Tuberculosis in Upper and Lower Egypt before and after directly observed treatment short-course strategy: a multi-governorate study

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Background Tuberculosis (TB) is a major problem in developing countries. TB in Egypt is considered an important public health problem. Egypt is ranked among the mid-level incidence countries.

Objective To evaluate TB status in 19 governorates and to compare the TB situation in Upper and Lower Egypt over 20 years from 1992 to 2012 before and after the application of directly observed treatment short-course strategy (DOTS).

Patients and methods This is a retrospective study involving record review. The registered data were collected from TB registration units in the 19 governorates.

Results The highest percentage of TB cases was in the age group 15–30 years. Infection was higher in males than females and in rural areas more than urban areas. Pulmonary TB and smear positivity at diagnosis, second, third, and fifth month were higher in Lower Egypt. Treatment after failure or relapse was significantly higher in Upper Egypt, whereas default rate, failure rate, and death rate were significantly higher in Lower Egypt. Regarding treatment outcome, cure, complete treatment, and transfer out were significantly increased after DOTS than before. Failure, default, and death were significantly reduced after DOTS than before DOTS. Upper Egypt included higher incidence rates of TB, new adult smear-positive cases, new extrapulmonary TB cases, and sputum conversion rate at the end of the initial phase of treatment. Cure rate and treatment success rate were significantly higher among patients of Upper Egypt, whereas transfer out rate and retreatment failure rate were significantly higher among Lower Egypt patients.

Conclusion TB is still a health problem in Egypt, with pulmonary TB more in Lower Egypt, whereas extrapulmonary more in Upper Egypt, but after the introduction of DOTS, there is a significant increase in cure and success rate, with markers of success being more in Upper Egypt.
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Keywords: directly observed treatment short-course strategy, Egypt, Lower, tuberculosis, Upper

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Introduction

Tuberculosis (TB) is one of the major public health threats, competing with the HIV as the cause of death owing to infectious diseases worldwide [1]. According to the WHO, nearly 8.6 million cases were estimated to have occurred in 2012. Most cases are estimated to be in Asia and Africa (58 and 27%, respectively) [2].

Near the end of the 20th century, TB prevention and care in Egypt faced numerous issues. The most significant of these issues were the rejection of the patients with TB to be hospitalized for their management, high lost follow-up rate, rising levels of resistance against anti-TB drugs, and inadequate health education to both general population and healthcare workers [3].

Major progress in TB prevention and care followed the widespread implementation of directly observed treatment short-course (DOTS) strategy. Efforts must continue to pursue high-quality DOTS expansion and enhancement [4]. DOTS implies that a trained healthcare worker or other assigned individual provides prescribed anti-TB medications and watches the patient while taking each dose [5].

Aim

The aim was to evaluate TB status in 19 governorates and to compare the TB situation in Upper and Lower Egypt over 20 years from 1992 to 2012 before and after the application of DOTS.

Patients and methods

This is a retrospective study involving record review (from June 2017 to January 2018), which was carried out at 19 governorates. The registered data about all TB cases covering a period of 20 years (1992–2012) were

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collected from the TB registration units in the 19 governorates. Governorates included in the study were based on accessibility of records. This period included two stages: before the application of DOTS and after it.

This research was accepted by research ethics committee of our institution. All the methodology performed was in agreement with the ethical standards of the institutional and/or national research council and with 1964 Helsinki assertion and its later amendments.

The gathered data entailed the following: TB registration code and the year; sociodemographic data, which included name, age, sex, and residence; forms of TB, either pulmonary (either smear positive or smear negative) or extrapulmonary (sites other than lungs, such as lymph node, intestine, meninges, breast, and renal); history of previous treatment if present (category of patients or type of the patient); new or relapse; treatment after failure; treatment after lost to follow-up; transfer in or others; and schedule of treatment (recommended standardized treatment regimen) according to NTP (2008) [6].

The recorded follow-up for smear-positive pulmonary TB included sputum smear microscopic examination for acid-fast bacilli, at the end of second month, fifth month, and at the end of treatment [7]. Outcomes included cure, treatment completed, treatment failure, died, lost to follow-up, and transfer out.

Statistical analysis

The recorded data were tabulated and analyzed using SPSS version 16 software (IBM inc, Chicago, USA). Categorical data were displayed as number and percentages, whereas continuous variables were displayed as mean and SD. χ^2-Test, Fisher's exact test, and Student *t*-test were used. Microstat software was used to calculate "*Z*" test for two proportions of two independent groups. *P* value less than 0.05 was considered significant.

Results

This study included data review of 120 094 cases with TB infection that were distributed among governorates of Lower and Upper Egypt, with 48.3% of the studied patients from Lower Egypt and 51.7% from Upper Egypt. Overall, 72.7% were detected after the application of DOTS in Cairo, Dakahlia, Kafrelsheikh, and El-Giza governorates. There was no patient records available before DOTS (Table 1).

Age distribution of patients was similar between Lower and Upper Egypt. The highest percentage of cases was

Table 1 Spatial distribution of cases of tuberculosis infection before and after application of directly observed treatment short-course strategy

	Before DOTS (32 792) [*N* (%)]	After DOTS (87 302) [*N* (%)]	Total (120 094)
Lower Egypt			
Elbhera	3404 (33.9)	6631 (66.1)	10 035
Damietta	481 (24.0)	1524 (76.0)	2005
Port Said	262 (17.2)	1260 (82.8)	1522
El Menoufia	2294 (56.9)	1741 (43.1)	4035
Alexandria	2068 (21.4)	7529 (78.6)	9597
Al Qalubia	934 (14.2)	5652 (85.8)	6586
Ismailia	763 (56.0)	600 (44.0)	1363
Cairo	0	6355 (100)	6355
Al Dakahlia	0	1736 (100)	1736
El Gharbia	1202 (34.0)	2329 (66.0)	3531
Kafrelsheikh	0	1723 (100)	1723
Fayoum	4070 (52.6)	3670 (47.4)	7740
Suze	916 (49.9)	919 (50.1)	1835
Total	16 394 (28.2)	41 669 (71.8)	58 063
Upper Egypt			
Banesuefe	2285 (48.0)	2474 (52.0)	4759
El Giza	0	21 164 (100)	21 164
Elmenia	4144 (52.7)	3716 (47.3)	7860
Aswan	884 (22.3)	3079 (77.7)	3963
Sohag	4333 (32.7)	8900 (67.3)	13 233
Assyout	4752 (43.0)	6300 (57.0)	11 052
Total	16 398 (19.0)	45 633 (81.0)	62 031

DOTS, directly observed treatment short-course strategy.

Table 2 Demographic criteria of tuberculosis cases in Lower and Upper Egypt

Governorate	Lower Egypt (58 063) [*N* (%)]	Upper Egypt (62 031) [*N* (%)]	Total (120 094)	*Z*	*P*
Age (years)					
<15	4053 (7.0)	6801 (11.0)	10 854	27.27	<0.001
15	17 670 (30.4)	18 331 (29.6)	35 094	8.38	<0.001
30	16 763 (28.9)	15 203 (24.5)	32 873	13.65	<0.001
45	13 901 (23.9)	13 559 (21.9)	27 460	2.06	0.02
≥60	5676 (9.8)	8137 (13.1)	13 813	21.28	0.001
Sex					
Male	38 374 (66.1)	38 914 (62.7)	77 288	1.94	0.03
Female	19 689 (33.9)	23 117 (37.3)	42 806	16.62	<0.001
Residence					
Urban	28 267 (48.7)	26 454 (42.6)	54 721	7.76	<0.001
Rural	29 796 (51.3)	35 577 (57.4)	65 373	22.70	0.001

between 15 to less than 30 years old (30.4 and 29.6% in Lower and Upper Egypt, respectively) and the least percentage was in extremes of age less than 15 years and after 60 years. Percentage was higher in males (66.1 and 62.7%, respectively). Rural percentages were more than urban regarding both Lower and Upper Egypt (Table 2).

Pulmonary TB was less in Upper Egypt (71.1%) than Lower Egypt (75.0%). With respect to the smear results at diagnosis, they were nearly equal (61.8% in Lower and 62.8% in Upper Egypt). The percentages of smear-positive cases at second, third, and fifth month and end of treatment were higher in Lower than Upper Egypt: 25.6, 19.5, 10.5, and 5.5%, respectively, in Lower and 17.9, 11.9, 3.6, and 0.8%, respectively, in Upper Egypt (Table 3).

According to the type of patient, treatment after failure and relapse were significantly higher in Upper Egypt. Regarding treatment outcome, the percentages of cure was significantly higher in Upper Egypt (55.8%) than Lower (45.4%). On the contrary, complete treatment, failure, death, lost to follow-up, and transfer out were higher in Lower Egypt (31.9, 6.6, 3.4, 8.8, and 3.8%, respectively) than in Upper (29.4, 3.8, 2.7, 5.5 and 2.8%, respectively) (Table 3).

Percentages of cure, lost to follow-up, transfer out, and death among urban patients (56.4, 4.6, 7.8 and 5.0%, respectively) were higher than rural patients (46.1, 1.6, 6.5 and 1.9%, respectively) whereas complete treatment and failure were higher among rural patients (37.2 and 6.7%, respectively) versus urban patients (22.8 and 3.4%, respectively) (Table 4).

After DOTS implementation, infection between younger ages (30 and 45 years) was significantly reduced (31.4 and 30.0% before, whereas 25.9 and 20.1% after DOTS). The ratio of infected females was less after DOTS than before (32.0 and 45.4%, respectively). Infection among urban patients was also reduced after DOTS than before (43.6 and 50.9%, respectively) whereas infection increased among rural patients (56.4 and 49.1%) after and before DOTS (Table 5).

Cases of pulmonary TB were less after the implementation of DOTS (68.6%) than before (84.8%). Concerning the smear results at diagnosis, they were 56.7% before DOTS and became 64.4% after. The percentages of smear-positive cases at second, third, and fifth month and end of treatment were lower after DOTS than before (19.2, 14.2, 4.7, and 1.7%, respectively, after DOTS and 28.7, 19.6, 13.5 and 7.2%, respectively, before DOTS) (Table 6).

According to patient type, new cases, treatment after failure, relapse, and treatment after lost to follow-up decreased significantly after the introduction of DOTS. In terms of treatment outcome, the percentages of cure, complete treatment, and transfer out significantly increased after DOTS (51.2, 31.5 and 7.6%, respectively) than before (49.6, 28.3 and 5.7%, respectively) ($P<0.001$). On the contrary, failure, lost to follow-up, and death decreased after DOTS (4.7, 1.4 and 3.5%, respectively) than before DOTS (6.4, 7.2 and 2.8%, respectively) (Table 6).

Table 7 showed that cure rate and treatment success rate were significantly higher among patients of Upper Egypt ($P<0.001$), whereas transfer out rate and retreatment failure rate were significantly higher among Lower Egypt patients.

Discussion

This study was aimed at comparing TB status in Upper Egypt versus Lower Egypt before and after the

Table 3 Comparison between tuberculosis disease criteria in Lower Egypt and Upper Egypt

	Lower Egypt (58 063) [*N* (%)]	Upper Egypt (62 031) [*N* (%)]	Total (120 094)	*Z*	*P*
Site of tuberculosis					
Pulmonary	43 551 (75.0)	44 127 (71.1)	87 678	1.95	0.03
Extrapulmonary	14 512 (25.0)	17 904 (28.9)	32 416	18.94	0.001
Sputum smear at diagnosis					
Positive	35 869 (61.8)	38 933 (62.8)	74 802	11.21	<0.001
Negative	22 194 (38.2)	23 098 (37.2)	45 292	4.25	<0.001
Sputum smear at second month (74 802)					
Positive	9193 (25.6)	6967 (17.9)	16 160	17.68	<0.001
Negative	20 113 (56.1)	30 876 (79.3)	50 989	48.76	<0.001
Dropouts	6563 (18.3)	1090 (2.8)	7653	89.51	<0.001
Sputum smear at third month (74 802)					
Positive	6995 (19.5)	4639 (11.9)	11 634	22.31	<0.001
Negative	21 886 (61.0)	30 192 (77.6)	52 078	36.87	<0.001
Dropouts	6988 (19.5)	4102 (10.5)	11 090	28.38	<0.001
Sputum smear at fifth month (74 802)					
Positive	3752 (10.5)	1417 (3.6)	5169	36.4	<0.001
Negative	23 216 (64.7)	33 895 (87.1)	57 111	45.49	<0.001
Dropouts	8901 (24.8)	3621 (9.3)	125 22	52.04	<0.001
Sputum smear at end of treatment (74 802)					
Positive	1968 (5.5)	311 (0.8)	2279	50.56	<0.001
Negative	27 209 (75.9)	34 980 (89.8)	62 189	31.41	<0.001
Dropouts	6692 (18.6)	3642 (9.4)	10 334	31.40	<0.001
Type of patient					
New	48 481 (83.5)	49 818 (80.3)	98 299	4.27	<0.001
Treatment after failure	2892 (5.0)	4811 (7.8)	7703	22.58	<0.001
Relapse	2677 (4.6)	5263 (8.5)	7940	30.70	<0.001
Treatment after lost follow-up	2762 (4.7)	749 (1.2)	3511	41.47	<0.001
Transfer	736 (1.3)	398 (0.6)	1134	10.52	<0.001
Others	515 (0.9)	992 (1.6)	1507	12.95	<0.001
Treatment outcome					
Cure	26 382 (45.4)	34 590 (55.8)	60 972	33.55	<0.001
Complete	18 531 (31.9)	18 256 (29.4)	36 787	1.43	0.08
Failure	3859 (6.6)	2372 (3.8)	6231	19.40	<0.001
Death	1951 (3.4)	1663 (2.7)	3614	4.81	<0.001
Lost to follow-up	5096 (8.8)	3438 (5.5)	8534	18.30	<0.001
Transfer out	2244 (3.8)	1712 (2.8)	3956	8.54	<0.001

Table 4 Treatment outcome in urban and rural areas

	Urban (54 721) [*N* (%)]	Rural (65 373) [*N* (%)]	Total (120 094)	*Z*	*P*
Treatment outcome					
Cure	30 859 (56.4)	30 113 (46.1)	60 972	3.02	0.001
Complete	12 453 (22.8)	24 334 (37.2)	36 787	65.45	<0.001
Failure	1869 (3.4)	4362 (6.7)	6231	34.46	<0.001
Lost to follow-up	2541 (4.6)	1073 (1.6)	3614	26.72	<0.001
Transfer out	4263 (7.8)	4271 (6.5)	8534	0.09	0.47
Death	2736 (5.0)	1220 (1.9)	3956	26.10	<0.001

application of DOTS. Cases of TB infection were distributed among governorates of Lower and Upper Egypt, with 48.3% of the studied patients from Lower Egypt. Overall, 28.3% of cases were detected before DOTS, and the majority 72.7% were detected after the application of DOTS. This can be explained by the lack of efficient recording systems before DOTS implementation, such as in Cairo, Dakahlia, and El-Giza, where no patient records were available before DOTS application. This can be owing to the lack of health education and fear of TB stigma. Recently, TB stigma is slightly

Table 5 Demographic criteria of cases of tuberculosis before and after application of directly observed treatment short-course strategy

	Before DOTS (32 792) [*N* (%)]	After DOTS (87 302) [*N* (%)]	Total (120 094)	*Z*	*P*
Age (years)					
<15	1957 (6.0)	8897 (10.2)	10 854	86.64	<0.001
15	8983 (27.4)	26 111 (29.9)	35 094	104.75	<0.001
30	10 284 (31.4)	22 589 (25.9)	32 873	73.19	<0.001
45	9861 (30.0)	17 599 (20.1)	27 460	48.67	<0.001
≥60	1707 (5.2)	12 106 (13.9)	13 813	134.43	<0.001
Sex					
Male	17 893 (54.6)	59 395 (68.0)	77 288	176.96	<0.001
Female	14 899 (45.4)	27 907 (32.0)	42 806	65.99	<0.001
Residence					
Urban	16 688 (50.9)	38 033 (43.6)	54 721	99.10	<0.001
Rural	16 104 (49.1)	49 269 (56.4)	65 373	150.52	<0.001

DOTS, directly observed treatment short-course strategy.

Table 6 Comparison between tuberculosis disease criteria before and after directly observed treatment short-course strategy

	Before DOTS (32 792) [*N* (%)]	After DOTS (87 302) [*N* (%)]	Total (120 094)	*Z*	*P*
Site of tuberculosis					
Pulmonary	27 820 (84.8)	59 858 (68.6)	87 678	116.24	<0.001
Extrapulmonary	4972 (15.2)	27 444 (31.4)	32 416	173.18	<0.001
Sputum smear at diagnosis					
Positive	18 597 (56.7)	56 205 (64.4)	74 802	159.07	<0.001
Negative	14 195 (43.3)	31 097 (35.6)	45 292		<0.001
Sputum smear at second month (74 802)					
Positive	5334 (28.7)	10 826 (19.2)	16 160	45.94	<0.001
Negative	10 018 (53.9)	40 971 (73.0)	50 989	172.50	<0.001
Dropouts	3245 (17.4)	4408 (7.8)	7653	13.45	<0.001
Sputum smear at third month (74 802)					
Positive	3641 (19.6)	7993 (14.2)	11 634	43.51	<0.001
Negative	10 113 (54.4)	41 965 (74.7)	52 078	176.42	<0.001
Dropouts	4843 (26.0)	6247 (11.1)	11 090	13.44	<0.001
Sputum smear at fifth month (74 802)					
Positive	2503 (13.5)	2666 (4.7)	5169	2.27	0.01
Negative	12 911 (69.4)	44 200 (78.6)	57 111	156.51	<0.001
Dropouts	3183 (17.1)	9339 (1.7)	12 522	63.17	<0.001
Sputum smear at end of treatment (74 802)					
Positive	1336 (7.2)	943 (1.7)	2279	8.36	<0.001
Negative	12 476 (67.1)	49 713 (88.4)	62 189	186.44	<0.001
Dropouts	4785 (25.7)	5549 (9.9)	10 334	7.54	<0.001
Type of patient					
New	27 118 (82.7)	71 181 (81.5)	98 299	157.22	<0.001
Failure	2187 (6.7)	5516 (6.3)	7703	42.06	<0.001
Relapse	2245 (6.8)	5695 (6.5)	7940	42.99	<0.001
Lost to follow-up	1062 (3.2)	2449 (2.8)	3511	25.48	<0.001
Transfer	20 (0.0)	1114 (1.3)	1134	123.41	<0.001
Others	160 (0.5)	1347 (1.5)	1507	49.63	<0.001
Treatment outcome					
Cure	16 266 (49.6)	44 706 (51.2)	60 972	130.21	<0.001
Complete	9281 (28.3)	27 506 (31.5)	36 787	109.39	<0.001
Failure	2093 (6.4)	4138 (4.7)	6231	27.43	<0.001
Lost to follow-up	2380 (7.2)	1234 (1.4)	3614	20.10	<0.001
Transfer out	1861 (5.7)	6673 (7.6)	8534	63.07	<0.001
Death	911 (2.8)	3045 (3.5)	3956	40.29	<0.001

below the average among the Egyptian population, which can be owing to the widespread application of TB stop strategies [8].

Age distribution of patients was similar between Lower and Upper Egypt as the highest percentage of cases was between 15 and less than 30 years, and the lowest

Table 7 Indicators of tuberculosis in Lower and Upper Egypt

	Indicator	Lower Egypt (58 063)		Upper Egypt (62 031)		*t*-Test	*P*
		Mean	SEM	Mean	SEM		
1	Incidence rate: new cases	12.12	0.82	14.71	1.19	1.64	0.11
2	Incidence rate: new and relapse cases	12.11	0.91	15.03	1.37	1.65	0.11
3	Incidence rate: all cases	13.04	1.03	17.04	1.56	2.0	0.05
4	Incidence rate new smear-positive pulmonary TB cases	5.26	0.35	5.76	1.22	0.778	0.44
5	New pulmonary TB cases with no smear result.	22.41	1.83	10.40	2.53	3.43	0.001
6	New adult smear-positive cases.	67.73	1.85	85.26	1.86	5.16	<0.001
7	Retreatment TB cases	14.44	1.40	10.19	1.23	1.68	0.10
8	New extrapulmonary TB cases	18.20	1.42	32.55	1.0	5.66	<0.001
9	New TB cases with no smear conversion result	25.74	2.89	11.61	2.52	2.69	0.01
10	Sputum conversion rate at the end of the initial phase of treatment	64.02	2.34	77.70	2.60	3.16	0.003
11	Cure rate	60.03	2.96	73.14	1.81	2.50	0.016
12	Treatment completion rate	12.89	0.93	9.10	0.67	2.28	0.03
13	Treatment success rate	71.43	2.89	84.61	2.80	2.62	0.012
14	Death rate	3.72	0.14	3.80	0.52	0.21	0.835
15	Treatment failure rate	3.55	0.18	3.60	0.52	0.109	0.91
16	Lost to follow-up	11.26	1.54	8.44	1.38	1.01	0.32
17	Transfer out rate	8.04	1.31	2.06	0.25	2.62	0.012
18	Retreatment failure rate (chronic TB rate)	30.98	5.77	9.69	1.54	2.38	0.03

TB, tuberculosis.

percentage was for extremes of age less than 15 years and after 60 years. These results are in agreement with many individual Egyptian governorate studies that showed same results [9–21]. However, in Alexandria, the highest percentage of cases was in the age range 30–45 years [22]. A study by Eldahshan *et al.* [23], in Suez Canal showed that the highest age group was 30–50 years followed by patients more than 50 years. The explanation of increased TB cases in this age group (15–30) may be the increased smoking in this age group. In addition; poorness, inadequate nutrition, physical, mental stress, along with more exposure to infection may also contribute.

The highest percentage was in males (66.1 and 62.7%, respectively), with statistically significant difference between males and females (Table 2), which was in concordance with most individual governorate studies [9–23]. This difference may be owing to low notification rates in females as many female patients do not seek medical advice because of factors such as illiteracy and the traditions predominant in the society, which may prohibit them from going out and seeking medical advice. TB stigma is felt more strongly in females [24]. Moreover, notification rates in men are higher, indicating differences in exposure owing to more outdoor activities and contact. Progression from infection to disease owing to sex differences were related to other risk factors for TB such as cigarette and shisha smoking [13].

This finding was in disagreement with that of Mohamed *et al.* [25] who studied TB in patients admitted to Assiut Chest Hospital from 2005 to 2009, where it was 70.87% for females and 29.13% for males. They attributed the higher incidence of TB in females to males in their study to different conditions in Upper Egypt, where females especially farmers have a main role of work outside or inside the home, with higher chance of exposure to infection.

In this study, TB cases were more in urban (51.3 and 57.4) than rural (42.6 and 48.7%) areas in both Lower and Upper Egypt, respectively. There is a difference in distribution of TB between governorates studies where El-Behira [13], Dakahlia [20], Qalyobia [9], Minofia [10], Assiut [25], Sohag [21], and Aswan [16] showed that TB cases were more in rural areas. Those studies explained the higher TB cases in rural areas owing to poverty, drinking contaminated milk, exposure to cough spray from infected cattle, or by close physical contact with infected animals. However, in Sharkia [19] and Ismailia [17], despite the rural population is more than the urban, TB cases were higher in the urban areas, and their explanation for that was the possibility of overcrowding at the urban areas, especially slums with lack of proper aeration and increase of air pollution, whereas the awareness among the rural population about TB especially after implementation of DOTS in all primary healthcare units may be the cause for lower percentage of cases. In Port Said, which is mainly urban governorate, cases were more common among the urban areas. In addition to the reasons described by Nafae *et al.* [19], demographic changes with population growth in urban areas resulting from the migration of people from rural to urban areas could be a cause [15].

The study also revealed that the percentage of pulmonary TB was lower in Upper Egypt (71.1%) than Lower Egypt (75.0%). The percentages of smear-positive cases at the second, third, and fifth month and end of treatment were higher in Lower Egypt compared with Upper Egypt. This can be explained by heterogeneous population distribution, with the two largest Metropolitan cities Cairo and Alexandria lying in Lower Egypt; this leads to crowdedness, spread of slums, low socioeconomic conditions, poor housing with poor ventilation, and more exposure between people to the infectious aerosols [26–28].

According to the type of patient, treatment after failure and relapse were significantly higher in Upper Egypt. Moreover, the percentages of cure were significantly higher in Upper Egypt (55.8%) than Lower (45.4%) ($P<0.001$). Conversely, increased failure rate, death, lost to follow-up, and transfer out were higher in Lower Egypt. These differences between Upper and Lower Egypt could be owing to the increased knowledge of the disease leading to increased percentage of people seeking medical care which increased the notified cases including relapse and treatment after failure in the Upper Egypt together with improvement and availability of health services per Capita which increased the percentage of cure cases relative to Lower Egypt which has more treatment failure rate and death rate. The increased death rate in Lower Egypt especially between urban more than rural areas can be attributed to the high demand for health services available in big cities such as Cairo and Alexandria; thus, many patients travel to these metropolitan areas to seek heath treatment. When deaths occur, they are registered in these metropolitan areas, which results in higher death rate [29].

After DOTS implementation in 1996 [7], infection between younger ages (30 and 45) declined significantly (31.4 and 30.0% before DOTS and 25.9 and 20.1% after DOTS). There was significant decrease in infection among females after DOTS than before (32.0 and 45.4%, respectively). This reflects the improvement in health awareness between patients, especially among females, who could overcome the TB stigma and seek medical care. This reflects also the success of TB stop strategy to reach the productive young community and females. Infection among urban patients was also reduced after DOTS than before (43.6 and 50.9%, respectively), whereas increased among rural patients (56.4 and 49.1%, respectively) after DOTS than before. This could be a false increase owing to increased case notification as a result of increased health awareness and availability of primary health services in rural areas.

Pulmonary TB infection was lesser after the introduction of DOTS (68.6%) than before (84.8%). The percentages of smear-positive cases at second, third, and fifth month and end of treatment were decreased after DOTS than before (19.2, 14.2, 4.7, and 1.7%, respectively, after DOTS, whereas 28.7, 19.6, 13.5 and 7.2%, respectively, before DOTS). This reflects greater treatment success, which is because of new regimens of treatment with rifampicin for 6 months, direct observation of cases on treatment, and better follow-up of patients [15]. On the contrary, there was an increase in extrapulmonary cases from 15.2% before DOTS to 31.4% after DOTS. This could be owing to more availability of diagnostic techniques like specific radiographs, ultrasound (US), computed tomography (CT) scans, or biopsy procedures, which are essential for diagnosing extrapulmonary TB [20].The smear positivity at diagnosis was 56.7% before DOTS and became 64.4% after; the rise in the smear positivity at diagnosis without increase in the overall pulmonary cases could be owing to improvement in the laboratory diagnosis, or increase in the notification rate of smear-positive cases.

Upper Egypt has higher incidence rates of new adult smear-positive cases, new extrapulmonary TB cases, and sputum conversion rate at the end of the initial phase of treatment, whereas new pulmonary TB cases, cases with no smear result, and new TB cases with no smear conversion result were significantly higher among TB residents of Lower Egypt ($P<0.05$). This can be explained by better case notification, laboratory diagnosis of sputum smears, and follow-up of patients with sputum smear at second, third, and fifth month in Upper Egypt. Increased life expectancy may reactivate quiescent TB lesion from extrapulmonary areas, and more physical contact with infected animals by drinking or handling contaminated milk may also contribute [20].

Conclusion

TB is still a health problem in Egypt, which affects the young active age group with pulmonary TB more in

Lower Egypt, whereas extrapulmonary cases were more in Upper Egypt, especially in the rural community, but after the introduction of DOTS, there is a significant increase in cure and success rate with decrease in treatment failure and death rates, with markers of success being more in Upper Egypt.

Limitations

Owing to difficult accessibility to records, the study did not cover all the Egyptian governorates. Additionally, there was a lack of recording before DOTS in four governorates, and cultures were not done for all patients, and if done, results were inconclusive, so not added in the study. Multidrug resistant status was not studied owing to technical or recording problems.

Recommendations

Health education is a vital part in implementing DOTS strategy with focusing on removing the TB stigma and encouraging patients to seek medical advice with more efforts needed, especially in Lower Egypt. Moreover, better recording of cases is essential for follow-up DOTS and putting future plans. The use of new technologies in the diagnosis to improve culture results is needed and also for extrapulmonary disease diagnosis.

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Conflicts of interest

There are no conflicts of interest.

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