

**Table 1** Participants' characteristics of all studies included in the meta-analysis

First author, year of publication	Period of data collection	Study location / governorate	Study design	Sample size (no. of TB cases)	Age, yr mean (SD) or range (no. of participants)	Gender		Residence		TB type		Prevalence / 100 000	Incidence / 100 000	Treatment outcomes		
						Male n (%)	Female n (%)	Urban n (%)	Rural n (%)	PTB n (%)	EPTB n (%)			Cured/ completed n (%)	Failure n (%)	Death n (%)
Abd El Malik, 2021 (S1)	1/1/2014–31/12/2018	Giza	Retrospective record analysis	3357	12–17 (n=182) 18–65 (n=2821)	2035 (60.6)	1322 (39.4)	3058 (91.1)	299 (8.9)	1900 (56.6)	1457 (43.4)	8.21	7.55	2884 (85.9)	57 (1.7)	112 (3.3)
Salem, 2021 [S2]	1/1/2014–31/12/2018	Alexandria	Retrospective record analysis	1413	39.5 (14.7)	1120 (79.3)	293 (20.7)			1318 (93.3)	95 (6.7)	5.61	4.49	1301 (92.1)	17 (1.2)	21 (1.5)
Omar, 2020 [S3]	1/1/2018–31/12/2018	El Behaira	Retrospective record analysis	207	12–25 (n=31), 25–40 (n=86), 40–60 (n=53)	123 (59.4)	84 (40.6)	68 (32.8)	139 (67.2)	142 (68.5)	65 (31.4)	3.23	0.12	135 (65.2)	17 (8.2)	16 (7.7)
Abd El Maseh, 2020 [S4]	1/1/2011–31/12/2016	Qena	Retrospective record analysis	266	20–30 (n=80), 30–40 (n=52), 40–50 (n=30), 50–60 (n=54)	160 (60.2)	106 (39.8)					1.47		210 (78.9)	12 (4.5)	18 (6.8)
El Emeiry, 2019 [S5]	1/1/2008–31/12/2013	El Gharbia	Retrospective record analysis	916	38.37 (16.06) 15–24 (n=188), 25–34 (n=208), 35–44 (n=149), 45–54 (n=175)	669 (73.0)	247 (27.0)	229 (25.0)	687 (75.0)			3.22	2.84	825 (90.1)	37 (4.0)	30 (3.3)
	1/1/2008–31/12/2013	El Menoufia	Retrospective record analysis	825	37.85 (14.86) 15–24 (n=187), 25–34 (n=209), 35–44 (n=134), 45–54 (n=138)	632 (76.6)	193 (23.4)	145 (17.6)	680 (82.4)			3.78	3.48	765 (92.7)	11 (1.3)	16 (1.9)
Negm, 2019 [S6]	1/1/2000–31/12/2012	Overall	Retrospective record analysis	87302	15–30 (n=26111), 30–45 (n=22 589), 45–60 (n=17 599)	59 395 (68.0)	27 907 (32.0)	38 033 (43.6)	49 269 (56.4)	59 858 (68.6)	27 444 (31.4)	10.82	8.82	72 212 (82.7)	4138 (4.7)	3045 (3.5)
	1/1/2000–31/12/2012	Lower Egypt (El Behaira, Damietta, Port Said, El Menoufia, Alexandria, Al Qalubia, Ismailia, Cairo, Al Dakahlia, El Gharbia Kafr El Sheikh, Fayoum, Suez)	Retrospective record analysis	41669	15–30 (n=12 667), 30–45 (n=12 042), 45–60 (n=9959)	27 543 (66.1)	14 125 (33.9)	20 292 (48.7)	21 376 (51.3)	31 252 (75.0)	10 417 (25.0)	7.66		35 322 (84.8)	2750 (6.6)	1416 (3.4)
	1/1/2000–31/12/2012	Upper Egypt (Banesuefe, Giza, Elmenia, Aswan, Sohag, Assiut)	Retrospective record analysis	45633	15–30 (n=13 444), 30–45 (n=10 547), 45–60 (n=7640)	31 852 (69.8)	13 782 (30.2)	17 741 (38.9)	27 893 (61.1)	28 606 (62.7)	17 027 (37.3)	17.35		36 890 (80.8)	1388 (3.0)	1629 (3.6)

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Ali, 2018 (S7)	1/1/2013-31/12/2017	Fayoum	Retrospective record analysis	912		519 (56.9)	393 (43.1)			588 (63.8)	333 (36.2)	14.15	13.31	770 (84.4)	9 (1.0)	47 (5.2)
Negm, 2017 (S8)	1/1/2006-31/12/2011	Dakahlia	Retrospective record analysis	1736	15-30 (n=560), 30-45 (n=458), 45-60 (n=426)	1139 (65.6)	597 (34.4)	174 (10.0)	1562 (90.0)	1161 (66.9)	575 (33.1)	5.49	4.87	1472 (84.8)	89 (5.1)	89 (5.1)
Nafae, 2017 (S9)	1/1/2008-31/12/2012	Sharkia	Retrospective record analysis	280	36.90 (13.50), 16-35 (n=143), 36-55 (n=104), 56-75 (n=28)	213 (76.1)	67 (23.9)	155 (55.4)	125 (44.6)	217 (77.5)	63 (22.5)	0.95	0.83	231 (82.5)	3 (1.1)	21 (7.5)
Negm, 2016 [S10]	1/1/2007-31/12/2012	Ismailia	Retrospective record analysis	600	15-30 (n=223), 30-45 (n=168), 45-60 (n=128)	435 (72.5)	165 (27.5)	542 (90.3)	58 (9.7)	500 (83.3)	100 (16.7)	8.41	7.66	527 (87.8)	8 (1.3)	38 (6.3)
Eissa, 2016 (S11)	1/1/2006-31/12/2012	Cairo	Retrospective record analysis	6355	15-35 (n=2319), 35-55 (n=2116), > 55 (n=1088)	4082 (64.2)	2273 (35.8)			4627 (72.8)	1728 (27.2)	11.80	6.90	5214 (82.0)	138 (2.2)	286 (4.5)
El-Borai, 2016 (S12)	1/1/2010-31/12/2015	Sohag	Retrospective record analysis	500		183 (36.6)	317 (63.4)	157 (31.4)	343 (68.6)			2.92		425 (85.0)	12 (2.4)	9 (1.8)
Alwani, 2015 [S13]	1/1/1999-31/12/2010	El Behaira	Retrospective record analysis	6631	15-30 (n=2651), 30-45 (n=1820), 45-60 (n=1373)	4322 (65.2)	2309 (34.8)	1854 (28.0)	4777 (72.0)	5128 (77.3)	1503 (22.7)	11.77	10.73	5285 (79.7)	411 (6.2)	252 (3.8)
Abu Shabana, 2015 [S14]	1/1/1997-31/12/2011	Port Said	Retrospective record analysis	1260	15-30 (n=396), 30-45 (n=433), 45-60 (n=292)	995 (79.0)	265 (21.0)	1163 (92.3)	97 (7.7)	1070 (84.5)	190 (15.1)	15.43		983 (78.0)	74 (5.9)	40 (3.2)
Eissa, 2015 (S15)	1/1/2006-31/12/2012	Giza	Retrospective record analysis	21164		13862 (65.5)	7302 (34.5)	9079 (42.9)	12085 (57.1)	16234 (76.7)	4930 (23.3)	14.51	13.44	17207 (81.3)	868 (4.1)	1143 (5.4)
Ismail, 2014 [S16]	1/1/2006-31/12/2012	Kafr El Sheikh	Retrospective record analysis	1723		1228 (71.3)	495 (28.7)	220 (12.8)	1503 (87.2)	1360 (78.9)	363 (21.1)	8.76	7.94	1439 (83.5)	76 (4.4)	64 (3.7)
Hendy, 2009 [S17]	1/1/2002-31/12/2006	Al Qalubia	Retrospective record analysis	719		389 (54.1)	330 (45.9)	548 (76.2)	171 (23.8)	531 (73.9)	188 (26.1)	3.67	3.38	643 (89.4)	12 (1.7)	24 (3.3)
Farghaly, 2021 [S18]	30/6/2015-30/6/2016	Assiut	Cross-sectional analytic study	88	4-18 (n=6), 19-33 (n=27), 34-48 (n=22), 49-63 (n=25), > 64 (n=8)	52 (59.1)	36 (40.9)	27 (30.7)	61 (69.3)	62 (70.5)	17 (29.5)	2.02				
ElBouhy, 2020 [S19]	1/1/2016-30/6/2017	Assiut	Retrospective descriptive analysis	198	39.12 (20.17)	101 (51.0)	97 (49.0)	121 (61.1)	77 (38.9)	71 (35.9)	127 (64.1)	4.4				

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Ibrahim, 2020 [S20]	1/1/2017–31/12/2018	El Menoufia	Prospective follow-up study	452	51.56 (15.43) 15–30 (n=34), 30–60 (n=260), > 60 (n=158)	328 (72.6)	124 (27.4)					5.17					
Gadallah, 2018 [S21]	1/1/2012–31/12/2012	All TB units	Nationwide population-based study	1608	< 30 (n=490), 30–39 (n=340), > 40 (n=778)	1132 (70.4)	476 (29.6)	847 (52.7)	761 (47.3)	1235 (76.8)	373 (23.2)	1.92					
Sobh, 2016 [S22]	1/1/2011–31/12/2015	Aswan	Retrospective record analysis	577	40.31 (18.87) < 15 (n=39), 15–30 (n=147), 30–45 (n=132), 45–60 (n=145), > 60 (n=114)	324 (58.2)	233 (41.8)	266 (47.7)	291 (52.2)	349 (62.7)	208 (37.3)	7.96	7.04				
Bassili 2010 [S23]	1/10/2007–31/12/2007	Cairo, Dakahlia, Fayum, Matrouh	Prospective longitudinal surveillance	528	0–4 (n=19), 5–14 (n=94), 15–24 (n=124), 25–34 (n=100), 35–44 (n=79), 45–54 (n=27), 55–64 (n=43), > 65 (n=42)	343 (65.0)	185 (35.0)			399 (75.6)	129 (24.4)	3.34					

### Prevalence and incidence of TB

The total population included in the 23 studies representing the prevalence of TB was 139 597. The pooled prevalence using the random effects model was 8.70 (95% CI: 5.80–12.41) cases per 100 000 population (Figure 3). The prevalence ranged from 0.95 (95% CI: 0.66–1.78) (S9) to 15.43 (95% CI: 12.84–19.02) (S14), with high heterogeneity ( $I^2 = 92.7\%$ ), and the variance between the studies was slightly elevated ( $I^2 = 0.34$ ).

There were 111 166 new and relapsed cases in the 15 studies reporting the incidence of TB. The pooled incidence was 9.10 (95% CI: 6.65–14.86) cases per 100 000 population (Figure 4). The highest incidence was 13.44 (95% CI: 10.65–16.31) (S15) and the lowest was 0.12 (95% CI: 0.08–0.85) (S3). The incidence showed high heterogeneity ( $I^2 = 95.5\%$ ), and the variance between the studies was slightly elevated ( $I^2 = 0.25$ ).

### Treatment outcomes of TB

There were 136 166 TB cases in 17 studies that reported treatment outcomes. Cured/completed treatment was reported in 112 528 (82.6%) cases, treatment failure in 5989 (4.4%), and death in 5271 (3.9%).

### Subgroup analysis of studied variables

There were insufficient data to pool the prevalence of TB among different age groups. The prevalence of TB was higher among males than females (pooled OR 2.05; 95% CI: 1.44–3.28); in rural than urban areas (pooled OR 1.29; 95% CI: 0.61–1.97); and in Upper Egypt and Greater Cairo than in Lower Egypt and Delta Region (pooled OR 1.85; 95% CI: 0.97–4.15). The prevalence of pulmonary TB was higher than that of extrapulmonary TB (pooled OR 2.43; 95% CI: 1.63–5.71). With the scarcity of data, we could not pool the incidence of TB among different subgroups.

There were insufficient data to pool the treatment outcomes of TB according to age group, gender, residence, or type of TB. The odds of cured/completed treatment (pooled OR 1.04; 95% CI: 0.96–1.51), failed treatment (pooled OR 1.71; 95% CI: 1.35–2.73), and death (pooled OR 1.12; 95% CI: 0.87–1.60) were higher in Lower Egypt than in Upper Egypt.

### Discussion

This systematic review was carried out to estimate the prevalence, incidence, and treatment outcomes of TB in Egypt over the past 2 decades. Twenty-three studies of moderate to high quality fulfilled the inclusion criteria, suggesting scarcity of data, therefore making it difficult to establish the true epidemiological pattern of TB in Egypt.

It is important to note that the focus of countries on TB prevalence had stopped by 2015 when the ambitious new WHO End TB Strategy came into force. It served as a blueprint for countries to reduce TB incidence by 95%, TB deaths by 95%, and to eliminate catastrophic costs for TB-affected households between 2015 and 2035