Prevalence of Refractive Errors and Amblyopia Among Primary School Children in Eligible Arab Countries: A Systematic Review and Meta-analysis of Diagnostic Approaches

Appendix 1: *The risk of bias in the included observational studies was assessed using a simplified Newcastle–Ottawa Scale (NOS), which covers the selection, comparability, and outcome domains. Ratings were classified as Low, Moderate, High.*

	Study	Year	Country/Region	Identification	Diagnostic Tools	Selection	Comparability	Outcome	Overall Risk
1	Rasheed et al.7	2018	Iraq (Baghdad)	Cycloplegic + Snellen	Retinoscope, Autorefractor	Low	Low	Low	Low
2	Alghamdi W.	2020	Saudi Arabia (Uyoun)	Snellen only	Autorefractor	Moderate	Moderate	Moderate	Moderate to High
3	Fayyadh et al.	2020	Iraq (Kurdistan)	Cycloplegic	Retinoscope	Low	Moderate	Low	Moderate
4	Hussam Ul Deen et al.	2018	Iraq (Amara)	Snellen only	Retinoscope, Autorefractor	Moderate	Moderate	Moderate	Moderate to High
5	Kandi et al.	2021	UAE (Dubai)	Cycloplegic + Snellen	Retinoscope, Autorefractor	Low	Low	Low	Low
6	Raed Al-Omair et al.	2020	Saudi Arabia (Riyadh)	Snellen only	Retinoscope, Autorefractor	Moderate	Moderate	Moderate	Moderate to High
7	Mohamed et al.	2023	Sudan (Al-Gezira)	Cycloplegic + Snellen	Retinoscope, Autorefractor	Low	Low	Low	Low
8	Mohamed et al.	2017	Sudan (Al-Gezira)	Snellen only	Retinoscope, Autorefractor	Moderate	Moderate	Moderate	Moderate to High
9	Awad et al.	2017	Palestine (Gaza)	Snellen only	Retinoscope, Autorefractor	Moderate	Moderate	Moderate	Moderate to High
10	Hegazy et al.	2018	Egypt (Menoufia)	Snellen only	Retinoscope	Moderate	Moderate	Moderate	Moderate to High
11	Al-Daajani et al.	2019	Saudi Arabia (NSBSP)	Cycloplegic + Snellen	Retinoscope, Autorefractor	Low	Low	Low	Low
12	Al-Bahhawi et al.	2018	Saudi Arabia (Jazan)	Snellen only	Autorefractor	Moderate	Moderate	Moderate	Moderate to High
13	Zahra Abdi et al.	2020	Somalia	Snellen only	Retinoscope	Moderate	Moderate	Moderate	Moderate to High
14	Yasir et al.	2019	Saudi Arabia (Riyadh)	Cycloplegic	Retinoscope	Low	Moderate	Low	Moderate
15	El-Majri et al.	2017	Libya (Darnah)	Snellen only	Retinoscope	Moderate	Moderate	Moderate	Moderate to High
16	Hawary et al.	2017	Egypt (Luxor)	Snellen only	Retinoscope, Autorefractor	Moderate	Moderate	Moderate	Moderate to High
17	Yamamah et al.	2016	Egypt (Sinai)	Snellen only	Autorefractor	Moderate	Moderate	Moderate	Moderate to High
18	Al-Rahili et al.	2017	Saudi Arabia (Medina)	Snellen only	Retinoscope, Autorefractor	Moderate	Moderate	Moderate	Moderate to High
19	Anera et al.	2019	Morocco	Snellen only	Retinoscope, Autorefractor	Moderate	Moderate	Moderate	Moderate to High
20	Arafa et al.	2019	Egypt (Beni-Suef)	Snellen only	Autorefractor	Moderate	Moderate	Moderate	Moderate to High
21	Halboos et al.	2023	Iraq (Babylon)	Snellen only	Retinoscope	Moderate	Moderate	Moderate	Moderate to High
22	Abdelrheem et al.	2021	Egypt (Luxor)	Snellen only	Retinoscope	Moderate	Moderate	Moderate	Moderate to High
23	Ahmed et al.	2017	Iraq (Erbil)	Cycloplegic + Snellen	Retinoscope, Autorefractor	Low	Low	Low	Low
24	Agha et al.	2018	Iraq (Erbil)	Cycloplegic + Snellen	Retinoscope, Autorefractor	Low	Low	Low	Low
25	Hnoosh et al.	2016	Iraq (Al-Kut)	Cycloplegic	Retinoscope	Low	Moderate	Low	Moderate
26	Al-Thomali et al.	2022	Saudi Arabia (Taif)	Cycloplegic	Retinoscope	Low	Moderate	Low	Moderate
27	Farahata et al.	2018	Egypt (Menoufia)	Snellen only	Autorefractor	Moderate	Moderate	Moderate	Moderate to High
28	Ghalib et al.	2020	Sudan (Khartoum)	Cycloplegic + Snellen	Retinoscope, Autorefractor	Low	Low	Low	Low
29	Harby et al.	2016	Oman	Cycloplegic + Snellen	Retinoscope, Autorefractor	Low	Low	Low	Low
30	Morad Amir	2017	Iraq (Erbil)	Cycloplegic	Retinoscope	Low	Moderate	Low	Moderate

Appendix 2: *Comprehensive Study Information on Refractive Errors in the Arab World.*

Author (Year)	Country/Region	Age Group (Years)	Sample Size	Sex N (ratio)	Refractive Error Prevalence (%)	Methodology	Urban/ Rural	Refractive Error Definition	Standardized Clinical Cut-off Applied
Rasheed et al. (2018)	Iraq (Baghdad)	8-12	179	M 80(44.7%) F 99(55.3%)	21.8%	Cycloplegic + Snellen	Urban	Myopia ≤ −0.50 D	Yes
Alghamdi W. (2020)	Saudi Arabia (Uyoun)	6-13	417	M 417(100%)	19.7%	Snellen only	Rural	Myopia ≤ −0.50 D	No
Fayyadh et al. (2020)	Iraq (Kurdistan)	6-12	553	M 287(51.9%) F 266(48.1%)	32.2%	Cycloplegic	Urban	Myopia ≤ −0.50 D	Yes
Hussam Ul Deen et al. (2018)	Iraq (Amara)	6-8	768	M 486(63.3%) F 282(36.7%)	47	Snellen only	Urban	Myopia ≤ −0.50 D	No
Kandi et al. (2021)	UAE (Dubai)	6-19	1591	M 835(52.5%) F 756(47.5%)	20.9	Cycloplegic + Snellen	Urban	Myopia ≤ −0.50 D	Yes
Raed Al-Omair et al. (2020)	Saudi Arabia (Riyadh)	6-15	850	M 475(55.9%) F 375(44.1%)	21.1	Snellen only	Urban	Myopia ≤ −0.50 D	No
Mohamed et al. (2023)	Sudan (Al-Gezira)	7-12	551	M 551(100%)	9.5	Cycloplegic + Snellen	Rural	Myopia ≤ −0.50 D	Yes
Mohamed et al. (2017)	Sudan (Al-Gezira)	6-15	822	M 822(100%)	8.9	Snellen only	Rural	Myopia ≤ −0.50 D	No
Awad et al. (2017)	Palestinian Territories (Gaza)	6-12	423	M 212(50.1%) F 211(49.9%)	31	Snellen only	Urban	Myopia ≤ −0.50 D	No
Hegazy et al. (2018)	Egypt (Menoufia)	6-12	960	M 473(49.3%) F 487(50.7%)	24.1	Snellen only	Urban	Myopia ≤ −0.50 D	No
Al-Daajani et al. (2019)	Saudi Arabia (NSBSP)	6-14	444259	M 207109(46.6%) F 237150(53.4%)	10.9	Cycloplegic + Snellen	Urban	Myopia <-0.50 D	Yes
Al-Bahhawi et al.(2018)	Saudi Arabia (Jazan)	6-10	395	M 395(100%)	22	Snellen only	Rural	Myopia <-0.50 D	No
Zahra Abdi et al. (2020)	Somalia	6-15	1204	M 658(54.8%) F 556(46.2%)	16.5	Snellen only	Rural	Myopia ≤ −0.50 D	No
Yasir et al. (2019)	Saudi Arabia (Riyadh)	5-8	300	M 118(39.3%) F 182(60.7%)	22	Cycloplegic	Urban	Myopia ≤ −0.50 D	Yes
El-Majri et al. (2017)	Libya (Darnah)	6-11	920	M 442(48.1%) F 478(51.9%)	11.6	Snellen only	Rural	Myopia ≤ −0.50 D	No
Hawary et al. (2017)	Egypt (Luxor)	7-12	6333	M 3103(48.9%) F 3230(51.1%)	8.2	Snellen only	Urban	Myopia ≤ −0.50 D	No
Yamamah et al. (2016)	Egypt (Sinai)	6-15	2070	M 1047(50.6%) F 1023(49.4%)	29.4	Snellen only	Urban	Myopia ≤ −0.50 D	No
Al-Rahili et al. (2017)	Saudi Arabia (Medina)	5-10	1893	M 947(50.1%) F 946(49.9%)	34.9	Snellen only	Urban	Myopia ≤ −0.50 D	No
Anera et al. (2019)	Morocco	6-16	545	M 300(55.1%) F 245(44.9%)	47.9	Snellen only	Rural	Myopia ≤ −0.50 D	No
Arafa et al. (2019)	Egypt (Beni-Suef)	12-14	469	M 258(55.1%) F 211(44.9%)	22.8	Snellen only	Urban	Myopia ≤ −0.50 D	No
Halboos et al. (2023)	Iraq (Babylon)	7-12	1014	M 422(41.7%) F 592(58.3%)	19.3	Snellen only	Urban	Myopia ≤ −0.50 D	No
Abdel Rheem et al. (2021)	Egypt (Luxor)	6-12	14787	M 7450(50.4%) F 7337(49.6%)	28.8	Snellen only	Urban	Myopia ≤ −0.50 D	No

Ahmed et al. (2017)	Iraq (Erbil)	7-12	1191	M 580(48.7%) F 611(51.3%)	19.6	Cycloplegic + Snellen	Urban	Myopia ≤ −0.50 D	Yes
Agha et al. (2018)	Iraq (Erbil)	6-14	804	M 321(39.9%) F 483(60.1%)	50	Cycloplegic + Snellen	Urban	Myopia ≤ −0.50 D	Yes
Hnoosh et al. (2016)	Iraq (Al-Kut)	6-12	897	M 450(50.2%) F 447(49.8%)	30.8	Cycloplegic	Rural	Myopia ≤ −0.50 D	Yes
Al-Thomali et al. (2022)	Saudi Arabia (Taif)	7-18	3678	M 1837(49.1%) F 1841(50.1%)	16.1	Cycloplegic	Urban	Myopia ≤ −0.50 D	Yes
Farahata et al. (2018)	Egypt (Menoufia)	6-15	276	M 134(48.5%) F 142(51.5%)	30.1	Snellen only	Urban	Myopia ≤ −0.50 D	No
Ghalib et al. (2020)	Sudan (Khartoum)	6-15	400	M 116(29%) F 284(71%)	38.5	Cycloplegic + Snellen	Urban	Myopia ≤ −0.50 D	Yes
Harby et al. (2016)	Oman	6-12	286	M 100(34.9%) F 186(65.1%)	38	Cycloplegic + Snellen	Rural	Myopia ≤ −0.50 D	Yes
Morad Amir (2017)	Iraq (Erbil)	6-12	3150	M 1364(43.3%) F 1786(56.7%)	23.3	Cycloplegic	Urban	Myopia ≤ −0.50 D	Yes

Appendix 3: *Distribution of refractive errors among primary school children described in the studies.*

Author name	Myopia		Hyperopia		Astigmatism		Amblyopia	
	Number	Percentage%	Number	Percentage%	Number	Percentage%	Number	Percentage%
Rasheed et al	17	9.5%	22	12.3	NT	NT	9	5%
Alghamdi, W	32	7.7%	37	8.9%	13	3.1%	NT	NT
Fayyadh et al	21	3.8%	77	13.9%	80	14.5%	10	1.8%
Hussam Uldeen et al	144	19.6%	148	20.1%	53	7.1%	37	4.8%
Kandi et al. (2021)	195	12.3%	29	1.8%	109	6.9%	64	4%
Raed Al-Omair et al. (2020)	89	10.5%	18	2.1%	72	8.5%	NT	NT
Mohamed et al. (2023)	28	5.1%	6	1.1%	18	3.3%	3	0.6%
Mohamed et al. (2017)	27	3.3%	9	1.1%	37	4.5%	NT	NT
Awad et al. (2017)	38	9%	47	11.1%	46	10.9%	79	18.5%
Hegazy et al. (2018)	95	9.9%	128	13.4%	11	1.5%	231	24.1%
Al Daajani et al. (2019)	25195	5.7%	21085	4.8%	875	0.2%	NT	NT
Al Bahhawi et al.(2018)	28	7.1%	19	4.8%	32	8.1%	NT	NT
Zahra Abdi et al. (2020)	110	9.1%	32	2.7%	57	4.7%	4	22.0%
Yasir et al. (2019)	34	11.3%	11	3.7%	20	6.7%	NT	NT
El-Majri et al. (2017)	16	1.7%	57	6.2%	34	3.7%	NT	NT
Hawary et al. (2017)	309	4.9%	165	2.5%	332	5.2%	NT	NT
Yamamah et al. (2016)	64	3.1%	75	3.6%	318	15.4%	1	0.4%
Al-Rahili et al. (2017)	13	2.3%	29	4.4%	479	25.3%	NT	NT
Anera et al. (2019)	50	9.1%	164	30.1%	48	8.8%	NT	NT
Arafa et al. (2019)	62	13.2%	31	6.6%	15	2.9%	NT	NT
Halboos et al. (2023)	92	9%	74	7.3%	30	3%	42	4.1%
Abdelrheem et al. (2021)	687	4.7%	1325	8.9%	2275	15.2%	NT	NT
Ahmed et al. (2017)	33	2.8%	12	1%	188	15.8%	NT	NT
Agha et al. (2018)	82	10.7%	86	10.9%	234	29.1%	80	9.9%
Hnoosh et al. (2016)	146	16.3%	40	4.5%	90	10.1%	NT	NT
Al-Thomali et al. (2022)	337	9.2%	99	2.7%	154	4.2%	NT	NT
Al-Thomali et al. (2022)	45	12.3%	16	4.6%	48	13.2%	NT	NT
Ghalib et al. (2020)	44	11%	54	13.5%	56	16%	NT	NT
Harby et al. (2016)	73	25%	12	4%	20	7%	NT	NT
Morad Amir (2017)	159	5.1%	190	6.1%	386	12.3%	34	1.1%

Appendix 4: *Meta-analysis of Prevalence and Weight Distribution of Hypermetropia, Astigmatism, and Amblyopia Across Studies in the Arab World.*

Study	Proportion Hypermetropia	95% CI Hypermetropia	Weight (%) Hypermetropia	Proportion Astigmatism	95% CI Astigmatism	Weight (%) Astigmatism	Proportion Amblyopia	95% CI Amblyopia	Weight (%) Amblyopia
Raed Al-Omair et al. (2020)	0.021	0.011 – 0.031	3.67	0.033	0.018 -0.048	3.76	0.006	–0.001- 0.012	10.01
Mohamed et al. (2023)	0.011	0.002 – 0.020	3.69	0.099	0.072 – 0.126	3.53	0.185	0.148 – 0.222	2.5
Mohamed et al. (2017)	0.006	0.001 – 0.011	3.76	0.039	0.028 – 0.050	3.81	0.002	0.000 – 0.004	10.87
Awad et al. (2017)	0.111	0.081 – 0.141	2.83	0.037	0.025 – 0.049	3.47	0.008	0.002 – 0.014	10.1
Hegazy et al. (2018)	0.021	0.012 – 0.030	3.68	0.154	0.138 – 0.170	3.8	0.004	–0.004 -0.012	9.52
Al-Daajani et al. (2019)	0.048	0.047 – 0.049	3.8	0.047	0.051 – 0.091	3.66	0.146	0.123 – 0.222	9.58
Al-Bahhawi et al.(2018)	0.071	0.051 – 0.091	3.3	0.051	0.060 – 0.092	3.8	0.04	0.002 – 0.040	9.89
Zahra Abdi et al. (2020)	0.027	0.018 – 0.036	3.68	0.028	0.026 – 0.055	3.81	0.003	0.000 – 0.012	10.1
Yasir et al. (2019)	0.133	0.095 – 0.171	2.43	0.075	0.071 – 0.132	3.73	0.006	0.001 – 0.009	11.87
El-Majri et al. (2017)	0.062	0.046 – 0.078	3.47	0.037	0035 – 0.063	3.72	0.006	0.005 – 0.013	10.62
Hawary et al. (2017)	0.025	0.021 – 0.029	3.78	0.153	0.110 – 0.150	3.98	0.071	0.022 – 0.040	9.22
Yamamah et al. (2016)	0.036	0.028 – 0.044	3.71	0.138	0.137 – 0.179	3.81	0.08	0.026 – 0.040	9.81
Al-Rahili et al. (2017)	0.052	0.042 – 0.062	3.66	0.049	0.015 – 0.050	3.95	0.122	0.020 – 0.060	10.1
Anera et al. (2019)	0.183	0.151 – 0.216	2.71	0.12	0.082 – 0.150	3.6	0.083	0.032 – 0.089	10.8
ARAFA et al. (2019)	0.132	0.089 – 0.175	2.21	0.065	0.084 – 0.129	3.87	0.03	0.030 – 0.043	10.04
Halboos et al. (2023)	0.073	0.057 – 0.089	3.46	0.1	0.110 – 0.178	3.62	0.009	0.010 – 0.022	11.1
Abdelrheem et al. (2021)	0.014	0.012 – 0.016	3.79	0.22	0.145 – 0.188	3.63	0.02	0.022 – 0.040	9.45
Ahmed et al. (2017)	0.01	0.004 – 0.016	3.75	0.06	0.140 – 0.170	3.68	0.018	0.005 – 0.080	8.21
Agha et al. (2018)	0.107	0.086 – 0.128	3.23	0.117	0.065 – 0.091	3.91	0.011	0.029 – 0.074	10.62

Hnoosh et al. (2016)	0.045	0.031 – 0.059	3.55	0.14	0.143 – 0.174	3.75	0.005	0.022 – 0.080	10.99
Al-Thomali et al. (2022)	0.176	0.164 – 0.188	3.59	0.08	0.083 – 0.105	3.68	0.022	0.022 – 0.052	10.3
Fayyadh et al	0.044	0.020 – 0.068	3.1	0.124	0.137 – 0.183	3.92	0.024	0.028 – 0.058	9.57
Ghalib et al. (2020)	0.08	0.053 – 0.107	2.99	0.069	0.122 – 0.142	3.67	0.018	0.022 – 0.045	10.56
Morad Amir (2017)	0.061	0.053 – 0.069	3.7	0.073	0.057 – 0.129	3.75	0.015	0.008 – 0.016	10.22
Rasheed et al	0.22	0.178 – 0.262	2.27	0.131	0.062 – 0.174	3.59	0.022	0.045 – 0.062	10.5