

# Assessment of directly observed therapy short-course (DOTs) of tuberculosis in Dakahlia governorate chest hospitals from 2006 to 2011

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**Aim** The aim of the study was to assess directly observed therapy short-course administered to diagnosed cases of tuberculosis (TB) in the period from 2006 to 2011 in Dakahlia chest hospitals as a tool for the treatment and control of TB in the community.

**Materials and methods** Comprehensive collection of data was carried out of all TB cases registered in the Dakahlia governorate (six hospitals) from 2006 to 2011.

**Results** TB was most commonly prevalent in the age group 15–29 years (32.3%). TB was common in male (65.6%) than female (34.4%), and common in rural areas (90%); in urban areas, the prevalence was 10%. Pulmonary cases (66.9%) were more prevalent than extrapulmonary cases (33.1%). There was a significant reduction in pulmonary cases from 69.2% in 2006 to 56.5% in 2011 and there was a significant increase in extrapulmonary cases from 30.8% in 2006 to 43.5% in 2011. The most common site of TB was sputum smear-positive pulmonary TB (74.2%) and sputum smear-negative pulmonary TB (25.8%). The most common site of extrapulmonary TB was pleural TB (50.9%) and tuberculous lymphadenitis (19.6%). New cases (88.8%) represented the highest percentage of all cases attending for treatment. Sputum conversion was 53, 51.5, and 75.9% at 2, 5 months,

and at the end of treatment, respectively. In all, 84.8% of cases were treated successfully (23.1% cured cases and 61.7% cases that completed treatment; almost achieving the WHO target of 85%). In all, 5.1% of cases failed treatment, 5.1% died, 2.4% were defaulters, and 2.6% of cases were transferred out.

**Conclusion** The introduction of directly observed therapy short-course in Dakahlia governorate chest hospitals has led to a significant increase in treatment success (84.8%) and a decrease in default and failure rates.

*Egypt J Bronchol* 2017 11:88–97

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*Egyptian Journal of Bronchology* 2017 11:88–97

**Keywords:** Dakahlia, directly observed therapy short-course, tuberculosis

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**Received** 8 July 2016 **Accepted** 1 August 2016

## Introduction

Tuberculosis (TB) is an infectious disease caused by the bacillus *Mycobacterium tuberculosis*. It typically affects the lungs (pulmonary TB), and also affect other sites (extrapulmonary TB) [1]. TB was the first disease for which the WHO declared a global emergency [2].

Egypt is ranked among the countries with an intermediate level of incidence. TB is considered a major public health problem in Egypt [3].

Directly observed therapy short-course (DOTS) is the internationally recommended strategy to ensure cure of TB. It is based on five key principles that are common to disease control strategies, relying on early diagnosis and cure of infectious cases to stop the spread of TB [4].

This study aimed to assess DOTS administered to diagnosed cases of TB in the period from 2006 to 2011 in Dakahlia chest hospitals as a tool for the treatment and control of TB in the community.

## Materials and methods

This was a retrospective analytic study that was carried out at Dakahlia chest hospitals to include all the

registered and diagnosed cases of TB according to DOTS from January 2006 to December 2011.

## Collection and analysis of data

Comprehensive collection of data was carried out on all TB cases registered in Dakahlia governorate (six hospitals) from 2006 to 2011. The following data were collected for each year:

- (1) Sociodemographic data: name, age, sex, and residence.
- (2) Type of patients: on the basis of the history of previous treatment, new, relapse, treatment after failure, treatment after default, transfer, or others.
- (3) Diagnosis: according to the site of the lesion: either pulmonary (smear-positive or smear-negative) or extrapulmonary (and its sites such as the intestine, lymph node, meninges, breast, and renal).

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- (4) Follow-up for smear-positive pulmonary tuberculosis: sputum smear microscopic examination was performed at the start of treatment (0 month), at the end of the second month, at the end of the fifth month, and at the end of treatment.
- (5) Schedule of treatment: recommended standardized treatment regimen [5].
- (6) Treatment outcome: for all cases at the end of treatment including cure, treatment completed, treatment failure, died, default, and transferred out.

#### Measurement of indicators (for every year alone)

These indicators were designed by the WHO [6], to determine the quality and effectiveness of National Tuberculosis Control Program. These indicators are as follows:

- (1) Incidence rate (case notification rate): for all cases and new smear-positive pulmonary cases.
- (2) New pulmonary TB cases with no smear result.
- (3) New adult smear-positive cases.
- (4) Retreatment TB cases.
- (5) New extrapulmonary TB cases.
- (6) Sputum conversion rate at the end of the initial phase of treatment.
- (7) Cure rate and death rate.
- (8) Treatment completion rate.
- (9) Culture results.
- (10) Treatment failure rate.
- (11) Default rate and transfer-out rate.
- (12) Retreatment failure rate (chronic TB rate).

#### Statistical analysis

The collected data were tabulated and statistically analyzed. An unpaired Student's *t*-test was used for the comparison of independent data that followed a normal distribution. The Student *t*-test was used for repeated measurements for paired data if they showed a normal distribution. Otherwise, the Wilcoxon rank-sum test was used and  $\chi^2$ -test, which was used to compare more than two percentages; the SPSS (SPSS Inc., Chicago, Illinois, USA) statistical program was used. Statistical significance was set at *P* value of less than 0.05. The analysis was carried out using SAS software (version 9.1 for Windows; SAS Institute, Cary, South Carolina, USA); the test of proportion (*Z*-test) was used to compare between two percentages (*P*<sub>1</sub> and *P*<sub>2</sub>) [7].

The level of significance included the following:

- (1) *P* value of greater than 0.05 indicated nonsignificance.
- (2) *P* value of less than 0.05 indicated significance.

#### Results

In the present study of epidemiology of TB, there were a total of 1736 patients in the study group. The highest total number of cases was reported in Mansoura [662 (38.1%)], of which 61.8% were pulmonary and 38.2% were extrapulmonary, whereas the lowest number of cases was reported in Shobrahor [71 (4.1%)] cases, 67.6% of which were pulmonary and 32.4% were extrapulmonary. The total number of pulmonary cases was 1161 (66.9%), whereas the total number of extrapulmonary cases was 575 (33.1%) (Table 1). There was a significant increase in extrapulmonary cases from 30.8% in 2006 to 43.5% in 2011, with a significant decrease in pulmonary cases from 69.2% in 2006 to 56.5% in 2011 (Table 2).

The highest distribution of cases was in May [196 (11.29%)], whereas the lowest distribution of cases was in September and December [115 (6.62%)]. The highest number of pulmonary cases was reported in May (141 cases) and extrapulmonary cases in June (70 cases); the lowest number was reported in September for the pulmonary cases (76) and December for extrapulmonary cases (35). The results were statistically significant, if *P* value is less than 0.0001 (Figure 1).

The highest incidence was found in the age group of 15–29 years (32.3%) and the lowest incidence was found in the extremes of age; the incidence was 5.8% in the age group younger than 15 years of age and 11% in the age group older than 60 years of age (Table 3). There were 43 (2.5%) cases less than or equal to 1 year among all tuberculous cases; of these, no cases were detected in 2006, one (2.3%) case was detected in 2007 and 2008, three (7%) cases in 2009, 10 (23.3%) cases in 2010, and 28 (65.1%) cases in 2011. TB was more common in men (65.6%) than women (34.4%) as shown in Table 3. The difference was statistically significant throughout the years of the study, *P* value of less than 0.001. The number of patients from rural areas (90%) was significantly higher than those in urban areas (10%) during the entire course of the study, with the highest percentage of patients from rural areas (91.2%) reported in 2006.

According to the type of patients, among all the patients with TB, new cases were the most common, with a percentage of 88.8%, followed by relapse cases (5%), treatment failure cases (3.6%), other cases (1.4%), default cases (1%), and transferred cases (0.2%) (Table 4).

Pleural cases represented the highest number of extrapulmonary cases (50.9%), followed by lymph node

**Table 1 Geographical distribution of pulmonary and extrapulmonary tuberculous cases and statistical analysis between both types (2006–2011)**

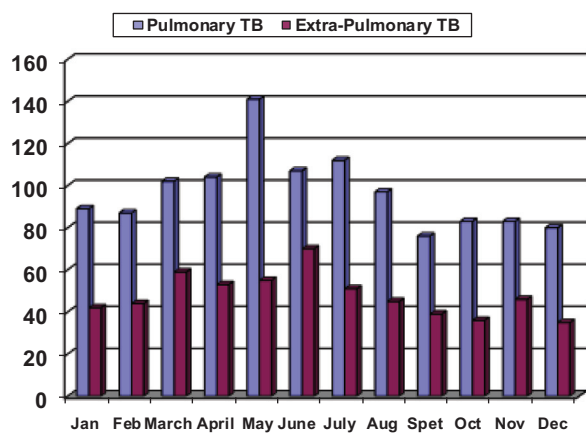
TB cases localities	Pulmonary TB [N (%)]	Extrapulmonary TB [N (%)]	Total [N (%)]
Mansoura	409 (61.8)	253 (38.2)	662 (38.1)
Bhoot	96 (79.3)	25 (20.7)	121 (7)
Shobrahoor	48 (67.6)	23 (32.4)	71 (4.1)
Dekrans	185 (69.5)	81 (30.5)	266 (15.3)
Manzala	278 (75.7)	89 (24.3)	367 (21.1)
Sherbin	145 (58.2)	104 (41.8)	249 (14.3)
Total	1161 (66.9)	575 (33.1)	1736 (100)

TB, tuberculosis.  $P < 0.0001$ , significant.

**Table 2 Distribution of pulmonary and extrapulmonary cases during the period of the study (2006–2011) and statistical analysis between pulmonary and extrapulmonary cases**

Years	Sputum result [N (%)]		
	Pulmonary TB	Extrapulmonary TB	Total
2006	245 (69.2)	109 (30.8)	354 (20.4)
2007	210 (67.5)	101 (32.5)	311 (17.9)
2008	214 (68.6)	98 (31.4)	312 (18)
2009	177 (66.8)	88 (33.2)	265 (15.3)
2010	228 (67.1)	112 (32.9)	340 (19.6)
2011	87 (56.5)	67 (43.5)	154 (8.9)
Total	1161 (66.9)	575 (33.1)	1736 (100)

TB, tuberculosis.  $P < 0.001$ , significant.

**Figure 1**

Distribution of pulmonary and extrapulmonary tuberculous (TB) cases according to the months of the year during the period of the study (2006–2011).

cases (19.6%), bone cases (12.7%), genital tract cases (4.4%), skin cases (2.1%), gastrointestinal tract cases (1.4%), and only (8.3%) cases in other sites such as the central nervous system (CNS), eye, and larynx.

Miliary and primary TB was considered smear-negative pulmonary TB. In the present study, the percentage of smear-positive cases (74.2%) was significantly higher than the percentage of smear-negative cases (25.8%), with the highest percentage of smear-positive cases (86%) reported in 2008 Table 5. No culture results were found for the registered cases.

**Table 3 Sociodemographic characteristics of the studied group**

Variables	N (%) [total=1736 (100%)]
Age (years)	
≤1	43 (2.5)
<15	101 (5.8)
15–30	560 (32.3)
30–45	458 (26.4)
45–60	426 (24.5)
>60	191 (11)
Sex	
Male	1139 (65.6)
Female	597 (34.4)
Residence	
Urban	174 (10)
Rural	1562 (90)

In the present study, from 2006 to 2011, 1563 (90%) cases were under treatment for category ? and 173 (10%) cases were under the treatment for category II. The percentage of cases that became sputum negative at 2 months of treatment was 53%; the highest percentage of converted cases (69.5%) was reported in 2006. The percentage of cases that became sputum negative at 5 months of treatment was 51.5%; the highest percentage of converted cases (59.1%) was reported in 2007. The percentage of cases that became sputum negative at the end of treatment was 75.9%; the highest percentage of converted cases (85.2%) was reported in 2008. Recorded extra-

**Table 4 Distribution of total tuberculous cases according to the type of patient on the basis of the history of previous treatment**

Years	Type [N (%)]						Total
	New	Relapse	Failure	Default	Transferred	Others <sup>a</sup>	
2006	307 (19.9)	18 (20.9)	19 (30.2)	2 (11.8)	3 (75)	5 (20)	354 (20.4)
2007	288 (18.7)	11 (12.8)	9 (14.3)	1 (5.9)	0 (0)	2 (8)	311 (17.9)
2008	270 (17.5)	20 (23.3)	10 (15.9)	5 (29.4)	0 (0)	7 (28)	312 (18)
2009	231 (15)	12 (14)	10 (15.9)	4 (23.5)	1 (25)	7 (28)	265 (15.3)
2010	306 (19.9)	17 (19.8)	10 (15.9)	3 (17.6)	0 (0)	4 (16)	340 (19.6)
2011	139 (9)	8 (9.3)	5 (7.9)	2 (11.8)	0 (0)	0 (0)	154 (8.9)
Total	1541 (88.8)	86 (5)	63 (3.6)	17 (1)	4 (0.2)	25 (1.4)	1736 (100)

<sup>a</sup>Others group included as chronic cases, patients who are sputum positive at the end of a re-treatment regimen.

**Table 5 Results of sputum smear microscopy for pulmonary cases during the period of the study**

Years	Sputum result [N (%)]		
	Sputum negative	Sputum positive	Total
2006	90 (36.7)	155 (63.3)	245 (21.1)
2007	52 (24.8)	158 (75.2)	210 (18.1)
2008	30 (14)	184 (86)	214 (18.4)
2009	51 (28.8)	126 (71.2)	177 (15.2)
2010	60 (26.3)	168 (73.7)	228 (19.6)
2011	17 (19.5)	70 (80.5)	87 (7.5)
Total	300 (25.8)	861 (74.2)	1161 (100)

$P < 0.001$ , significant.

pulmonary cases were not subjected to follow-up (Table 6).

The distributions of treatment outcome cases that were treated successfully were 84.8% (the cure rate was 23.1%, the rate of completion of treatment was 61.7%); the rate of failure ranged between 6.2 and 3.2%, with an average of 5.1%; the default rate ranged between 5.2 and 1.5%, with an average of 2.4%; the transfer-out rate ranged between 4.8 and 1%, with an average of 2.6%; and the percentage of death of patients ranged between 6.8 and 3.1%, with an average of 5.1% (Table 7).

Table 8 presents the distribution of total tuberculous cases according to the sex; it is clear that the number of cured female (23.5%) was highly significantly higher than cured male (22.9%) and highly significantly more male patients completed treatment (70%) than their female counterparts (61.1%). Highly significantly higher number of female failed treatment (6.4%) than male (4.5%). The number of male patients who died (5.6%) was not significantly higher than the number of female patients who died (4.2%). There were significantly more defaulters among male (2.5%) than female (2%). The numbers of female who were transferred out (2.8%) were not significantly higher than their male counterparts (2.4%).

The percentage of cured cases, that completed treatment, and transferred out cases were

significantly higher in the age group ranging from 15 to 30 years (34.8, 33.4, and 35.7%, respectively) than the other age groups; also, failed cases, patients who died, defaulters, and transferred out cases were significantly higher in the age group of 60 years and older (14.6, 27, 14.6, and 13.3%, respectively) than the other age groups.

In the present study, cases that were treated successfully in rural areas (84.8%; 24% cured plus 60.8% completed treatment) were not significantly higher than those in urban areas (84.4%; 14.9% cured and 69.5% completed treatment). Failed cases in urban areas (6.9%) were not significantly higher than their rural counterparts (4.9%). Rural patients who died (5.2%) were equal to those in urban areas (5.2%); urban defaulters (2.9%) were not significantly higher than their rural counterparts (2.3%), and transferred-out cases in rural areas (2.8%) were not significantly higher than their urban counterparts (0.6%).

## Discussion

In this epidemiological study of TB in Dakahlia governorate chest hospitals (2006–2011), which included cases from January 2006 to cases which outcome ended in December 2011, there were a total of 1736 patients in the study group; 66.9% were pulmonary cases, whereas 33.1% were extrapulmonary cases. The highest total number of cases was reported in Mansoura [662 (38.1%)], whereas the lowest



**Table 6 Conversion rate for all tuberculous cases and statistical analysis between negative and positive cases during the period of the study (2006–2011)**

Years	Sputum results [N (%)]			
	Negative			Positive
	Smear at the end of 2 months	Smear at the end of 5 months	Smear at the end of treatment	
2006 (155)	107 (69.5)	80 (51.9)	123 (79.9)	23 (14.8)
2007 (158)	102 (64.2)	94 (59.1)	122 (76.7)	12 (7.6)
2008 (184)	114 (62.6)	93 (51.1)	155 (85.2)	17 (9.2)
2009 (126)	27 (21.3)	70 (55.1)	90 (70.9)	16 (12.7)
2010 (168)	68 (40.7)	72 (43.1)	125 (74.9)	21 (12.5)
2011 (70)	37 (52.9)	33 (47.1)	37 (52.9)	5 (7.1)
Total (861)	455 (53)	442 (51.5)	652 (75.9)	94 (10.9)

$P < 0.001$ , significant.

**Table 7 Distribution of cases according to the treatment outcome (2006–2011)**

Years	Outcomes [N (%)]						Total
	Cure	Complete	Failure	Death	Default	Transferred out	
2006	52 (14.7)	260 (73.4)	18 (5.1)	11 (3.1)	7 (2)	6 (1.7)	354 (20.4)
2007	89 (28.6)	176 (56.6)	10 (3.2)	15 (4.8)	6 (1.9)	15 (4.8)	311 (17.9)
2008	85 (27.2)	177 (56.7)	19 (6.1)	20 (6.4)	8 (2.6)	3 (1)	312 (18)
2009	56 (21.1)	167 (63)	16 (6)	18 (6.8)	4 (1.5)	4 (1.5)	265 (15.3)
2010	86 (25.3)	196 (57.6)	21 (6.2)	19 (5.6)	8 (2.4)	10 (2.9)	340 (19.6)
2011	33 (21.4)	95 (61.7)	5 (3.2)	6 (3.9)	8 (5.2)	7 (4.5)	154 (8.9)
Total	401 (23.1)	1071 (61.7)	89 (5.1)	89 (5.1)	41 (2.4)	45 (2.6)	1736 (100)

$P < 0.001$ , significant.

**Table 8 Distribution of total tuberculous cases according to the sex and statistical analysis between male and female (2006–2011)**

	Sex [N (%)]			P value	Significance
	Male	Female	Total		
Cured <sup>a</sup>	261 (22.9)	140 (23.5)	401 (23.1)	0.00001	Highly significant
Completed	706 (70)	365 (61.1)	1071 (61.6)	0.00001	Highly significant
Failed <sup>a</sup>	51 (4.5)	38 (6.4)	89 (5.1)	0.00001	Highly significant
Died	64 (5.6)	25 (4.2)	89 (5.1)	0.199	Nonsignificant
Default	29 (2.5)	12 (2)	41 (2.4)	0.004	High significant
Transferred out	28 (2.4)	17 (2.8)	45 (2.6)	0.628	Nonsignificant
Total	1139 (100)	597 (100)	1736 (100)	0.00001	Highly significant

<sup>a</sup>For smear-positive cases.

number of cases was reported in Shobrahor [71 (4.1% cases)]; statistical analysis comparing pulmonary and extra-pulmonary cases was highly significant in all localities.

These results were similar to those in Benha Chest Hospital (2002–2006), where significantly higher numbers of pulmonary cases (73.9%) were reported than extrapulmonary cases (26.1%) during the entire course of the study [8]. In Menoufia governorate (1992–2008), 70% of studied cases had pulmonary TB and 30% had extrapulmonary TB [9]. The high proportion of pulmonary cases compared with the extrapulmonary cases could be explained by the fact that TB occurs almost exclusively from inhalation of droplet nuclei containing *M. tuberculosis*.

In the present study (2006–2011), there was a significant increase in extrapulmonary cases from 30.8% in 2006 to 43.5% in 2011, with a significant decrease in pulmonary cases from 69.2% in 2006 to 56.5% in 2011 (Table 2). This could be explained by the availability of diagnostic facilities such as specified radiographic or biopsy procedures, which are necessary to detect extrapulmonary TB. Increased life expectancy, which may reactivate latent tuberculous lesion from extrapulmonary sites, and more physical contact with infected animals by drinking or handling of infected milk may also be implicated. This is similar to the results obtained in Benha Chest Hospital (2002–2006), where there was a significant increase in extrapulmonary cases from 23.1% in 2002 to 34.1% in 2006, with a significant decrease in pulmonary cases

from 76.9% in 2002 to 65.9% in 2006 because of the same reasons [8].

In the present study, in Dakahlia governorate chest hospitals, the highest incidence was reported in May [196 (11.29%)] and the lowest incidence was reported in September and December [115 (6.62%)] among total tuberculous cases, and statistical analysis comparing pulmonary TB and extrapulmonary TB was highly significant in different months (Figure 1). In Menoufia governorate, a study was carried out over the years 1992–2008; there were a total of 4035 tuberculous cases, the tuberculous cases diagnosed fluctuated throughout the year, with the highest incidence in June (10.76%) and the lowest incidence in February (6.37%) among the total tuberculous cases [9].

The highest incidence occurred in the age group 15–29 years (32.3%) (Table 3). These results were similar to those obtained by Shargie and Lindtjorn [10], who found that the highest number of tuberculous cases was in the age group between 15 and 24 years; this study was carried out in South Ethiopia in service coverage for TB. In contrast to the current results, Long *et al.* [11] found, in a study in Canada on the epidemiology of TB, that the highest rate of TB infection was present in the age group older than 65 years, given that in industrialized countries, TB is mostly the reactivated form of primary infection. The high prevalence in the older age group may be a result of weaker immunity in these patients [12]. In the present study, the lowest incidence was found in the extremes of age; the age group younger than 15 years of age (5.8%) and older than 60 years of age (11%) (Table 2). This was in agreement with the study carried out in Benha Chest Hospital (2002–2006); the lowest percentage of tuberculous patients (4.2%) was found in the age group of younger than 15 years [8].

In the study by Al-Aarag [13], no cases below 1 year of age were diagnosed with TB during all 5 years of the research. In Mehalla-Kubra, only one patient younger than 1 year of age was diagnosed during the same period of the research. It was found that the Benha chest dispensary doesn't survey contacts of discovered cases aged 1–2 years for examination. Another explanation could be that the mother sought medical advice for her infant at that age in pediatric clinics because of fear of infection at the Chest Hospital; thus, the majority of these cases could have been diagnosed in these clinics and were not notified to the dispensary. This study was carried out at Kalubya governorate over the years 1977–1981. There were a total of 1779 tuberculous cases [13].

In the present study, there were 43 cases less than or equal to 1 year (2.5%) among all tuberculous cases presents with localized lymphadenopathy; no cases were detected in 2006, one (2.3%) case was detected in 2007 and 2008, three (7%) cases were detected in 2009, 10 (23.3%) cases were detected in 2010, and 28 (65.1%) cases were detected in 2011. This high prevalence in the last year may be explained either by overdosing or by incorrect route of injection of the BCG (Bacillus of Calmette and Guerin) vaccine.

TB was more common in men (65.6%) than women (34.4%) as shown in Table 3. The difference between male and female was statistically significant throughout the course of the study ( $P < 0.001$ ). In Benha Chest Hospital (2002–2006), the same results were obtained [8]; there were significantly higher numbers of male patients (54.1%) than female patients (45.9%). According to area of residence, there were significantly higher numbers of patients from rural cases (90%) than urban areas (10%) during the entire course of the study (Table 3). Increased numbers of tuberculous cases in rural areas could be explained by poverty, close interaction within the community, as well as a low level of water supply and sanitation; it may also have been caused by drinking or handling of contaminated milk. Also, agricultural workers may acquire the diseases by inhaling cough spray from infected cattle and by close physical contact with potentially infected animals. Similar results were obtained by Suhadev *et al.* [14], who found that significantly higher numbers of patients were from rural areas (73%) than urban areas (27%). In Benha Chest Hospital (2002–2006), cases in rural areas (76.2%) were significantly higher than cases in urban areas (23.8) [8].

In the present study, as shown in Table 4, the distribution of tuberculous cases according to the type of patient on the basis of previous history of treatment indicated that new cases were the most common type, with a percentage of 88.8%; followed by relapse cases, with a percentage of 5%; failure cases, with a percentage of 3.6%; other cases, with a percentage of 1.4%; default cases, with a percentage of 1%; and transferred in cases, with a percentage of 0.2% of all tuberculous cases. New cases (88.8%) represented the highest number of cases as shown in Table 4. This could be explained by the fact that the appearance of symptoms in new patients may have been alarming enough for them to seek medical advice, whereas pretreated patients may have been slow in seeking medical advice because of the possibility of repeating treatment, with its long duration, and fear of side effects.

Similar results were obtained in Benha Chest Hospital (2002–2006); it was found that new cases (92.2%) represented the highest percentage of cases presenting for treatment [8]. In Menoufia governorate, over the years 1992–2008, new cases were the most common, with a percentage of 93.31% [9].

In the present study, the percentage of smear-positive cases (74.2%) was significantly higher than the percentage of smear-negative cases (25.8%), with the highest percentage of smear-positive cases (86%) reported in 2008 (Table 5). Similar results were obtained by Anuwatnonthakate *et al.* [15], who found in a study of directly observed therapy and improved TB treatment outcomes in Thailand that 63% of pulmonary cases were sputum smear-positive and the number of sputum smear-negative cases was lower (37%). In Benha Chest Hospital (2002–2006), there were highly significantly more sputum smear-positive cases (68%) in comparison with sputum smear-negative cases (32%) [8]. If there is an increased number of smear-negative pulmonary cases (in the absence of increased overall tuberculous or smear-positive pulmonary cases), a problem with laboratory false-negative smears and overuse or over-reading of radiographs or other methods of diagnosing pulmonary TB should be considered [16].

In the present study, the total number of extrapulmonary tuberculous cases was 566; pleural cases (50.9%) represented the highest number of extrapulmonary cases, followed by lymph node cases (19.6%), bone cases (12.7%), urinary tract cases (4.4%), gastrointestinal tract cases (1.9%), skin cases (2.1%), and only 8.3% cases in other sites such as the CNS, eye, and larynx. Miliary and primary TB was considered smear-negative pulmonary TB. The high incidence of pleural TB in Dakahlia governorate could be because of the overdiagnosis of pleural effusion by the physicians as pleural effusion because of other causes of TB was common in our governorate such as hepatic, cardiac, and renal causes.

In Menoufia governorate (1992–2008), 44.46% of the total extrapulmonary cases were pleural TB, 13.8% were TB of the bones and joints, 22.73% were tuberculous lymphadenitis, 5.12% were TB of the urinary tract, 52 (4.3%) were TB of the gastrointestinal tract, 2.4% were TB of the skin, and only 7.19% of cases had TB in other sites such as the CNS, eye, and larynx [9].

Different results were obtained by Te Beek *et al.* [17], who found in a study in the Netherlands from 1993 to 2001 that lymph node cases represented the most

frequent types of extrapulmonary TB (38.9%), followed by pleural cases (20.5%) and bone cases (9.2%). In Turkey, lymph node TB accounted for nearly half of the cases of extrapulmonary TB [18]. In extrapulmonary TB, all organs can be affected, but the frequencies of different clinical sites of extrapulmonary TB may vary according to country [19].

The regimen of treatment depends on the type of the patient and diagnosis [20]. In the present study, 90% of cases were under treatment in category I and 10% were under the treatment in category II. In the present study, the total number of pulmonary cases was 861; most patients with sputum smear-positive TB became smear-negative by the end of treatment as shown in Table 6. The conversion rate ranged between 52.9 and 84.2% and the percentage of sputum negative cases was 75.7% of the total number of treated cases while 10.9% remained sputum positive at the end of treatment; statistical analysis between negative and positive cases was significant across all the years.

In Table 6, the percentage of cases that became sputum negative at 2 months of treatment was 53%; the highest percentage of converted cases (69.5%) was reported in 2006. The percentage of cases that became sputum negative at 5 months of treatment was 51.5%; the highest percentage of converted cases (59.1%) was reported in 2007. The percentage of cases that became sputum negative at the end of treatment was 75.9%; the highest percentage of converted cases (85.2%) was reported in 2008. Recorded extrapulmonary cases were not subjected to follow-up. The results were similar to the study in Menoufia governorate (1992–2008); 65.11, 70.9, and 59.27% of cases, respectively, became sputum negative at 2, 5 months, and the end of treatment ([9], whereas in Benha Chest Hospital (2002–2006), 87.5, 89.5, and 92.8% of cases, respectively, became sputum negative at 2, 5 months, and at the end of treatment. The high conversion rate can be attributed to competency of the healthcare workers, with regular supervision, mobilization of healthcare services, stable supply of antituberculous drugs, and better patient adherence to treatment [8].

In the present study, 84.8% of cases were treated successfully (the cure rate was 23.1%, complete rate was 61.7%); the rate of failure ranged between 6.2 and 3.2%, with an average of 5.1%; the default rate ranged between 5.2 and 1.5%, with an average of 2.4%; the transfer-out rate ranged between 4.8 and 1%; with an average of 2.6%; and the rate of death ranged between

6.8 and 3.1%, with an average of 5.1% (Table 7). This result may have been obtained because of compliance, which can significantly influence treatment outcomes; increased coverage by short-course chemotherapy, improved access to care through decentralization of the service, and improved patient follow-up with the introduction of DOTS most likely played a significant role in improving the treatment outcomes.

Also, these results were in agreement with those of a study on TB control in Bangladesh. Kumaresan *et al.* [21] found that 79% of the cases were treated successfully; 75% of cases were cured, and only 4% completed treatment. Volmink and Garner [22], found that both the percentage of cured cases and cases that completed treatment were 66%.

In the present study, the percentage of failed cases was 5.1%; treatment failure may be because of poor compliance of the patient or practitioner error, for example, inadequate regimens and/or shortened regimens. In Benha Chest Hospital (2002–2006), the percentage of failed cases was 1.7% [8]. In Iraq, treatment failure in patients administered the DOTS strategy was 2.0% and in the control group, it was 5.8%, which was in agreement with our findings and emphasizes the importance of the DOTS strategy [23].

In the present study, the rate of death was 5.1%; another study in Benha Chest Hospital (2002–2006) reported that the percentage of patients who died under the DOTS strategy was 3.3% [8]. In a study in Cairo and Giza (Egypt) [24], it was found that percentage of patients who died under the DOTS strategy was 2%. Death during treatment of TB may have occurred because tuberculous patients may have also had other diseases, such as diabetes, which can affect both the development of TB and mortality. Nonadherence and defaulting, which may result from alcohol and drug abuse, may also be implicated. Also, death may have been caused by drug-resistant TB. Possibly, TB case fatality rate is increased if the disease duration has been sufficient for causing extensive disease.

The percentage of defaulters in the present study was 2.4% as shown in Table 7. Defaulting could be explained by the lack of patients' knowledge of the nature of their disease and they may not be aware of the importance of continuing treatment; the distance between the clinic and the home of the patient and the perception of improvement by the patients may also cause the patient to discontinue treatment. Also, the long duration of treatment may cause the patient to

discontinue treatment and some patients may also have other diseases.

In a study in northern India [25], it was found that the percentage of defaulters was 6.8%. The study in Benha Chest Hospital (2002–2006) reported that the percentage of defaulters was 3.1% [8].

Table 8 presents the distribution of total tuberculous cases according to sex; the cure rate and the rate of failed treatment were significantly higher in female than male. The rate of completion of treatment and defaulters' rate were higher in male than female, with a statistically significant difference between male and female, whereas in terms of the rate of deaths, there was a nonsignificant difference between both sexes, lower successful outcomes with more unfavorable outcomes among male could be explained by more defaulting among male because of risk factors such as smoking. Also, this defaulting may result from the inability of men to attend the clinics during work hours. This defaulting may result in drug resistance and increased rates of death among men. Also, it was found that higher numbers of female were treated successfully than their male counterparts, whereas in Menoufia governorate (1992–2008), there were highly significantly greater numbers of cured male than cured female, and in contrast to this study, highly significantly greater numbers of female patients completed treatment than their male counterparts [9].

In the present study, the percentage of cured cases, completed treatment cases, and transferred-out cases were significantly higher in the age group from 15 to 30 years (34.8, 33.4, and 35.7%, respectively) than the other age groups. Also, failed cases, patients who died, defaulters, and transferred-out patients were significantly higher in the age group of 60 years and older (14.6, 27, 14.6, and 13.3%, respectively) than the other age groups as shown in Table 9. Lower rates of favorable outcomes in elderly cases could be explained by a high default rate, which may attributed to poor tolerance of therapy, other concomitant illnesses, and operational factors that pose problems for regular visits to DOTS centers. Apart from the increased physiological risk of death, vague symptoms in the elderly, diagnostic problems, and concomitant illnesses could be some of the factors contributing toward the increased rates of death in this age group, and this increased rate of deaths may have led to lower rates of treatment completion.

The same results were obtained in Benha Chest Hospital (2002–2006) [8]. In a study in Guangzhou



**Table 9 Outcome of the study cases according to age group (2006–2011)**

Age (years)	Outcomes [N (%)]						
	Cure	Complete	Failure	Death	Default	Transferred out	Total
<15	1 (0.3)	94 (8.9)	3 (3.4)	0 (0)	1 (2.4)	2 (4.4)	101 (5.8)
15–30	139 (34.8)	358 (33.4)	23 (25.8)	11 (12.4)	13 (31.7)	16 (35.6)	560 (32.3)
30–45	108 (27)	280 (26.1)	24 (27)	20 (22.5)	18 (43.9)	8 (17.8)	458 (26.4)
45–60	110 (27.5)	240 (22.4)	26 (29.2)	34 (38.1)	3 (7.4)	13 (28.9)	426 (24.5)
>60	43 (10.8)	99 (9.2)	13 (14.6)	24 (27)	6 (14.6)	6 (13.3)	191 (11)
Total	401 (100)	1071 (100)	89 (100)	89 (100)	41 (100)	45 (100)	1736 (100)

**Table 10 Indicators of the success of directly observed therapy short-course (2006–2011)**

Years	Cure [N (%)]	Complete [N (%)]	Success rate [N (%)]
2006	52 (14.7)	260 (73.4)	312 (88.1)
2007	89 (28.6)	176 (56.6)	265 (85.2)
2008	85 (27.2)	177 (56.7)	262 (83.9)
2009	56 (21.1)	167 (63)	223 (84.1)
2010	86 (25.3)	196 (57.6)	282 (82.9)
2011	33 (21.4)	95 (61.7)	128 (83.1)
Total	401 (23.1)	1071 (61.7)	1472 (84.8)

(China) [26], it was found that the highest percentage of cured cases was in the age group from 15 to 39 years (45.1%), whereas failed cases, patients who died, defaulters, and transferred-out cases were higher in the age group of 65 years and older (7.5, 8.9, 0.9, and 3.7%, respectively) than the other age groups.

The outcomes of treatment were similar in rural and urban areas, with insignificant differences. This was also found in the study by Hindi [8] and Abdelghany [8,9]. This could be explained by decentralization of health services with better application of DOTS in both urban and rural areas, with improved quality of health services in the primary health units. Also, training of healthcare workers to be competent in provision of health services may have played a role.

In the present study, the cure rate was 23.1%, the rate of treatment completion was 61.7%, and the rate of successful treatment was 84.8% (almost achieving the WHO target of 85%) as shown in Table 10; this may be attributed to the high compliance with DOTS and use of fixed combination medications. Also, the success of DOTS can largely be attributed to commitment on the part of the government to the program with maintenance of its quality, mobilization of healthcare workers, and stable supply of anti-TB drugs. Other factors that may account for this success are adequate funding, clear objectives, experienced staff, a working laboratory with quality control mechanisms, and good management structures.

## Conclusion

The introduction of DOTS in Dakahlia governorate chest hospitals has led to a significant increase in treatment success (84.8%: close to the WHO target of 85%) and a decrease in the default and failure rates.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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