	n.s.	n.s.	94 (28.8)	n.s.	n.s.	-	-	-	-		-	-	n.s.	Cazorla et al. 2007
Germany	n.s.	1890	n.s.	n.s.	14 (0.7)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Jahnke et al. 2008
Iraq	n.s.	1000	500	500	72 (7.2)	27 (5.4)	45 (9.0)	-	-	-	-	-	-	-	7–15 years	Al-Aboody 2008
Iran	2006	40,586	19,774	20,812	721 (1.8)	118 (0.6)	603 (2.9)	-	< 0.05	-	-	-	-	-	6–12 years	Motovali-Emami et al. 2008
Iran	2006	2795	847	1948	102 (3.6)	00 (0.0)	102 (5.2)	-	-	-	-	-	-	-	5–19 yeras	Hodjati et al. 2008
Pakistan	2006	1560	215	1345	1352 (87.0)	98 (45.6)	1254 (93.2)	-	-	-	-	-	-	-	5–13 years	Saddozai and Kakarsulemankhel 2008
Yemen	n.s.	860	474	386	114 (13.3)	41 (8.6)	73 (18.9)	> 0.05	> 0.05	< 0.05	> 0.05	> 0.05	> 0.05	> 0.05	6–14 years	Al-Maktari 2008
Iran	2005	113,828	54,050	59,778	561 (0.5)	6 (0.01)	555 (0.9)	-	-	-	-	-	-	-	6–11 years	Davarpanah et al. 2009
Argentina	2006	1856	886	970	551 (29.6)	201 (22.6)	350 (36.0)	> 0.05	-	-	-	-	-	-	3–13 years	Toloza et al. 2009
Greece	2008	2025	n.s.	n.s.	244 (12.0)	n.s.	n.s.	-	-	-	-	-	-	-	3–13 years	Soultana et al. 2009
Iran	2008	900	450	450	12 (1.3)	2 (0.4)	10 (2.2)	-	< 0.05	<0.05	-	-	> 0.05	–	n.s.	Moradi et al. 2009
Turkey	2007	622	426	196	59 (9.5)	14 (3.3)	45 (23.0)	-	-	-	-	-	-	-	12–15 years	Dursun and Cengiz 2010
Malaysia	n.s.	120	52	68	37 (30.8)	26 (50.0)	11 (16.0)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	4–18 years	Muhammad Zayyid et al. 2010
Malaysia	2009	944	488	456	233 (24.7)	00	233 (51.0)	-	-	-	-		-	-	~ 16 years	Yap et al. 2010

Table 1 (continued)

Location of study	Study year	Sample size			No. positive (%)			Association between prevalence of head lice with variables (*P* value)							Age group	Ref.
		Total	Boy	Girl	Total	Boy	Girl	Hair size	Edu. of mother	Edu. of father	Job of mother	Job of father	Falimy size	Freq. of hair washing		
South Korea	2008	15,373	8018	7355	624 (4.1)	149 (1.9)	475 (6.5)	-	-	-	-	-	-	-	4–11 years	Oh et al. 2010
Iran	2008	500	200	300	24 (4.8)	4 (2.0)	20 (6.6)	-	> 0.05	< 0.05	-	-	< 0.05	< 0.05	n.s.	Shayeghi et al. 2010
Iraq	2009	540	240	300	73 (13.5)	21 (8.7)	52 (17.3)	< 0.05	-	-	-	-	-	-	6–12 years	Mahmood 2010
Australia	2006–08	11,154	5654	5500	2553 (22.9)	946 (16.7)	1607 (29.2)	-	-	-	-	-	-	-	~ 5.5 years	Currie et al. 2011
Mexico	2007	140	n.s.	n.s.	19 (13.6)	n.s.	n.s.	-	-	-	-	-	-	-	7–12 years	Manrique-Saide et al. 2011
Saudi Arabia	n.s.	860	n.s.	n.s.	114 (13.3)	n.s.	n.s.	-	-	-	-	-	-	-	6–13 years	Bosely and El-Alfy 2011
South Korea	2007	2210	n.s.	n.s.	334 (15.1)	n.s.	n.s.	-	-	-	< 0.05	< 0.05	< 0.05	< 0.05	n.s.	Sim et al. 2011
Norway	n.s.	8145	n.s.	n.s.	133 (1.63)	n.s.	n.s.	-	-	-	-	-	-	-	6–12 years	Rukke et al. 2011
Angola	2010	171	86	85	72 (42.1)	3 (3.5)	69 (81.2)	-	-	-	-	-	-	-	5–13 years	Magalhães et al. 2011
Indonesia	2010	158	91	65	31 (19.6)	18 (19.7)	13 (20.0)	-	-	-	-	-	-	-	8–16 years	Manusamy et al. 2011
Turkey	2010	405	214	191	44 (10.9)	3 (1.4)	41 (21.4)	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	-	> 0.05	6–14 years	Cetinkaya et al. 2011
Turkey	2010	2222	1106	1116	291 (13.1)	35 (3.2)	256 (22.9)	-	-	-	-	-	-	-	6–15 years	Akkas and Cengiz 2011
Turkey	2007	414	n.s.	n.s.	59 (14.3)	n.s.	n.s.	-	-	-	-	-	-	-	6–13 years	Aktürk et al. 2012
Egypt	2008–2009	2194	n.s.	n.s.	825 (37.6)	n.s.	n.s.	-	-	-	-	-	-	-	≤ 18 years	Yamamah et al. 2012
Turkey	2010	772	n.s.	n.s.	46 (6.0)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Değerli et al. 2012
Argentina	2011	220	95	125	94 (42.7)	27 (28.4)	67 (53.6)	-	-	-	-	-	-	-	n.s.	Gutiérrez et al. 2012
Iran	2009	1772	926	846	20 (1.12)	6 (0.64)	14 (1.65)	> 0.05	< 0.05	< 0.05	-	-	< 0.05	< 0.05	n.s.	Yousefi et al. 2012
Jordan	2009	1550	832	718	412 (26.6)	163 (19.6)	249 (34.7)	< 0.05	-	-	> 0.05	-	< 0.05	< 0.05	6–13 years	Al-Bashtawy 2012
Iran	2010	2040	866	1174	81 (4.0)	16 (1.8)	65 (5.5)	< 0.05	> 0.05	>0.05	> 0.05	> 0.05	-	> 0.05	5–16 years	Hazrati-Tappeh et al. 2012
Palestine	2010	600	282	318	53 (8.8)	5 (1.7)	48 (15.1)	> 0.05	> 0.05	< 0.05	-	-	< 0.05	> 0.05	6–15 y	Al-Zain 2012
Iran	n.s.	810	-	810	38 (4.7)	-	38 (4.7)	> 0.05	< 0.05	< 0.05	> 0.05	> 0.05	-	> 0.05	n.s.	Vahabi et al. 2012
Thailand	2011	3747	1901	1898	892 (23.4)	892 (46.9)	00 (00)	-	-	-		-	-	-	5–12 years	Rassami and Soonwera 2012
Nigeria	2011	204	108	96	54 (26.5)	20 (18.5)	34 (35.4)	-	-	-	-	-	-	-	6–12 years	Etim et al. 2012
Turkey	2011	342	93	249	35 (10.2)	1 (1.1)	34 (13.7)	-	-	-	-	-	-	-	6–15 years	Değerli et al. 2013
Peru	2006	302	n.s.	n.s.	60 (19.9)	n.s.	n.s.	-	-	-	-	-	-	-	≤ 15 years	Lesshafft et al. 2013
Iran	2010	10,841	6350	4491	114 (1.05)	7 (0.1)	107 (2.3)	-	-	-	-	-	-	-	n.s.	Omidi et al. 2013
Iran	2012	1846	n.s.	n.s.	106 (5.7)	n.s.	n.s.	-	-	-	-	-	> 0.05	-	7–11 years	Modarresi et al. 2013
Iran	n.s.	358	-	358	61 (15.8)	-	61 (15.8)	< 0.05	< 0.05	> 0.05	> 0.05	> 0.05	< 0.05	< 0.05	n.s.	Sayyadi et al. 2013
Iran	2010	750	-	750	60 (8.0)	-	60 (8.0)	> 0.05	< 0.05	< 0.05	> 0.05	< 0.05	-	< 0.05	n.s.	Vahabi et al. 2013
Nigeria	n.s.	1350	607	743	10 (0.7)	00 (0.0)	10 (1.3)	-	-	-	-	-	-	-	6–12 years	Okoh and Alikor 2013
Turkey	n.s.	8122	4032	4090	1066 (13.1)	35 (0.86)	1031 (25.2)	-	< 0.05	< 0.05	< 0.05	-	< 0.05	-	5–16 years	Gulgun et al. 2013
Turkey	n.s.	110	39	71	37 (33.6)	3 (2.7)	34 (30.9)	-	-	-	-	-	-	-	1–16 years	Başarslan et al. 2014
Iran	n.s.	384	164	220	54 (14.1)	14 (8.5)	40 (18.2)	-	< 0.05	> 0.05	> 0.05	< 0.05	> 0.05	< 0.05	6–12 years	Sayyadi et al. 2014
Iran	2008	2700	-	2700	97 (3.6)	-	97 (3.6)	-	-	-	-	-	-	-	n.s.	Mohammadi-Azni 2014
Iran	2010	3589	2096	1493	17 (0.7)	2 (0.1)	15 (1.0)	-	< 0.05	-	-	> 0.05	-	-	6–12 years	Doroodgar et al. 2014
Chile	2010	467	217	250	188 (40.3)	50 (23.0)	138 (55.2)	-	-	-	-	-	-	-	6–12 years	Gazmuri et al. 2014
Iran	2012	1510	-	1510	55 (3.6)	-	55 (3.6)	-	-	< 0.05	-	< 0.05	< 0.05	-	n.s.	Motevalli Haghi et al. 2014
Iran	2012	624	302	322	27 (4.3)	00 (0.0)	27 (8.3)	-	> 0.05	> 0.05	-	> 0.05	-	-	6–12 yeas	Salehi et al. 2014
Iran	95–2010	323	n.s.	n.s.	31 (9.6)	n.s.	n.s.	-	-	-	-	-	-	-	< 9 years	Berenji et al. 2014
Turkey	n.s.	214	125	89	29 (13.5)	7 (5.6)	22 (24.7)	-	-	-	-	-	-	-	6–11 years	Karakus et al. 2014

Table 1 (continued)

Location of study	Study year	Sample size			No. positive (%)			Association between prevalence of head lice with variables (*P* value)							Age group	Ref.
		Total	Boy	Girl	Total	Boy	Girl	Hair size	Edu. of mother	Edu. of father	Job of mother	Job of father	Falimy size	Freq. of hair washing		
Turkey	2007	863	n.s.	n.s.	198 (22.9)	n.s.	n.s.	-	-	-	-	-	-	-	5–15 years	Karaaslan and Yılmaz 2015
Poland	09–2012	17,141	n.s.	n.s.	345 (2.01)	138 (40.0)	207 (60.0)	-	-	-	-	-	-	-	n.s.	Bartosik et al. 2015
Brazil	2010–13	652	n.s.	n.s.	24 (3.7)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Nunes et al. 2015
Bangladesh	2012	300	n.s.	n.s.	179 (59.6)	n.s.	n.s.	-	-	-	-	-	-	-	1–7 years	Karim et al. 2015
Egypt	2013	10,935	n.s.	n.s.	1826 (16.7)	n.s.	n.s.	-	-	-	-	-	-	-	6–12 years	Abd El Raheem et al. 2015
Egypt	n.s.	1335	n.s.	n.s.	809 (60.6)	n.s.	n.s.	-	-	-	-	-	-	-	6–13 years	El-Maghrabi et al. 2015
Pakistan	2013	1320	465	855	980 (74.2)	272 (58.5)	708 (82.8)	-	-	-	-	-	-	-	5–15 years	Lashari et al. 2015
Saudi Arabia	2013	590	-	590	72 (12.2)	-	72 (12.2)	< 0.05	< 0.05	< 0.05	> 0.05	-	> 0.05	> 0.05	n.s.	Al-Megrin 2015
Greece	2004–2006	434	219	215	23 (5.3)	2 (0.9)	21 (9.7)	-	-	-	-	-	-	-	n.s.	Tagka et al. 2016
Norway	2008	3596	n.s.	n.s.	62 (1.7)	n.s.	n.s.	-	-	-	-	-	-	-	6–12 years	Birkemoe et al. 2016
Iran	n.s.	485	-	485	85 (17.5)	-	85 (17.5)	-	< 0.05	< 0.05	> 0.05	> 0.05	> 0.05	-	6–12 years	Sayyad et al. 2016
Iran	2009	750	405	345	15 (2.0)	6 (1.5)	9 (2.6)	< 0.05	-	-	-	-	< 0.05	< 0.05	n.s.	Kassiri and Gatifi 2016
Turkey	2013	6004	3300	2704	90 (1.5)	7 (0.2)	83 (3.1)	-	-	-	-	-	-	-	5–11 years	Eroglu et al. 2016
Turkey	2014	6004	3300	2704	415 (6.9)	10 (0.3)	405 (15.0)	-	-	-	-	-	-	-	5–11 years	Eroglu et al. 2016
Iran	2014	750	-	750	36 (4.8)	-	36 (4.8)	> 0.05	> 0.05	> 0.05	> 0.05	< 0.05	> 0.05	> 0.05	7–11 years	Alborzi et al. 2016
Iran	2013–15	500	200	300	24 (4.8)	4 (2.0)	20 (6.6)	-	-	< 0.05	-	-	-	-	n.s.	Raeisi et al. 2016
Saudi Arabia	2014	672	-	672	306 (45.4)	-	306 (45.4)	> 0.05	> 0.05	< 0.05	> 0.05	< 0.05	–	-	n.s.	Gharsan et al. 2016
Honduras	2014	15,002	-	-	1486 (9.9)	-	-	-	-	-	-	-	-	-	n.s.	Hernández et al. 2016
Iran	2015	541	265	276	35 (6.5)	5 (1.9)	30 (10.9)	< 0.05	> 0.05	> 0.05	-	> 0.05	> 0.05	< 0.05	7–12 years	Maleky et al. 2016
Thailand	2015	703	378	325	106 (15.1)	00 (0.0)	106 (32.6)	-	-	-	-	-	-	-	n.s.	Ruankham et al. 2016
Iran	2016	600	188	412	14 (2.3)	1 (0.5)	13 (3.2)	< 0.05	> 0.05	> 0.05	> 0.05	> 0.05	< 0.05	> 0.05	6–14 years	Nazari et al. 2016
India	2014	1000	528	472	143 (14.3)	25 (17.4)	118 (82.5)	-	-	-	-	-	-	-	5–14 years	Jose et al. 2017
Malaysia	n.s.	1336	n.s.	n.s.	205 (15.3)	n.s.	n.s.	-	-	-	-	-	-	-	mean 9.3 years	Lye et al. 2017
Mexico	2014	840	425	415	245 (28.0)	140 (33.7)	95 (22.3)	< 0.05	> 0.05	< 0.05	> 0.05	> 0.05	> 0.05	> 0.05	6–12 y	Molina-Garza and Galaviz-Silva 2017
Iran	2015	358	-	358	201 (56.1)	-	201 (56.1)	-	< 0.05	< 0.05	-	< 0.05	< 0.05	-	n.s.	Sanei-Dehkordi et al. 2017
Iraq	2016	906	n.s.	n.s.	147 (14.0)	n.s.	n.s.	-	-	-	-	-	-	-	7–12 years	Salih et al. 2017
Iran	2016	717	n.s.	**n.s.**	49 (6.8)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Majidi et al. 2017
Malaysia	2015	1336	680	451	205 (15.3)	26 (3.8)	179 (39.6)	< 0.05	-	-	-	-	-	-	7–12 years	Tohit et al. 2017
Colombia	2016	148	n.s.	n.s.	17 (11.5)	n.s.	n.s.	< 0.05	-	-	-	-	-	-	1–5 years	López-Valencia et al. 2017
Iran	n.s.	150	n.s.	n.s.	101 (67.3)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Soleimani-Ahmadi et al. 2017
Iran	2016	26,417	n.s.	n.s.	8305 (31.4)	n.s.	n.s.	> 0.05	< 0.05	> 0.05	> 0.05	> 0.05	< 0.05	> 0.05	≤ 15 years	Saghafipour et al. 2017
Iran	n.s.	1950	n.s.	n.s.	200 (10.2)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Moradiasl et al. 2018
Iraq	n.s.	818		818	187 (22.9)	-	187 (22.9)	-	-	-	-	-	-	-	7–12 years	Al-Zayyadi 2018
Iran	2016	28,410	n.s.	n.s.	2995 (10.5)	n.s.	n.s.	-	-	-	-	-	-	-	7–11 years	Nejati et al. 2018
Iran	2016	130	n.s.	n.s.	127 (97.7)	n.s.	n.s.	-	-	-	-	-	-	-	1–9years	Firoozfar et al. 2018
Jordan	2015	481	238	243	98 (20.4)	31 (13.0)	67 (27.6)	> 0.05	> 0.05	> 0.05	-	-	> 0.05	> 0.05	6–12 years	Khamaiseh 2018
Mexico	n.s.	658	324	334	88 (13.3)	24 (27.2)	64 (72.7)	-	-	-	-	-	-	-	n.s.	Barbosa et al. 2018
Turkey	n.s.	12,880	6616	6264	1606 (12.4)	238 (3.5)	1368 (21.8)	-	-	-	-	-	-	-	n.s.	Karaman et al. 2018

Table 1 (continued)

Location of study	Study year	Sample size			No. positive (%)			Association between prevalence of head lice with variables (*P* value)							Age group	Ref.
		Total	Boy	Girl	Total	Boy	Girl	Hair size	Edu. of mother	Edu. of father	Job of mother	Job of father	Falimy size	Freq. of hair washing		
Syria	2017	8689	4297	4292	1243 (14.3)	201 (4.6)	1042 (23.7)	-	-	-	-	-	-	-	6–12 years	Ismail et al. 2018
Turkey	2018	491	395	96	255 (51.9)	236 (59.7)	19 (19.7)	-	-	-	-	-	-	-	~ 15 years	Ozdemir et al. 2019
Cambodia	2016	323	n.s.	n.s.	143 (44.3)	n.s.	n.s.	-	-	-	-	-	-	-	6–16 years	Liao et al. 2019
Ethiopia	2018	402	n.s.	n.s.	264 (65.7)	n.s.	n.s.	> 0.05	< 0.05	> 0.05	>0.05	> 0.05	> 0.05	> 0.05	5–12 years	Dagne et al. 2019
Iran	n.s.	3033	-	3033	240 (7.9)	-	240 (7.9)	-	<0.05	-	-	-	< 0.05	-	n.s.	Moosazadeh et al. 2019
Iran	2017–2018	851	-	851	199 (23.3)	-	199 (23.3)	> 0.05	< 0.05	> 0.05	<0.05	> 0.05	> 0.05	> 0.05	~ 9 years	Ghofleh Maramazi et al. 2019
Iran	n.s.	1595	n.s.	n.s.	125 (7.8)	n.s.	n.s.	-	-	-	-	-	-	-	n.s.	Dehghani et al. 2019
Sri Lanka	2016–17	205	n.s.	n.s.	86 (42.0)	n.s.	n.s.	-	-	-	-	-	-	-	5–13 years	Gunathilaka et al. 2019

$p > 0.05$ = no statistically significant; $p < 0.05$ = statistically significant; *n.s.*, not stated

To evaluate the prevalence of pediculosis capitis in school-age children, published studies from the databases of MEDLINE (via PubMed) (https://www.ncbi.nlm.nih.gov/pubmed/), Scopus (https://www.scopus.com/), and Web of Science (https://www.webofknowledge.com/) were retrieved with no restriction on language from Jan 1, 1977 to Jan 1, 2020. Search terms included a combination of Medical Subject Heading terms (MeSH) and free-text words in titles, abstracts, and full texts. The syntax for PubMed search was as follows: ("*Pediculus humanus capitis*" OR "*Pediculus capitis*" OR nits OR Pediculi OR "pediculosis capitis" OR "head louse infestation" OR "head lice infestation" OR "head louse" OR (head AND louse) OR "head lice" OR (head AND lice) OR "skin disorder" OR "skin disease") AND ("primary school student" OR "primary school" OR "school-aged children" OR "elementary school student" OR "school children" OR "school child") AND 1977/01/01:2020/01/01[dp]. Scopus and Web of Science were searched using the same strategy (Additional file 2). The Google Scholar search engine was used for checking the search strategy. Researchers from parasitic disease organizations were contacted by email for help in identifying potentially relevant studies that may have been missed through electronic searches. In some cases, authors were contacted directly for raw data collection, especially from some of the earlier literature.

Selection of studies

Screening of the search results by manuscript titles and abstracts was performed independently by two researchers (KHN and AD). The same two review authors then independently assessed the full texts of all potentially relevant studies, and applied inclusion criteria. Discrepancies were resolved by discussion and consensus (EA, RRS, and KHN).

Studies providing details on the prevalence rate of pediculosis capitis in school children were included. Studies were excluded based on the following criteria: studies involving *P. capitis* in adults; studies where hair samples were collected from the ground at the barbershop; where data from each person not independently retrievable; articles that only presented the final result and did not provide the raw data on children and gender, or those without a definite sample size; non-English full papers without an English abstract, experimental studies, case-control studies, and clinical trials that could not report a correct estimate of prevalence. If more than one report was published from the same study, only one report was included and any duplicated research was excluded.

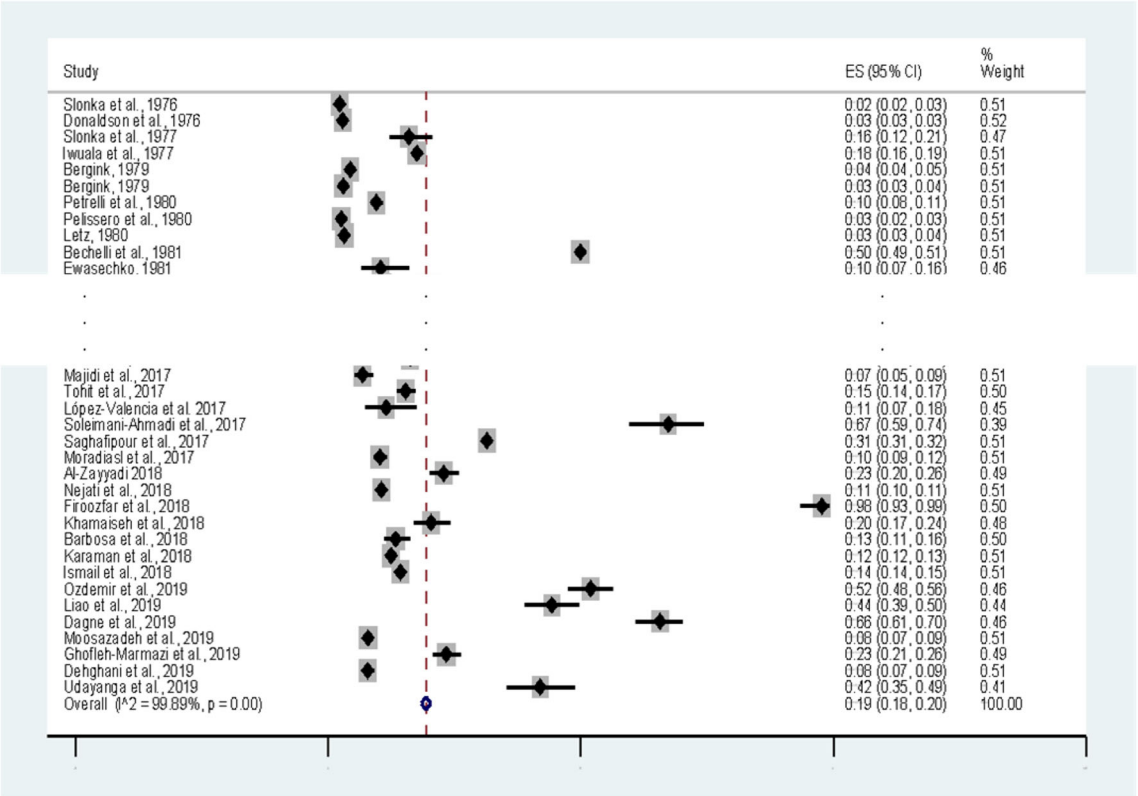

Fig. 2 Forest plot diagram: the estimated pooled prevalence of pediculosis capitis among worldwide school-aged students by random effect meta-analysis in included studies (first author and year of publication). The diamond represents the pooled estimate

Quality assessment

In order to assess the quality of reporting of the studies, standard Strengthening the Reporting of Observational Studies in Epidemiology checklist (STROBE) was used (Additional file 3) (Elm et al. 2007). This checklist included items assessing the study methodology, study type, sample size, sample collection methods, and statistical tests. In the present study, articles were evaluated based on STROBE assessment (low quality, less than 16.5; moderate quality, 16.6–25.5; and high quality, 25.6–34). The articles entered in the meta-analysis had acceptable quality.

Data extraction

The characteristics of the included studies including the first author name, publication year, country and study area, period of study, sample size, age groups, infestation prevalence based on sex, *p* value for the relationship among potential risk factors, and infestation were derived from each study and were entered into an excel spreadsheet.

Meta-analysis

Data were pooled with statistical meta-analysis using Stata 14 (Stata Corporation, College Station, TX, USA) (http://www.statsdirect.com/). Prevalence and their 95% confidence intervals were conducted for analysis. Heterogeneity was evaluated statistically by the standard chi squared and I^2 tests. Statistical analyses were performed using random effects (Der Simonian and Laird 1986). Subgroup analyses were conducted for sex and continent. As there were more studies included in the meta-analysis, a funnel plot was generated in Stata to assess publication bias. Statistical tests for funnel plot asymmetry (Egger test) were also performed. Finally, meta-regression for assessing effect sizes of sex and study year on prevalence changes was carried out.

Results

The database searches retrieved 7206 papers, of which 6966 studies were excluded due to not meeting inclusion criteria, while 8 papers were added after the review of references. A total of 248 studies were retained for investigation. During eligibility assessment of papers, a further 47 papers were excluded. Finally, studies ($n = 201$) evaluating the prevalence of pediculosis capitis during five decades met the eligibility criteria and were retained for analysis (Fig. 1; Table 1). Publication dates varied between 1977 and 2020. Selected manuscripts for meta-analysis encompassed a total of 1,218,351 school students (Table 1). The results of meta-

Table 2 The prevalence of pediculosis capitis based on the country

Country	No. study	Sample size	No. positive	ES	(95% conf. interval)
Asia	138	807,093	87,514	0.18	0.17–0.19, $I^2 = 99.87\%$
Turkey	24	77,476	6295	0.12	0.1–0.14
Iran	43	286,381	22,554	0.12	0.1–0.13
Jordan	5	10,778	1387	0.16	0.1–0.21
Syria	1	8689	1243	0.14	0.14–0.15
Palestine	2	3008	393	0.13	0.12–0.14
Thailand	2	4450	998	0.18	0.11–0.25
Taiwan	4	18,825	3438	0.2	0.12–0.29
Bangladesh	1	300	179	0.6	0.54–0.65
Cambodia	1	323	143	0.44	0.39–0.50
India	4	2756	507	0.23	0.16–0.31
Malaysia	8	317,655	34,885	0.23	0.18–0.28
Pakistan	4	6683	3774	0.59	0.32–0.84
Saudi Arabia	8	10,292	1017	0.14	0.08–0.19
Israel	3	4778	1289	0.41	0.06–0.76
Indonesia	1	158	31	0.2	0.14–0.27
Iraq	5	3984	518	0.13	0.07–0.19
Yemen	1	860	114	0.13	0.11–0.16
Nepal	1	818	172	0.21	0.18–0.24
Sri Lanka	1	205	86	0.42	0.35–0.49
South Korea	10	48,674	8491	0.31	0.21–0.41
Africa	26	57,147	18,139	0.31	0.22–0.41, $I^2 = 99.95\%$
Nigeria	7	19,497	1578	0.09	0.05–0.13
Egypt	7	16,498	3571	0.34	0.22–0.45
Libya	1	13,734	10,796	0.79	0.78–0.79
Sierra Leone	2	1091	94	0.08	0.06–0.10
Ghana	1	319	158	0.5	0.44–0.55
Mali	1	1817	85	0.05	0.04–0.06
Kenya	1	1270	217	0.17	0.15–0.19
South Africa	1	175	15	0.09	0.05–0.14
Angola	1	171	72	0.42	0.35–0.50
Ethiopia	4	2575	1553	0.68	0.48–0.89
Europe	21	302,111	9295	0.05	0.04–0.06, $I^2 = 99.28\%$
Poland	4	182,854	3596	0.02	0.02–0.03
Holand	1	9834	369	0.04	0.03–0.04
Norway	2	11,741	195	0.02	0.01–0.02
Greece	2	2459	267	0.1	0.09–0.11
Germany	2	11,190	312	0.02	0.02–0.02
UK	3	45,076	1281	0.06	0.03–0.10
Italy	2	5064	271	0.04	0.03–0.04
Spain	1	23,624	2219	0.09	0.09–0.10
Belgium	2	6393	598	0.09	0.08–0.10
Czech Rep.	1	531	75	0.14	0.11–0.17
France	1	3345	112	0.03	0.03–0.04
Central and South America	16	34,498	9879	0.33	0.22–0.44, $I^2 = 99.81\%$
Chile	1	467	188	0.40	0.36–0.45
Colombia	1	148	17	0.11	0.07–0.18
Mexico	3	1638	352	0.19	0.07–0.3
Honduras	1	15,002	1486	0.1	0.09–0.1
Argentina	5	5123	2377	0.51	0.35–0.67
Brazil	3	11,491	5305	0.3	0.04–0.63
Peru	1	302	60	0.2	0.16–0.25
Venezuela	1	327	94	0.29	0.24–0.34
NORTH AMERICA	4	4456	206	**0.08**	**0.04–0.11, $I^2 = 95.43\%$**
USA	3	4293	189	0.07	0.03–0.11
Canada	1	163	17	0.1	0.07–0.16
AUSTRALIA	**3**	**13,448**	**2894**	**0.19**	**0.12–0.27, $I^2 = 99.65\%$**
Australia	3	13,448	2894	0.19	0.12–0.27
Overall	201	1,218,351	127,927	0.19	0.18–0.20, $I^2 = 99.89\%$

ES, effect size

analysis showed that the total prevalence of infestation among worldwide school-age students was 19% (CI 95% = 0.18–0.20) (Fig. 2). The heterogeneity of the included studies was high ($I^2 = 99.89\%$, $P > 0.001$). The subgroup analysis based

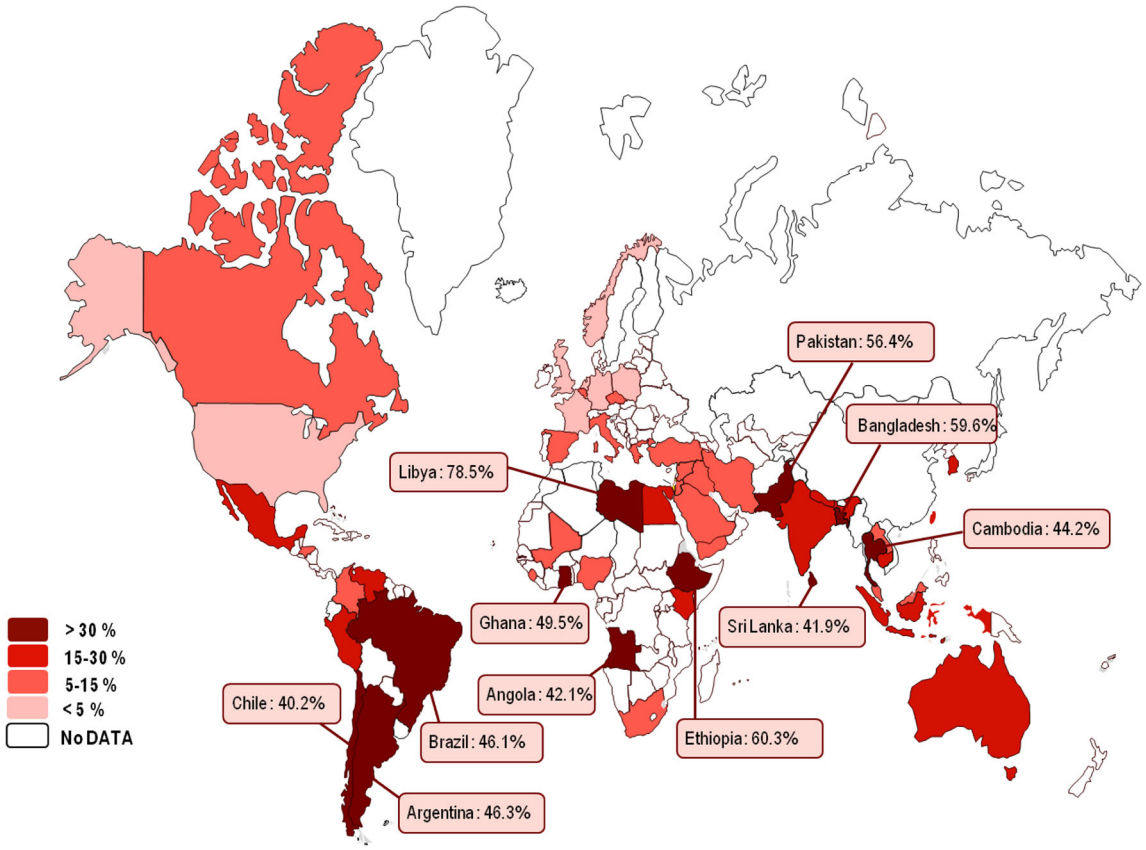

Fig. 3 Map of geographical distribution of pediculosis capitis worldwide

on sex and continent was performed. Of the 201 studies, 106 had separate gender-related data. Only 16 studies included girls as the study population. According to the results, the prevalence of pediculosis capitis among boys was 7% (CI 95% = 0.05–0.10) compared to 19% (CI 95% = 0.15–0.24) in girls. There was a significant difference between two groups (Additional file 4). The highest prevalence was in Central and South America (33%, CI 95% = 0.22–0.44, I^2 = 99.81%), followed by Africa (31%, CI 95% = 0.22–0.41, I^2 = 99.95%), Australia (19%, CI 95% = 0.12–0.27, I^2 = 99.65%), Asia (18%, CI 95% = 0.17–0.19, I^2 = 99.87%), and North America (8%, CI 95% = 0.04–0.11, I^2 = 95.43%). The lowest prevalence was observed in Europe (5%, CI 95% = 0.04–0.06, I^2 = 99.28%) (Table 2; Additional file 5). In the Americas, there was a different prevalence between North and South American countries. The highest prevalence was in Argentina (51%, CI 95% = 0.35–0.67), followed by Chile (40%, CI 95% = 36–45), Brasil (30%, CI 95% = 0.4–0.63), Venezuela (29%, CI 95% = 0.24–0.34), Peru (20%, CI 95% = 0.16–0.25), Mexico (19%, CI 95% = 0.07–0.30), Colombia (11%, CI 95% = 0.07–0.18), Honduras (10%, CI 95% = 0.09–0.10), Canada (10%, CI 95% = 0.07–0.16), and USA (7%, CI 95% = 0.03–0.11) (Table 2). In Asia, the highest prevalence was in Bangladesh (60%, CI 95% = 54–65), and the lowest prevalences were in Iran (12%, CI 95% = 0.01–0.13) and Turkey (12%, CI 95% = 0.01–0.14), respectively. In Africa, the highest prevalence was in Libya (79%, CI 95% 0.78–0.79), and the lowest was in Mali (5%, CI 95% 0.04–0.06) (Table 2 and Fig. 3). In Europe, the highest prevalence was observed in the Czech Republic (14%, CI 95% = 0.11–0.17), and the lowest prevalences were in Germany (2%, CI 95% = 0.02–0.02), Poland (2%, CI 95% = 0.01–0.03), and Norway (2%, CI 95% = 0.01–0.02) (Table 2 and Fig. 3). In Australia, the pooled prevalence was 19% (CI 95% = 0.12–0.27) (Table 2). Meta-regression was carried out to evaluate the changes in prevalence during the different years, but it was not statistically significant (p = 0.304) (Table 3 and Fig. 4). The Egger regression graph for assessing publication bias showed that there was publication bias in all studies (Fig. 5) and low precision in most studies. The Egger regression test also indicated possible publication bias in female-related studies (p = 0.047) (Table 4). The relationship among pediculosis capitis and hair length was explored in 38 studies, 18 of which

Table 3 Meta-regression of the prevalence changes during the years

_ES	Coef.	Std. err.	t	$P>\|t\|$	(95% conf. interval)
Slope	.0105125	.0036117	2.91	0.004	.0033741, .0176509
Bias	17.79863	2.044112	8.71	0.000	13.75853, 21.83874

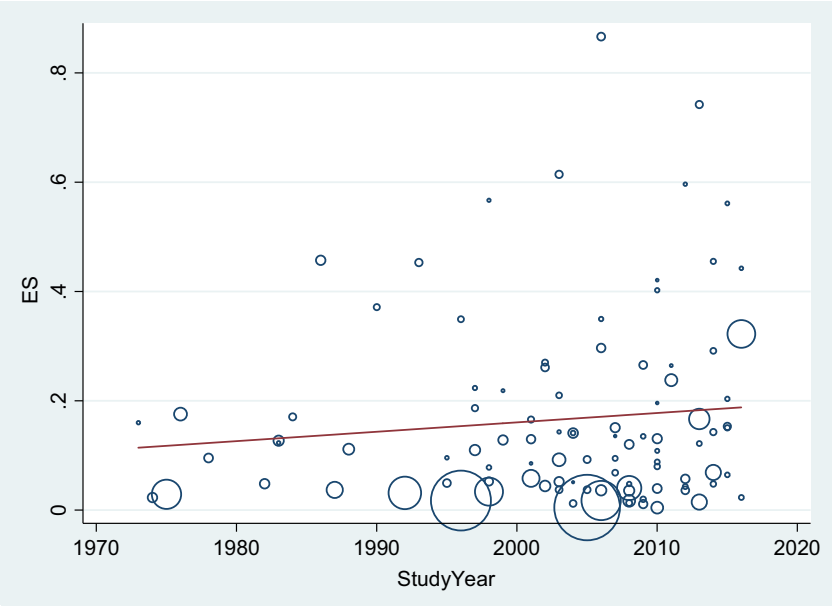

Fig. 4 Meta-regression of the prevalence changes during the years

detailed a critical impact of long hair ($p < 0.05$). Of 27 studies evaluating the association between pediculosis and the frequency of hair washing, 12 studies revealed a significant relationship between the practice of washing hair and the development of pediculosis capitis ($p < 0.05$). Thirty-eight investigations explored the effect of the mother's education level, where 22 demonstrated statistically higher infestation risk among children whose mothers had low education levels ($p < 0.05$). Paternal low education levels and pediculosis capitis prevalence were significant in 24 out of 37 ($p < 0.05$). In terms of maternal employment, 9 out of 28 studies reported a significant association between the mother's job and pediculosis capitis ($p < 0.05$) and 13 out of 32 studies were significant for the father's job and pediculosis capitis ($p < 0.05$). Thirty-five investigations evaluated the association between prevalence and family size, 21 of which a higher infestation risk was revealed in students living in larger families ($p < 0.05$).

Discussion

This study attempts to relate, reconcile, and draw conclusions from data collected in disparate geographical locations over a period of 45 years; although, there have been enormous changes in social structure, demography, social stability,

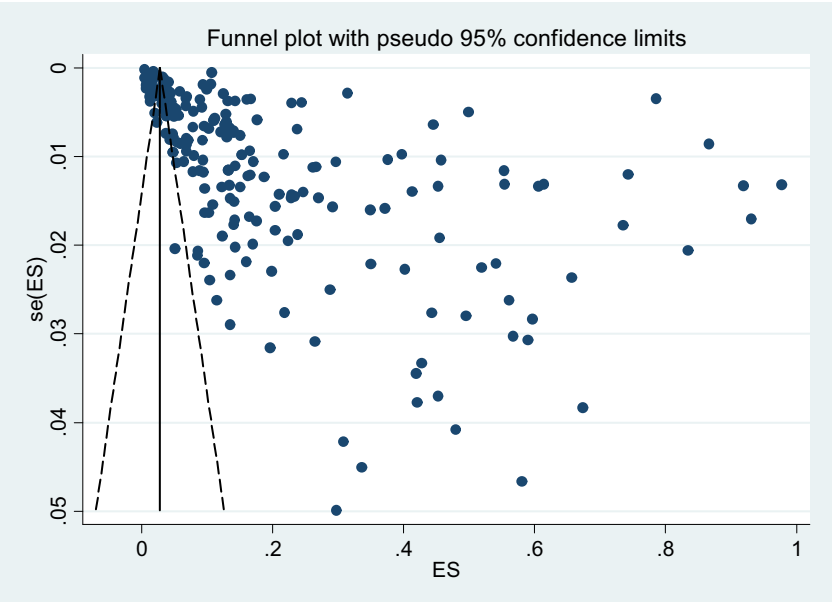

Fig. 5 Funnel plot of all studies

Table 4 Egger meta-regression test for female-related studies

Std_eff	Coef.	Std. err.	t	$P>\|t\|$	(95% conf. interval)
slope	− .0006745	.0010253	− 0.66	0.511	− .0026966, .0013476
bias	13.86908	1.681441	8.25	0.000	10.55283, 17.18533

migration, and medical therapeutics in different geographical areas, especially remote and underdeveloped regions.

In the present meta-analytic study carried out among 1,218,351 school-age students, the overall prevalence rate of infestation was 19%. Girls were infested 2.5 times higher than boys. In the study conducted by Karakus et al. (2014) in Turkey, contamination of school girls were 3.1-fold higher than boys, which can be attributed to gender-related behavioral differences such as the girls' maintaining closer contact in small gatherings. Hair length was another factor associated with the infestation of head lice. Eighty-six papers reported sex-specific prevalence estimates. The prevalence among boys differed from 0% in Iran (Ghavanini 1999; Hodjati et al. 2008), Nigeria (Okoh and Alikor 2013) and Thailand (Fan et al. 2004; Ruankham et al. 2016) to 58.5% in Pakistan (Lashari et al. 2015). The prevalence among girls differed from 0% in Thailand (Rassami and Soonwera 2012) and Jordan (Shakkoury and Abu-Wandy 1999) to 93.2% in Pakistan (Saddozai and Kakarsulemankhel 2008). Comparing the results of different studies in different countries showed that the total prevalence, regardless of gender, among Pakistani students was higher than those in other countries. The highest prevalence was in Central and South America (33%), followed by Africa (31%), Australia (19%), Asia (18%), North America (8%), and Europe (5%). In the Americas, the highest prevalence was related to a study conducted by Chouela and colleagues (Chouela et al. 1997) in Argentina (83.4%), and the lowest was a study conducted by Slonka et al. (1976) in the USA (2.3%). In Asia, the total prevalence varied from 0.5% in the study conducted by Davarpanah et al. (2009) in Iran to 87% and 97.7% in two studies carried out by Saddozai and Kakarsulemankhel (2008) in Pakistan and Firoozfar et al. (2018) in Iran, respectively. In Africa, the highest prevalence was in Libya (93.0%) (Figueroa et al. 1997), and the lowest was in Nigeria (0.7%) (Okoh and Alikor 2013). In Europe, the highest and the lowest infestations were related to Belgium (21.9%) (De Maeseneer et al. 2000) and Germany (0.7%) (Jahnke et al. 2008), respectively. In Australia, the highest prevalence was 22.4% (Speare and Buettner 1999), and the lowest was 13% (Counahan et al. 2004). Stated prevalence in various nations fluctuated widely. These reports demonstrated that in spite of the fact that there is a heterogeneous rate of infestation around the world, and socioeconomic conditions determine infestation (Slonka et al. 1976; Khamaiseh 2018).

Combining data from across the world during half a century in a meta-analysis could not per se improve policy making for head lice, so the results in each country were combined and analyzed to provide an overall perspective on the prevalence of pediculosis capitis for researchers and public health decision-makers.

Many studies demonstrated that the prevalence of pediculosis capitis among school-age students is related to various factors, such as educational level of parents and the profession of parents. The infestation was more common among school students with poorly educated parents, long hair, large family size, jobless mothers and fathers, and a lower frequency of bathing at home. However, some studies did not report any significant level of association. In the study conducted by Sim et al. (2011) in South Korea, the infestation prevalence was correlated to small family size, and no relationship was detected among infestation and education of parents. Some of the potential risk factors have only been reported in some of the studies conducted in developing countries, primarily in Western Asia. Pediculosis prevalence declines with enhanced living standards, family incomes, and better medicinal service frameworks. In several developed economies, all the above "remedies" are important, and people have been practicing them for decades but they still have lice. In most European countries, as well as in North America, Australia, and some others, clear policies for detection, diagnosis, treatment, management, and prevention of infestation have been in place for a long a period—but without success. The central matter in the inhibition of re-infestation is the introduction and follow-up of proper hygienic practices under constant supervision.

Our findings provide a non-comprehensive description of pediculosis capitis around the world. Future studies should take advantage of the description of pediculosis capitis already provided in this study.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

Abd El Raheem TA, El Sherbiny NA, El-Sayed GA, Moustafa N, Shahen S (2015) Epidemiological comparative study of pediculosis capitis among primary school children in Fayoum and Minofiya governorates, Egypt. J Community Health 40:222–226

Abolfotouh MA, Abu-Zaid HAH, Bahamdan K, Abdel Aziz M, Bassuni WA, Eid O (1996) Skin disorders among male schoolchildren in the Asir Region, Southwestern Saudi Arabia. Ann Saudi Med 16:342–345

Akisu C, Aksoy U, Delibas SB (2005) The prevalence of head lice infestation in school children in Izmir, Turkey. Pediatr Dermatol 22:372–373

Akkas O, Cengiz ZT (2011) Prevalence of head lice in some primary schools in Iğdır province. Turkiye Parazitol Derg 35:199–203

Aksin N, Ilhan F, Aksin NE (2002) The prevalence of lice infestation in primary school in Elaziğ and Elazig suburban towns. Turkiye Parazitol Derg 26:106–109

Aktürk AS, Özkan O, Gökdemir M, Tecimer S, Bilen N (2012) The prevalence of Pediculosis capitis and factors related to the treatment success in primary school children and their family members in Kocaeli. TAF Prev Med Bull 11:181–188

Al-Aboody BA (2008) Prevalence of head lice (*Pediculus humanus capitis*) among primary schools pupils in Nassirya city. Baghdad Sci J 5:207–210

Al-Megrin WAI (2015) Assessment of the prevalence of pediculosis capitis among primary school girls in Riyadh, Saudi Arabia. Res J Environ Sci 9:193–199

Al-Shawa RM (2006) Head louse infestations in Gaza governorates. J Med Entomol 43:505–507

Alempour Salemi J, Shayeghi N, Zeraati H, Akbarzadeh K, Basseri H, Ebrahimi B, Rafinejad J (2003) Some aspects of head lice infestation in Iranshahr area (southeast of Iran). Iran J Public Health 32:60–63

Al-Maktari MT (2008) Head louse infestations in Yemen: prevalence and risk factors determination among primary schoolchildren, Al Mahweet Governorate, Yemen. J Egypt Soc Parasitol 38:741–748

Al-Bashtawy M (2012) Head lice infestation in schoolchildren and related factors in Mafraq governorate, Jordan. Int J Dermatol 51:168–172

Al-Rubaiy KK, Habib OS, Ebrahim S (2004) Pattern of skin diseases among primary school children in Basrah, southern Iraq. Med J Basrah Univ 22:40–42

Ali N, Ramzan F (2004) Head lice infestation in school children at Dera Ismail Khan. Pak J Zool 36:273–280

Alborzi M, Shekarriz-Foumani R, Moin-Vaziri V (2016) The prevalence of *Pediculus capitis* among primary schools of Shahriar County, Tehran province, Iran, 2014. Novel Biomed 4:24–27

Al-Saeed WY, Al-Dawood KM, Bukhari IA, Bahnassy AA (2006) Prevalence and pattern of skin disorders among female schoolchildren in Eastern Saudi Arabia. Saudi Med J 27:227–234

Al-Zain B (2012) Pediculosis capitis infestation in school children of a low socioeconomic area of the North Gaza Governorate. Turk J Med Sci 42:1286–1291

Al-Zayyadi SW (2018) Study of prevalence of *Pediculus humanus capitis* among primary school pupils in Al-Najaf Al-Ashraf Province. Biochem Cell Arch 18:1141–1143

Amr ZS, Nusier MN (2000) Pediculosis capitis in northern Jordan. Int J Dermatol 39:919–921

Atambay M, Karaman O, Karaman U, Aycan O, Yoloğlu S, Daldal N (2007) The frequency of intestinal parasites and head lice among students of the Akşemsettin Primary School for Deaf Students. Turkiye Parazitol Derg 31:62–65

Bachok N, Nordin RB, Awang CW, Ibrahim NA, Naing L (2006) Prevalence and associated factors of head lice infestation among primary schoolchildren in Kelantan, Malaysia. S Asian J Trop Med Public Health 37:536–543

Bahamdan K, Mahfouz AAR, Tallab T, Badawi IA, Al-Amari OM (1996) Skin diseases among adolescent boys in Abha, Saudi Arabia. Int J Dermatol 35:405–407

Barbosa MAV, de la Torre AM, Villavicencio MEF, Bañuelos JRR (2018) Pediculosis capitis among Mexican public school students. Rev Cubana Med Trop 70:1–8

Bartosik K, Buczek A, Zając Z, Kulisz J (2015) Head pediculosis in schoolchildren in the eastern region of the European Union. Ann Agric Environ Med 22:599–603

Başarslan F, Kaya ÖA, İnci M, Motor VK, Kaya S, Şen BB, Yılmaz C (2014) Frequency of *Pediculus Capitis* in pediatric neurology outpatients. Duzce Medical J 16:35–37

Bechelli LM, Haddad N, Pimenta WP, Pagnano PMG, Melchior E, Fregnan RC, Zanin LC, Arenas A (1981) Epidemiological survey of skin diseases in schoolchildren living in the purus valley (Acre State, Amazonia, Brazil). Dermatologica 163:78–93

Berenji F, Marvi-Moghadam N, Naghibozakerin Meibodi P (2014) A retrospective study of ectoparasitosis in patients referred to Imam Reza Hospital of Mashhad, Iran. BioMed Res Int ID 104018. https://doi.org/10.1155/2014/104018

Bergink HA (1979) Prevalence of head lice in a district of the school medical service in The Hague in 1977 and 1978. Tijdschr Kindergeneeskd 47:193–200

Bharija SC, Kanwar AJ, Singh G, Belhaj MS (1988) Pediculosis capitis in Benghazi, Libya: a school survey. Int J Dermatol 27:165–166

Bhatia V, Nayar S (1997) Prevalence of pediculosis capitis among children in a rural community. Indian J Matern Child Health 8:39–41

Birkemoe T, Lindstedt HH, Ottesen P, Soleng A, Næss Ø, Rukke BA (2016) Head lice predictors and infestation dynamics among primary school children in Norway. Fam Pract 33:23–29

Borges R, Mendes J (2002) Epidemiological aspects of head lice in children attending day care centres, urban and rural schools in Uberlândia, central Brazil. Mem Inst Oswaldo Cruz 97:189–192

Bosely HA, El-Alfy NM (2011) Head lice infestations (Anoplura: Pediculidae) in Saudi and non-Saudi school-aged children. J Egypt Soc Parasitol 41:131–140

Boyle P (1987) Pilot study of the prevalence of head lice infestation in a population of Saudi Arabian children. Fam Pract 4:138–142

Buczek A, Kawa IM, Markowska-Gosik D, Widomska D (2001) Pediculosis in rural schools of Lublin Province. Wiad Parazytol 47:359–364

Buczek A, Markowska-Gosik D, Widomska D, Kawa IM (2004) Pediculosis capitis among schoolchildren in urban and rural areas of eastern Poland. Eur J Epidemiol 19:491–495

Catala S, Carrizo L, Córdoba M, Khairallah R, Moschella F, Bocca JN, Calvo AN, Torres J, Tutino R (2004) Prevalence and parasitism intensity by *Pediculus humanus capitis* in six to eleven-year-old schoolchildren. Rev Soc Bras Med Trop 37:499–501

Catala S, Junco L, Vaporaky R (2005) *Pediculus capitis* infestation according to sex and social factors in Argentina. Rev Saude Publica 39:438–443

Cazorla D, Ruiz A, Acosta M (2007) Clinical and epidemiological study of pediculosis capitis in schoolchildren from Coro, Venezuela. Investig Clin 48:445–457

Cetinkaya U, Hamamcı B, Delice S, Ercal BD, Gücüyetmez S, Yazar S I(2011) The prevalence of *Pediculus humanus capitis* in two primary schools of Hacılar, Kayseri. Turkiye Parazitol Derg 35:151–153

Chao D, Liu HY, Fan PC (1981) Prevalence of *Pediculus humanus capitis* among school girls of Chuang-Wei and Nan-Ao districts in I-Lan County and Man-Chow district in Ping-Tung County, Taiwan. Chin J Microbiol Immunol 14:10–18

Chouela E, Abeldano A, Cirigliano M, Ducard M, Neglia V, Forgia ML, Colombo A (1997) Head louse infestations: epidemiologic survey and treatment evaluation in Argentinian schoolchildren. Int J Dermatol 36:819–825

Chunge RN (1986) A study of head lice among primary schoolchildren in Kenya. Trans R Soc Trop Med Hyg 80:42–46

Ciftci IH, Karaca S, Dogru O, Cetinkaya Z, Kulac M (2006) Prevalence of pediculosis and scabies in preschool nursery children of Afyon, Turkey. Korean J Parasitol 44:95–98

Counahan M, Andrews R, Büttner P, Byrnes G, Speare R (2004) Head lice prevalence in primary schools in Victoria, Australia. J Paediatr Child Health 40:616–619

Currie MJ, Ciszek K, Kljakovic M, Bowden FJ (2011) Prevalence of head lice among children entering school in the ACT 2006-08. Aust NZ J Publ Heal 35:195–196

Dagnew MB, Erwin G (1991) Epidemiology of common transmissible skin diseases among primary school children in North-West Ethiopia. Trop Geogr Med 43:152–155

Dagne H, Aba Biya A, Tirfie A, Yallew WW, Dagnew B (2019) Prevalence of *pediculosis capitis* and associated factors among schoolchildren in Woreta town, northwest Ethiopia. BMC Res Notes 12:465. https://doi.org/10.1186/s13104-019-4521-8

Davarpanah MA, Mehrabani D, Khademolhosseini F, Mokhtari A, Bakhtiari H, Neirami R (2009) The prevalence of *Pediculus capitis* among school children in Fars province, southern Iran. Iran J Parasitol 4:48–53

De Buruaga MSG, Goiria Ormazabal JI, López Martínez I, Pérez Rodrigo C, Bonet Romero T, Caturla Latorre J (1989) Pediculosis capitis: epidemiologic study of 23,624 schoolchildren in Bilbao. Rev Sanid Hig Publica Madr 63:49–62

De Doucet MMA, Miranda MB, Arce MA (1997) Prevalences of *Pediculosis humanus capitis* and *Sarcoptes scabies* in primary school of Cordoba, Argentina, analysis in relation to sex, age and socioeconomic conditions. Res Rev Parasitol 57:67–69

Değerli S, Malatyali E, Çeliksöz A, Ozçelik S, Mumcuoğlu KY (2012) The prevalence of *Pediculus humanus capitis* and the coexistence of intestinal parasites in young children in boarding schools in Sivas, Turkey. Pediatr Dermatol 29:426–429

Değerli S, Malatyali E, Mumcuoğlu KY (2013) Head lice prevalence and associated factors in two boarding schools in Sivas. Türkiye Parazitol Derg 37:32–35

Dehghani R, Saberi HR, Takhtfiroozeh S, Ashrafi R (2019) Head louse infestation rate in primary school students of Badrud, Isfahan-Iran. J Entomol Res 43:105–110

De Maeseneer J, Blokland I, Willems S, Vander Stichele R, Meersschaut F (2000) Wet combing versus traditional scalp inspection to detect head lice in schoolchildren: observational study. BMJ 321:1187–1188

Der Simonian R, Laird N (1986) Meta-analysis in clinical trials. Control Clin Trials 7:177–188

Donaldson RJ (1976) The head louse in England: prevalence amongst schoolchildren. R Soc Health J 96:55–57

Doroodgar A, Sadr F, Doroodgar M, Doroodgar M, Sayyah M (2014) Examining the prevalence rate of *Pediculus capitis* infestation according to sex and social factors in primary school children. Asian Pac J Trop Dis 4:25–29

Downs AM, Stafford KA, Coles GC (1999) Head lice*:* prevalence in schoolchildren and insecticide resistance. Parasitol Today 15:1–4

Dunne CL, Malone CJ, Whitworth JAG (1991) A field study of the effects of ivermectin on ectoparasites of man. Trans R Soc Trop Med 85:550–551

Durand R, Millard B, Bouges-Michel C, Bruel C, Bouvresse S, Izri A (2007) Detection of pyrethroid resistance gene in head lice in schoolchildren from Bobigny, France. J Med Entomol 44:796–798

Dursun N, Cengiz ZT (2010) Distribution of head lice in the Erciş district of Van. Turkiye Parazitol Derg 34:45–49

Ebomoyi E (1988) Pediculosis capitis among primary schoolchildren in urban and rural areas of Kwara State, Nigeria. J Sch Health 58:101–103

Ebomoyi EW (1994) Pediculosis capitis among urban school children in Ilorin, Nigeria. J Natl Med Assoc 86:861–864

El-Enin AA, Osman A (2007) The prevalence of pediculosis capitis in primary school children in Assuit Governorate (A socioeconomic study). Egypt J Hosp Med 29:732–737

El-Maghrabi NM, El Houfey AA, Mahmoud SR (2015) Screening for prevalence and associated risk factors of head lice among primary school student in Assiut city. Adv Environ Biol 9:87–95

El-Sahn AA, Hassan MH, Ftohy EM (2000) Parasitic infections and maternal awareness of preschool children in Karmouz district, Alexandria. J Egypt Public Health Assoc 75:1–29

Elm EV, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP (2007) The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol 61:344–449

Eroglu F, Basaran U, Kürklü CG, Yüceer M, Yalcıntürk RG, Tanrıverdi M, Daglı EI, Koltas IS (2016) Pediculosis capitis is a growing neglected infestation due to migration in southeast Turkey. Parasitol Res 115:2397–2401

Etim SE, Ohioma ME, Okon OE, Akpan PA (2012) Pediculosis among primary school children in Calabar, Nigeria and implications for control. Sci Res Essays 7:4071–4075

Ewasechko CA (1981) Prevalence of head lice (*Pediculus capitis* [De Geer]) among children in a rural, central Alberta school. Can J Public Health 72:249–252

Fan PC, Chung WC, Kuo CL, Hsu HM, Chow CY (1991) Present status of head louse (*Pediculus capitis*) infestation among school children in Yunlin County, Taiwan. Gaoxiong Yi Xue Ke Xue Za Zhi 7:151–159

Fan PC, Chung WC, Fan CK, Huang P, Yen CW (1999) Prevalence and treatment of *Pediculus capitis* infestation among aboriginal school children in Northern Taiwan. Kaohsiung J Med Sci 15:209–217

Fan CK, Liao CW, Wu MS, Hu NY, Su KE (2004) Prevalence of *Pediculus Capitis* infestation among school children of Chinese refugees residing in mountainous areas of northern Thailand. Kaohsiung J Med Sci 20:183–187

Farzinnia B, Hanafi Bojd A, Reis Karami S (2004) Epidemiology of pediculosis capitis in female primary school pupils Qom. HMJ 8:103–108

Figueroa JI, Fuller LC, Abraha A, Hay RJ (1996) The prevalence of skin disease among school children in rural Ethiopia - a preliminary assessment of dermatologic needs. Pediatr Dermatol 13:378–381

Figueroa JI, Hawranek T, Abrah A, Hay RJ (1997) Prevalence of skin diseases in school children in rural and urban communities in the Illubabor province, south-western Ethiopia: a preliminary survey. J Eur Acad Dermatol Venereol 9:142–148

Firoozfar F, Moosa-Kazami SH, Bahrami A, Ahmed-Yusuf M, Saghafipour A, Armoon Z, Rajabzadeh R, Hosseini SH (2018) Head lice infestation (*Pediculus humanus capitis*) prevalence and its associated factors, among the kormanj tribes in North Khorasan Province. Shiraz E Med J 20:e80292

Galassi FG, Fronza G, Toloza AC, Picollo MI, Gonzalez-Audino I (2018) Response of *Pediculus humanus capitis* (Phthiraptera: Pediculidae) to volatiles of whole and individual components of the human scalp. J Med Entomol 55:527–533

Gazmuri BP, Arriaza TB, Castro SF, González NP, Maripan VK, Saavedra RI (2014) Epidemiological study of pediculosis in elementary schools of Arica, northern Chile. Rev Chil Pediatr 85:312–318

Gbakima AA, Lebbie AR (1992) The head louse in Sierra Leone: an epidemiological study among school children, in the Njala area. West Afr J Med 11:165–171

Gharsan FN, Abdel-Hamed NF, Mohammed Elhassan SAA, Gubara NGAR (2016) The prevalence of infection with head lice *Pediculus humanus capitis* among elementary girl students in Albaha region- Kingdom of Saudi Arabia. Int J Res Dermatol 2:12–17

Ghavanini AA (1999) *Pediculus humanus capitis* infestation in a Shiraz rural area, Iran. Ann Saudi Med 19:277–278

Ghofleh Maramazi H, Sharififard M, Jahanifard E, Maraghi E, Mahmoodi Sourestani M, Saki Malehi A, Rasaei S (2019) Pediculosis humanus capitis prevalence as a health problem in girl's elementary schools, Southwest of Iran (2017-2018). J Res Health Sci 19:e00446

Govere JM, Speare R, Durrheim DN (2003) The prevalence of pediculosis in rural South African schoolchildren. S Afr J Sci 99:21–23

Gulgun M, Balci E, Karaoglu A, Babacan O, Türker T (2013) Pediculosis capitis: prevalence and its associated factors in primary school children living in rural and urban areas in Kayseri, Turkey. Cent Eur J Public Health 21:104–108

Gunathilaka N, Chandrasena N, Udayanga L (2019) Prevalence of ectoparasitic infections and other dermatological infections and their associated factors among school children in Gampaha District, Sri Lanka. Can J Infect Dis Med 2019:10. https://doi.org/10.1155/2019/5827124

Gutiérrez MM, González JW, Stefanazzi N, Serralunga G, Yañez L, Ferrero AA (2012) Prevalence of *Pediculus humanus capitis* infestation among kindergarten children in Bahía Blanca city, Argentina. Parasitol Res 111:1309–1313

Ha YC, Heo JM, Kim HJ, Go GM, Lee SJ, Jeong SH, Ahn SI, Kim MC, Kim JE, Song HY, Park JW, Kim BS, Sohn WM (2000) Infestation status of head louse and treatment with lindane shampoo in children of primary school and kindergarten in Chinju-shi, Kyongsangnam-do, Korea. Korean J Parasitol 38:41–43

Harris J, Crawshaw JG, Millership S (2003) Incidence and prevalence of head lice in a district health authority area. Commun Dis Public Health 6:246–249

Hazrati-Tappeh K, Chavshin AR, Mohammadzadeh-Hajipirloo H, Khashaveh S, Hanifian H, Bozorgomid A, Mohammadi M, Gharabag DJ, Azizi H (2012) Pediculosis capitis among primary school children and related risk factors in Urmia, the main city of West Azerbaijan, Iran. J Arthropod Borne Dis 6:79–85

Hernández KC, Enamorado BC, Delgado LQ, Martel B, Sierra M, Espinoza I (2016) Prevalence of skin disorders in school children in Honduras. Med Cutan Iber Lat Am 44:177–182

Hodjati MH, Mousavi N, Mousavi M (2008) Head lice infestation in school children of a low socioeconomy area of Tabriz city, Iran. African J Biotechol 7:2292–2294

Hong HK, Kim CM, Lee JS, Lee WJ, Yang YC (1995) Infestation rate of head lice in primary school children in Inchon, Korea. Korean J Parasitol 33:243–244

Huh S, Pai KS, Lee SJ, Kim KJ, Kim NH (1993) Prevalence of head louse infestation in primary school children in Kangwon-do, Korea. Korean J Parasitol 31:67–69

Ilhan F, Budak S, Guruz AY (1997) The prevalence of *Pediculus humanus capitis* among the students of a secondary and three elementary schools in Karsiyaka-Izmir, Turkey. J Egypt Soc Parasitol 27:157–161

Inanir I, Sahin MT, Gündüz K, Dinç G, Türel A, Oztürkcan S (2002) Prevalence of skin conditions in primary school children in Turkey: differences based on socioeconomic factors. Pediatr Dermatol 19: 307–311

Ismail MT, Kabakibi MM, Al-Kafri A (2018) Epidemiology of pediculosis capitis among schoolchildren in Damascus, Syria. Indian J Paediatr Dermatol 19:331–334

Iwuala MOE, Onyeka JOA (1977) The incidence of head lice *Pediculus humanus* var *capitis* in primery school pupils in Nsukka, East Central State, Nigeria. Nigerian med J 7:274–283

Jahnke C, Bauer E, Feldmeier H (2008) Pediculosis capita in childhood: epidemiological and socio-medical results from screening of school beginners. Gesundheitswesen 70:667–673

Jinadu MK (1985) Pediculosis humanus capitis among primary school children in lie-ife, Nigeria. J R Soc Health 105:25–27

Jose G, Vellaisamy SG, Govindarajan N, Gopalan K (2017) Prevalence of common dermatoses in school children of rural areas of Salem; a region of South India. Indian J Paediatr Dermatol 18:202–208

Kamiabi F, Nakhaei FH (2005) Prevalence of pediculosis capitis and determination of risk factors in primary-school children in Kerman. East Mediterr Health J 11:988–992

Karaaslan S, Yılmaz H (2015) The distribution of *Pediculus humanus capitis* among primary school pupils of the Turkish chamber of commerce and stock exchange organization in Van. Turkiye Parazitol Derg 39:27–32

Karakus M, Arıcı A, Toz SO, Özbel Y (2014) Prevalence of head lice in two socio-economically different schools in the center of Izmir City, Turkey. Turkiye Parazitol Derg 38:32–36

Karaman Ü, Enginyurt Ö, Karaman Ö, Colak C, Kaçmaz G (2018) Determination of the prevalence of head lice *Pediculus humanus capitis* in primary school students in Ordu province. Turk Hij Den Biyol Derg 75:383–390

Karim T, Musa S, Khanum H, Mondal D (2015) Occurrence of *Pediculus humanus capitis* in relation to their personal hygiene and social behaviour among the children in Dhaka City. Bangladesh J Zool 43:327–332

Kassiri H, Gatifi A (2016) The frequency of head lice, health practices and its associated factors in primary schools in Khorramshahr, Iran. Health Scope 5:e31570

Khamaiseh AM (2018) Head lice among governmental primary school students in southern Jordan: prevalence and risk factors. J Global Infect Dis 10:11–15

Khokhar A (2002) A study of pediculosis capitis among primary school children in Delhi. Indian J Med Sci 56:449–452

Kim TK, Park CP, Hŏ S (1984) Head louse infestation among the students in Yŏngyang-gun, Kyŏngsangbuk-to. Korean J Parasitol 22: 273–276

Kokturk A, Baz K, Bugdayci R, Sasmaz T, Tursen U, Kaya TI, Ikizoglu G (2003) The prevalence of pediculosis capitis in schoolchildren in Mersin, Turkey. Int J Dermatol 42:694–698

Kwaku-Kpikpi JE (1982) The incidence of the head louse (*Pediculus humanus capitis*) among pupils of two schools in Accra. Trans R Soc Trop Med Hyg 76:378–381

Lashari MH, Sial N, Akhtar MS, Siddique F, Nawaz M, Yousaf M, Chaundhary MS, Tasawar Z (2015) Prevalence of head lice among school children. Gomal J Med Sci 13:239–242

Lee SH, Oh CW, Chai JY (1984) Head louse infestation among primary school children in Seosan-gun, Chungnam Province. Korean J Parasitol 22:141–143

Lesshafft H, Baier A, Guerra H, Terashima A, Feldmeier H (2013) Prevalence and risk factors associated with pediculosis capitis in an impoverished urban community in Lima, Peru. J Global Infect Dis 5:138–143

Letz A (1980) Spread of head lice infestation in Kassel schools. Offentl Gesundheitswes 42:228–231

Liao CW, Cheng PC, Chuang TW, Chiu KC, Chiang IC, Kuo JH, Tu YH, Fan YM, Jiang HT, Fan CK (2019) Prevalence of *Pediculus capitis* in schoolchildren in Battambang, Cambodia. J Microbiol Immunol Infect 52:585–591

López-Valencia D, Medina-Ortega A, Vásquez-Arteaga LR (2017) Prevalence and variables associated with pediculosis capitis in kindergarten children from Popayán, Colombia. Rev Fac Med 65:425–428

Lye MS, Tohit NF, Rampal L (2017) Prevalence and predictors of pediculosis capitis among primary school children in Hulu Langat, Selangor. Med J Malaysia 72:12–17

Magalhães P, Figueiredo EV, Capingana DP (2011) Head lice among primary school children in Viana, Angola: prevalence and relevant teachers' knowledge. Hum Parasit Dis 3:11–18

Mahé A, Prual A, Konaté M, Bobin P (1995) Skin diseases of children in Mali: a public health problem. Trans R Soc Trop Med Hyg 89:467–470

Mahmood S (2010) Head pediculosis among in Baghdad area elementary school children. Iraqi J Sci 51:49–55

Majidi S, Farahmandfard MA, Solhjoo K, Mosallanezhad H, Arjomand M (2017) The prevalence of pediculosis capitis and its associated risk factors in primary school students in Jahrom, 2016. Pars J Med Sci 15:50–56

Maleky A, Yazdani-Charati J, Abdollahi F (2016) The prevalence of pediculosis capitis and its related risk factors in primary school students in Kalaleh, Iran in 2015. J Health Rec Commun 2:23–31

Mallik S, Chaudhuri RN, Biswas R, Biswas B (2004) A study on morbidity pattern of child labourers engaged in different occupations in a slum area of Calcutta. J Indian Med Assoc 102:198–200

Manrique-Saide P, Pavıa-Ruz N, Rodrıguez Buenfil JC, Herrera Herrera R, Gomez-Ruiz P, Pilger D (2011) Prevalence of pediculosis capitis in children from rural school in Yucatan, Mexico. Rev Inst Med Trop S Paulo 53:325–327

Manusamy H, Murhandarwati EEH, Umniyati SR (2011) The relationship between the prevalence of head lice infestation with hygiene and knowledge 959 among the rural school children in Yogyakarta. TMJ 1:102–109

Modarresi M, Mansoori Ghiasi M, Modarresi M, Marefat A (2013) The prevalence of head lice infestation among primary school children in Tonekabon, Iran. Iran J Infect Dis Trop Med 18:41–45

Mohammadi-Azni S (2014) Prevalence of head lice at the primary schools in Damghan. Zahedan J Res Med Sci 16:47–49

Moher D, Liberati A, Tetzlaff J, Altman DG (2009) Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med 6:e1000097

Molina-Garza ZJ, Galaviz-Silva L (2017) *Pediculus capitis* in schoolchildren of the urban area of Nuevo León, México: analyses of associated factors. Biomédica 37:333–340

Moosazadeh M, Afshari M, Keianian H, Nezammahalleh A, Enayati AA (2015) Prevalence of head lice infestation and its associated factors among primary school students in Iran: a systematic review and meta-analysis. Osong Public Health Res Perspect 6:346–356

Moosazadeh M, Afshari M, Hajheydari Z, Charkameh A, Nezammahalleh A, Zerafat A, Rezaei F, Rankoohi M, Safari N, Shojaei J, Enayati AA (2019) Prevalence of pediculosis and its related factors among primary school girls in the North of Iran. Int J Adolesc Med Health 0. https://doi.org/10.1515/ijamh-2018-0039

Moradi A, Zahirnia A, Alipour A, Eskandari Z (2009) The prevalence of pediculosis capitis in primary school students in Bahar, Hamadan province, Iran. J Res Health Sci 9:45–49

Moradiasl E, Habibzadeh S, Rafinejad J, Abazari M, Sadeghieh-Ahari S, Saghafipour A, Mehrtak M, Edalatkhah H (2018) Risk factors associated with head lice (pediculosis) infestation among elementary school students in Meshkinshahr County, North West of Iran. Int J Pediatr 6:7383–7392

Morsy TA, Farrag AM, Sabry AH, Salama MM, Arafa MA (1991) Ecto and endoparasites in two primary schools in Qualyob city, Egypt. J Egypt Soc Parasitol 21:391–401

Morsy TA, el-Ela RG, Mawla MY, Khalaf SA (2001) The prevalence of lice infesting students of primary, preparatory and secondary schools in Cairo, Egypt. J Egypt Soc Parasitol 31:43–50

Motevalli Haghi F, Golchin M, Yousefi M, Hosseini M, Parsi B (2014) Prevalence of Pediculosis and associated risk factors in the girls primary school in Azadshahr city, Golestan Province, 2012-2013. Iran J Health Sci 2:63–68

Motovali-Emami M, Aflatoonian MR, Fekri A, Yazdi M (2008) Epidemiological aspects of pediculosis capitis and treatment evaluation in primary-school children in Iran. Pak J Biol Sci 11:260–264

Muhammad Zayyid M, Saidatul Saadah R, Adil AR, Rohela M, Jamaiah I (2010) Prevalence of scabies and head lice among children in a welfare home in Pulau Pinang, Malaysia. Trop Biomed 27:442–446

Mumcuoglu KY, Miller J, Gofin R, Adler B, Ben-Ishai F, Almog R, Kafka D, Klaus S (1990) Epidemiological studies on head lice infestation in Israel. Int J Dermatol 29:502–506

Mumcuoglu KY, Friger M, Ioffe-Uspensky I, Ben-Ishai F, Miller J (2001) Louse comb versus direct visual examination for the diagnosis of head louse infestations. Pediatr Dermatol 18:9–12

Nazari M, Saidijam M (2006) *Pediculus capitis* infestation according to sex and social factors in Hamedan-Iran. Pak J Biol Sci 10:3473–3475

Nazari S, Nazari S, Goudarztalejerdi R, Nazari M (2016) Prevalence of head lice infestation among schoolchildren in urban and rural areas in a region of western Iran-school year 2015-2016. Int J Med Res Health Sci 5:372–377

Nejati J, Keyhani A, Tavakoli Kareshk A, Mahmoudvand H, Saghafipour A, Khoraminasab M, Tavakoli Oliaee R, Mousavi SM (2018) Prevalence and risk factors of pediculosis in primary school children in south west of Iran. Iran J Public Health 47:1923–1929

Nunes SCB, Moroni RB, Mendes J, Justiniano SCB, Moroni FT (2015) Head lice in hair samples from youths, adults and the elderly in Manaus, Amazonas State, Brazil. Rev Inst Med Trop S Paulo 57:239–244

Nutanson I, Steen CJ, Schwartz RA, Janniger CK (2008) *Pediculus humanus capitis*: an update. Acta Dermatoven APA 17:147–154

Ogunrindae AF, Oyejide CO (1984) Pediculosis capitis among rural and urban schoolchildren in Nigeria. Trans R Soc Trop Med Hyg 78:590–592

Oguzkaya Artan M, Baykan Z, Koç AN (2006) The prevalence of *Pediculus capitis* in students of eight primary schools in the rural area of the Kayseri province. Turkiye Parazitol Derg 30:112–114

Oh JM, Lee IY, Lee WJ, Seo M, Park SA, Lee SH, Seo JH, Yong TS, Park SJ, Shin MH, Pai KS, Yu JR, Sim S (2010) Prevalence of *Pediculosis capitis* among Korean children. Parasitol Res 107:1415–1419

Okoh BA, Alikor EA (2013) Prevalence of head lice infestation in primary school children in Port Harcourt. East Afr Med J 90:269–274

Omar AA (2000) Ringworm of the scalp in primary-school children in Alexandria*:* infection and carriage. E Mediterr Health J 6:961–967

Omidi A, Khodaveisi M, Moghimbeigi A, Mohammadi N, Amini R (2013) Pediculosis capitis and relevant factors in secondary school students of Hamadan, west of Iran. J Res Health Sci 13:176–180

Ozçelik S, Degerli S, Aslan A (2006) Investigation of the prevalence of *Pediculus* in Alahacı village primary school students in the Sivas Province. Turkiye Parazitol Derg 30:184–186

Ozdemir A, Unal E, Ceki L (2019) The prevalence of *Pediculus capitis* and personal hygiene status in two vocational high schools. Int J Caring Sci 12:658–665

Pai KS, Huh S (1987) Head louse infestation among school children in Sanbuk-myon, Mungyong-gun, Kyongsangbuk-do (1985). Korean J Parasitol 25:85–86

Pai KS, Park MS, Lee YS, Kim DH, Chung KS, Lee KY, Kim PK, Kim KY, Yong TS, Ree HI, Huh S (1989) The prevalence of head louse infestation among urban and rural children in Korea. Korean J Parasitol 27:271–275

Pelissero G, Marchetti R, Neri M, De Carneri I (1980) Epidemiology of head lice in a Lombard school population. G Mal Infett Parassit 32:345–349

Petrelli G, Majori G, Maggini M, Taggi F, Maroli M (1980) The head louse in Italy: an epidemiological study among schoolchildren. R Soc Health J 100:64–66

Pourbaba R, Moshkbide Haghighi M, Habibpour R, Mirzanezhade M (2004) A survey of prevalence of pediculosis among primary school students of Gilan province. J Guilan Univ Med Sci 13:15–23

Rabi A, Al-Khateeb N, Abo-Shehada MN (1996) Prevalence of head louse infestation among Russeifa school children. Saudi Med J 17:604–607

Raeisi S, Eteghadi A, Poodineh Z, Balouchi A (2016) Prevalence of head lice infestation and its associated factors among primary school students in Zabol. IJPTONLINE 8:19135–19141

Rafinejad J, Norollahi A, Javadian E, Kazemnejad A, Shemshad KM (2005) Epidemiology of head lice and its effective factors in primary school students of Amlash city, Guilan province, 2003-2004. Iran J Epidemiol 2:51–63

Rassami W, Soonwera M (2012) Epidemiology of pediculosis capitis among schoolchildren in the eastern area of Bangkok, Thailand. Asian Pac J Trop Biomed 2:901–904

Ruankham W, Winyangkul P, Bunchu N (2016) Prevalence and factors of head lice infestation among primary school students in Northern Thailand. Asian Pac J Trop Dis 6:778–782

Rukke BA, Birkemoe T, Soleng A, Lindstedt HH, Ottesen P (2011) Head lice prevalence among households in Norway: importance of spatial variables and individual and household characteristics. Parasitology 138:1296–1304

Rupes V, Vlcková J, Mazánek L, Chmela J, Ledvinka J (2006) Pediatric head lice: taxonomy, incidence, resistance, delousing. Epidemiol Mikrobiol Imunol 55:112–119

Saddozai S, Kakarsulemankhel JK (2008) Infestation of head lice, *Pediculus humanus capitis*, in school children at Quetta city and its suburban areas, Pakistan. Pak J zool 40:45–52

Saghafipour A, Nejati J, Zahraei-Ramazani A, Vatandoost H, Mozaffari E, Rezaei F (2017) Prevalence and risk factors associated with head louse (*Pediculus humanus capitis*) in central Iran. Int J Pediatr 5: 5245–5254

Salih HA, Shamran SJ, Al-Shimerty DFH (2017) Prevalence of pediculosis capitis (head lice) and treating among children in Al-Najaf city, IRAQ. Al-Kufa Univ J Biol 9:179–183

Salehi S, Ban M, Motaghi M (2014) A study of head lice infestation (pediculosis capitis) among primary school students in the villages of Abadan in 2012. Int J Community Based Nurs Midwifery 2:196–200

Sanei-Dehkordi A, Soleimani-Ahmadi M, Zare M, Madani A, Jamshidzadeh A (2017) Head lice infestation (pediculosis) and associated factors among primary school girls in Sirik County, Southern Iran. Int J Pediatr 5:6301–6306

Sarov B, Neumann L, Herman Y, Naggan L (1988) Evaluation of an intervention program for head lice infestation in school children. Pediatr Infect Dis J 7:176–179

Sayyadi M, Vahabi A, Sayyad S (2013) An epidemiological survey of head louse infestation among primary school children in rural areas of Ravansar County, West of Iran. Life Sci J 10:869–872

Sayyadi M, Vahabi A, Sayyad S, Sahne Sh H (2014) Prevalence of head louse (*Pediculus humanus capitis*) infestation and associated factors among primary schoolchildren in Bayengan city, west of Iran. Life Sci J 11:19–22

Sayyad S, Vahabi A, Vahabi B, Sayyadi M, Ahmadian M (2016) Head louse (*Pediculus humanus capitis*) infestation in primary schoolchildren in rural areas of Paveh County, Kermanshah province. J Chem Pharm Sci 7:35–38

Serarslan G, Savaş N (2005) Prevalence of skin diseases among children and adolescents living in an orphanage in Antakya, Turkey. Pediatr Dermatol 22:490–492

Shakkoury WA, Abu-Wandy E (1999) Prevalence of skin disorders among male school-children in Amman. E Mediterr Health J 5: 955–959

Shakya SR, Bhandary S, Pokharel PK (2004) Nutritional status and morbidity pattern among governmental primary school children in the Eastern Nepal. Kathmandu Univ Med J 2:307–314

Shayeghi M, Paksa A, Salim Abadi Y, Sanei Dehkoordi A, Ahmadi A, Eshaghi M, Bazrafkan S (2010) Epidemiology of head lice infestation in primary school pupils, in Khajeh city, East Azerbaijan province, Iran. Iran J Arthropod Borne Dis 4:42–46

Sim S, Lee IY, Lee KJ, Seo JH, Im KI, Shin MH, Yong TS (2003) A survey on head lice infestation in Korea (2001) and the therapeutic efficacy of oral trimethoprim/sulfamethoxazole adding to lindane shampoo. Korean J Parasitol 41:57–61

Sim S, Lee WJ, Yu JR, Yong Lee I, Hyun Lee S, Oh SY, Seo M, Chai JY (2011) Risk factors associated with head louse infestation in Korea. Korean J Parasitol 49:95–98

Sinniah B, Sinniah D, Rajeswari B (1981) Epidemiology of *Pediculus humanus capitis* infestation in Malaysian school children. Am J Trop Med Hyg 30:734–738

Sinniah B, Sinniah D, Rajeswari B (1983) Epidemiology and control of human head louse in Malaysian school children. Trop Geogr Med 35:337–342

Sinniah B, Shekhar C, Ramphal L, Senan P (1984) Pediculosis among rural school children in Kelang, Selangor, Malaysia and their susceptibility to malathion, carbaryl, perigen and kerosene. J R Soc Health 104:114–115

Slonka GF, McKinley TW, McCroan JE, Sinclair SP, Schultz MG, Hicks F, Hill N (1976) Epidemiology of an outbreak of head lice in Georgia. Am J Trop Med Hyg 25:739–743

Slonka GF, Fleissner ML, Berlin J, Puleo J, Harrod EK, Schultz MG (1977) An epidemic of *Pediculosis capitis*. J Parasitol 63:377–383

Soleimani M, Zare S, Hanafi-Bojd AA, Amir-Haidarasha M (2007) The epidemiological aspect of pediculosis in primary school of Qeshm, south of Iran. J Med Sci 7:299–302

Soleimani-Ahmadi M, Jaberhashemi A, Zare M, Sanei-Dehkordi A (2017) Prevalence of head lice infestation and pediculicidal effect of permethrine shampoo in primary school girls in a low-income area in southeast of Iran. BMC Dermatol 17:10

Soultana V, Euthumia P, Antonios M, Angeliki RS (2009) Prevalence of pediculosis capitis among schoolchildren in Greece and risk factors: a questionnaire survey. Pediatr Dermatol 26:701–705

Speare R, Buettner PG (1999) Head lice in pupils of a primary school in Australia and implications for control. Int J Dermatol 38:285–290

Suleman M, Fatima T (1988) Epidemiology of head lice infestation in school children at Peshawar, Pakistan. J Trop Med Hyg 91:323–332

Tagka A, Lambrou GI, Braoudaki M, Panagiotopoulos T, Papanikolaou E, Laggas D (2016) Socioeconomical factors associated with pediculosis (Phthiraptera: Pediculidae) in Athens, Greece. J Med Entomol 53:919–922

Tanyuksel M, Araz RE, Albay A, Aycicek H (2003) Prevalence and treatment of *Pediculus humanus capitis* with 1% permethrin and 0.4% d-phenothrin in Turkey. Acta Med Austriaca 46:73–75

Tohit NF, Rampal L, Lye MS (2017) Prevalence and predictors of pediculosis capitis among primary school children in Hulu Langat, Selangor. Med J Malaysia 72:12–17

Toloza A, Vassena C, Gallardo A, González-Audino P, Picollo MI (2009) Epidemiology of Pediculosis capitis in elementary schools of Buenos Aires, Argentina. Parasitol Res 104:1295–1298

Vahabi B, Vahabi A, Gharib A, Sayyadi M, Sayyad S (2013) Prevalence of head louse infestations and factors affecting the rate of infestation among primary schoolchildren in Paveh City, Kermanshah Province, Iran in the years 2009 to 2010. Life Sci J 10:360–364

Vahabi A, Shemshad K, Sayyadi M, Biglarian A, Vahabi B, Sayyad S, Shemshad M, Rafinejad J (2012) Prevalence and risk factors of *Pediculus* (*humanus*) *capitis* (Anoplura: Pediculidae), in primary schools in Sanandaj City, Kurdistan Province, Iran. Trop Biomed 29:207–211

Wegner Z, Racewicz M, Stanczak J (1994) Occurrence of pediculosis capitis in a population of children from Gdansk, Sopot, Gdynia and the vicinities. Appl Parasitol 35:219–225

Williams LK, Reichert A, MacKenzie WR, Hightower AW, Blake PA (2001) Lice, nits, and school policy. Pediatrics 107:1011–1015

Willems S, Lapeere H, Haedens N, Pasteels I, Naeyaert JM, De Maeseneer J (2005) The importance of socio-economic status and individual characteristics on the prevalence of head lice in schoolchildren. Eur J Dermatol 15:387–392

Wu YH, Su HY, Hsieh YJ (2000) Survey of infectious skin diseases and skin infestations among primary school students of Taitung County, Eastern Taiwan. J Formos Med Assoc 99:128–134

Yamamah GA, Emam HM, Abdelhamid MF, Elsaie ML, Shahata H, Farid T, Kamel MI, Taalat AA (2012) Epidemiologic study of

dermatologic disorders among children in South Sinai, Egypt. Int J Dermatol 51:1180–1185

Yap FBB, Elena EMT, Pubalan M (2010) Prevalence of scabies and head lice among students of secondary boarding schools in Kuching, Sarawak, Malaysia. Pediatr Infect Dis J 29:682–683

Yingklang M, Sengthong C, Haonon O, Dangtakot R, Pinlaor P, Sota C, Pinlaor S (2018) Effect of a health education program on reduction of pediculosis in school girls at Amphoe Muang, Khon Kaen Province, Thailand. PLoS One 13:e0198599

Yousefi S, Shamsipoor F, Salim-Abadi Y (2012) Epidemiological study of head louse (*Pediculus humanus capitis*) infestation among primary school students in rural areas of Sirjan County, South of Iran. Thrita J Med Sci 1:53–56

Zimmo SK, Qari MA, El-Gamal FM, Kordy MN (1996) Prevalence of skin disorders among male primary school children in the City of Jeddah, Saudi Arabia. Saudi Med J 17:56–61