

# The Trend of Mandatory Vaccination among Children in Egypt

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**Abstract:** Increase of immunization coverage rate is the most effective method for decreasing the burden of childhood vaccine-preventable diseases. The objective of this work was to present an up-to-date review of the efficacy and the trend of mandatory vaccination regimens among children in Egypt, and its efficacy in decreasing the burden of vaccine-preventable diseases among children under 5 years in Egypt during the period 1995-2005. The sources of data depend on the bibliographic review on MEDLINE, published studies and reports, and WHO and EMRO databases that covered the period from 1995 to 2005. Statistic analysis of the available data revealed that the coverage rate of the existing vaccination program in Egypt has greatly expanded over years and is significantly associated with a swift reduction in the burden of the vaccine-preventable childhood diseases (measles, mumps, rubella, neonatal tetanus, pertussis, diphtheria, poliomyelitis, and hepatitis B). Varicella vaccine is strongly recommended to be added to the mandatory vaccination of children in Egypt.

**Key Words:** Egypt, Children, Time trend, Mandatory vaccination coverage, and Childhood illness.

## INTRODUCTION

Every year, three million children die world-wide from diseases that can be easily prevented with one to three doses of readily available vaccines. The United Nations International Children's Emergency Fund (UNICEF) advocated that protection against preventable diseases is a right of every child, and immunization is a hallmark of UNICEF's activities for more than two decades.

Over the past years, the Egyptian Ministry of Health and Population (MOHP) has implemented a national program for childhood immunization. During this period, national guidelines on infection control have been developed by MOHP staff and Egyptian academic experts in collaboration with external partners from American Practitioners for Infections, WHO and NAMRU-3 [1].

A cornerstone strategy is maintenance of high levels of immunization coverage among children through routine immunization and implementation of supplementary immunization activities. Health authorities in Egypt have also taken important steps to strengthen the immunization coverage. These steps include: bolstering of the cold chain, introduction of vaccine vial monitors used in both routine immunization and campaigns, preparation of local registers based on frequent community census, strengthening of the system for defaulter tracing, as well as vaccine potency testing and the conduct of serosurveys [1, 2].

Immunization is extremely cost-effective, when a suitable vaccine has been developed. Coverage of existing vaccination aimed to eliminate or decrease the burden of childhood diseases has greatly expanded over years. The

present study aims to present an up-to-date review of the efficacy and the trend of mandatory vaccination regimens among children in Egypt, as well as its efficacy in decreasing the burden of vaccine-preventable diseases among children under 5 years in Egypt during the period 1995-2005.

## METHODOLOGY

### First Step: Collection of Data

- 1- Data of morbidity rates, number of cases, and immunization coverage of the mandatory vaccination for Egyptian children under 5 years in both sexes, were used in the present study.
- 2- Sources of Data: Bibliographic review on MEDLINE, published studies and reports, and WHO and EMRO databases that covered the period from 1995 to 2005.
- 3- The data were revised and filtered according to documentation; all non-documented data were excluded from the final statistical analysis.

### Second Step: Statistical Analysis of the Collected Data

Statistical models are used to identify the direct statistical correlations between the predictor variables (the time in years as well as the immunization coverage) and the outcome of interest (e.g. morbidity rates of childhood diseases i.e. number of cases, incidence or prevalence of the diseases) through SPSS version 14.0. Pearson correlation coefficient and linear regression models were used in the analysis of the data. The significance level was considered at P-value < 0.05.

## RESULTS

### Measles

Statistical analysis of the collected data proved that there was significant increase in the immunization coverage rate of

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measles vaccination during the period of the study ( $r = 0.9$ ,  $P < 0.0001$ ), and a significant decline in the morbidity rate of measles ( $r = -0.9$ ,  $P < 0.0001$ ), (Fig. 1). In 1996, the morbidity rate was 14.3 and the vaccination coverage rate was 91%; in 2003 the corresponding rates were 0.2 and 97% respectively while in 2005 the rates were 0.1 and 97.3%.

**Tetanus**

The trend of maternal tetanus immunization was fluctuating during the period of study ( $r = 0.6$ ,  $P > 0.05$ ), as it was 69.5% in the year 1995, increased to 72.7% in 2000, and then decreased again to 69% in 2004 (Fig. 2). During the period 1996 to 2005, there was significant increase in the immunization coverage rate of DPT (Diphtheria, Pertussis and Tetanus) of Egyptian children ( $r = 0.8$ ,  $P < 0.0001$ ), (Fig.

3). Immunization coverage rate of DPT was 91% in the year 1995, and increased to 97.3% in 2005.

Consequently, there was significant decline in the morbidity rate of neonatal tetanus throughout the period of the study ( $r = -0.9$ ,  $P < 0.0001$ ) (Fig. 4). In the year 1995, there were 790 recorded cases of neonatal tetanus, the morbidity rate was 0.49, and the immunization coverage was 91%. By the year 2005, only 25 cases were recorded and the morbidity rate was 0.03 with an immunization coverage 97.3%.

The morbidity rate of neonatal tetanus significantly declined with the increase in the immunization coverage rate of DPT ( $r = -0.9$ ,  $P = 0.001$ ), but it was not significantly affected by the increase in the immunization coverage rate of maternal tetanus ( $r = -0.4$ ,  $P > 0.05$ ), (Fig. 5).

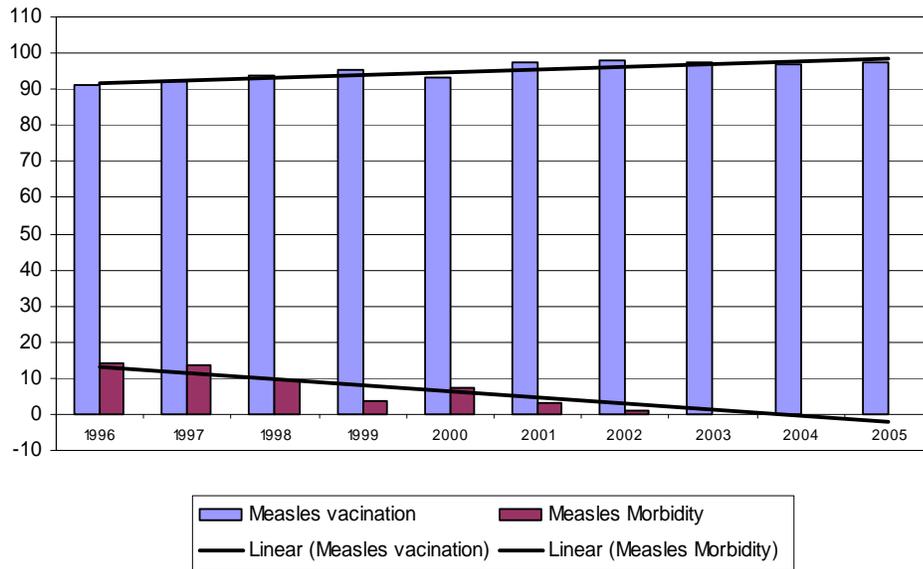


Fig. (1). Trend of morbidity rate and vaccination coverage rate of measles in children under 5 years in Egypt during the period 1996-2005.

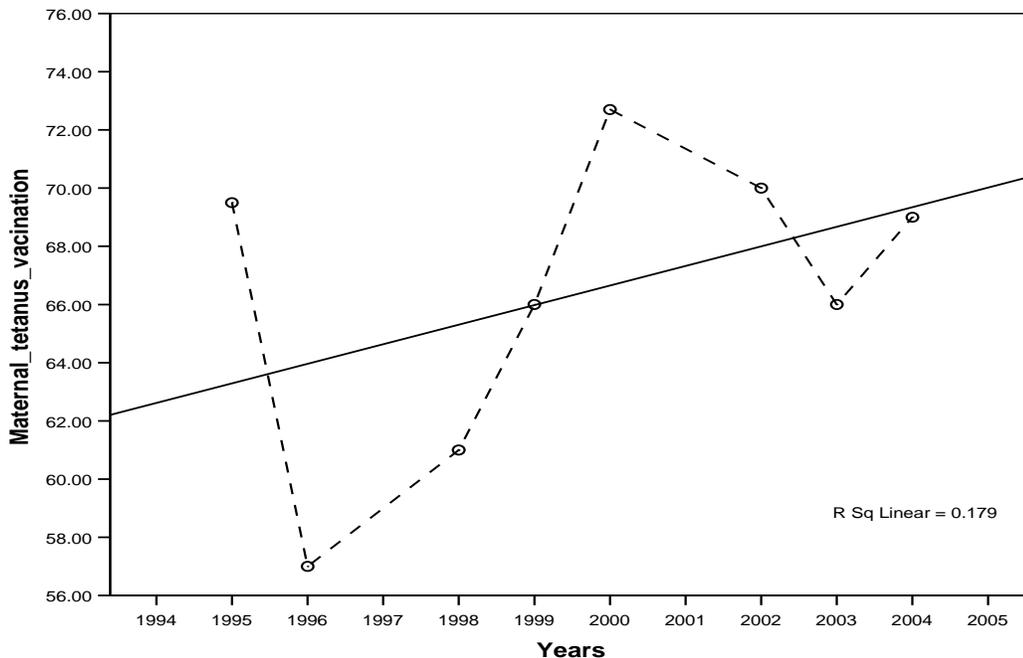


Fig. (2). Trend of immunization coverage of maternal tetanus vaccination in Egypt during the period 1995-2005.

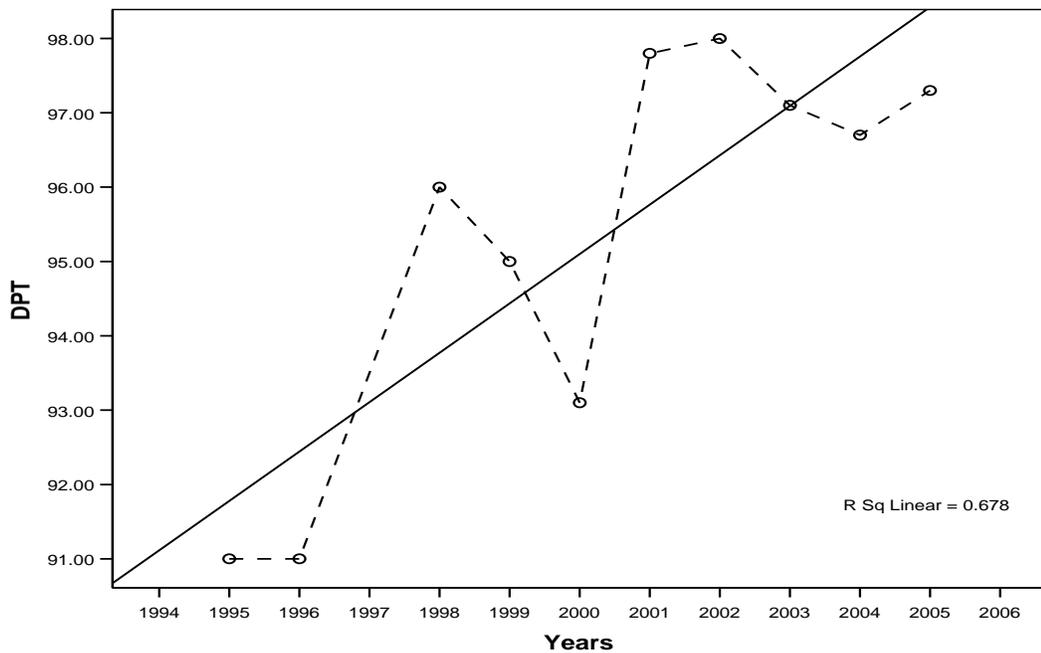


Fig. (3). Trend of immunization coverage of DPT among children under 5 years in Egypt during the period 1995-2005.

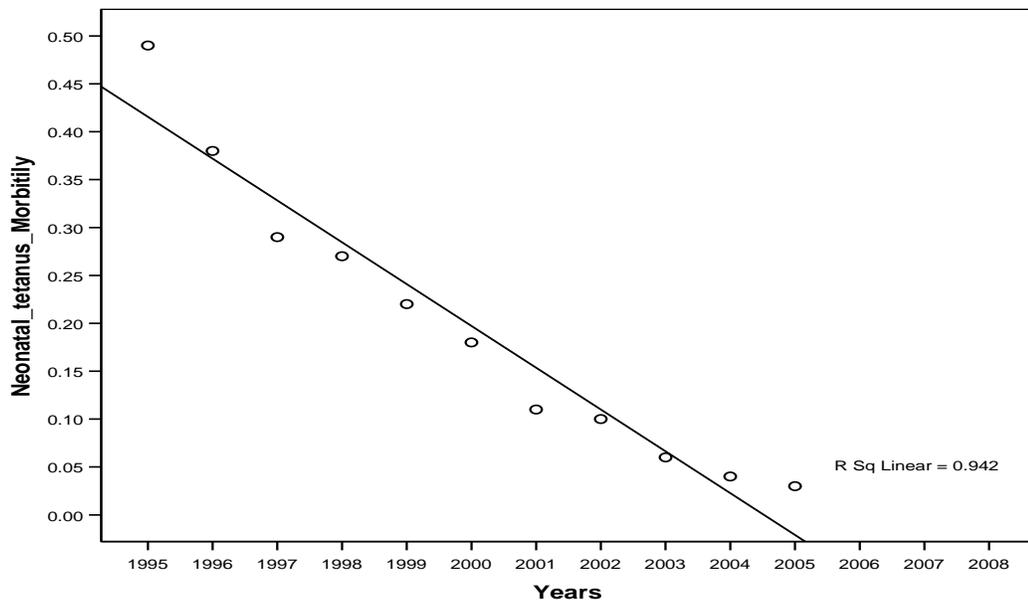


Fig. (4). Trend of morbidity rate of neonatal tetanus in children under 5 years in Egypt during the period 1995-2005.

**Diphtheria**

There was significant decline in the number of diphtheria cases in children under 5 years during the studied period ( $r = -0.8, P < 0.005$ ), (Fig. 6). In the year 1999, only two cases were recorded, and since that time no cases were recorded. DPT immunization coverage rate was 91% in the year 1995, and increased to 95% in 1999 and to 97.3% in 2005. There was a significant inverse correlation between the recorded cases of diphtheria and the immunization coverage rate of DPT ( $r = -0.7, P < 0.05$ ), as shown in Fig. (7).

**Poliomyelitis**

Vaccination coverage rate of poliomyelitis was 90% in the year 1995, and increased significantly during the period

of the study ( $r = 0.9, P < 0.0001$ ) to reach 97.4% by the year 2005. The number of recorded cases significantly decreased ( $r = -0.8, P < 0.0005$ ), (Fig. 8) and the last confirmed poliomyelitis case was recorded in 2004, with no case recorded up to 2009.

**Hepatitis B (HBV)**

Immunization coverage rate against HBV was significantly increased during the period of the study ( $r = 0.8, P = 0.01$ ), (Fig. 9). The coverage rate was 90% in the year 1996, and increased to 96.3% in 2005. Although, there are no available data on the incidence of hepatitis B infection in Egyptian children, there was marked decline in the number of recorded cases.

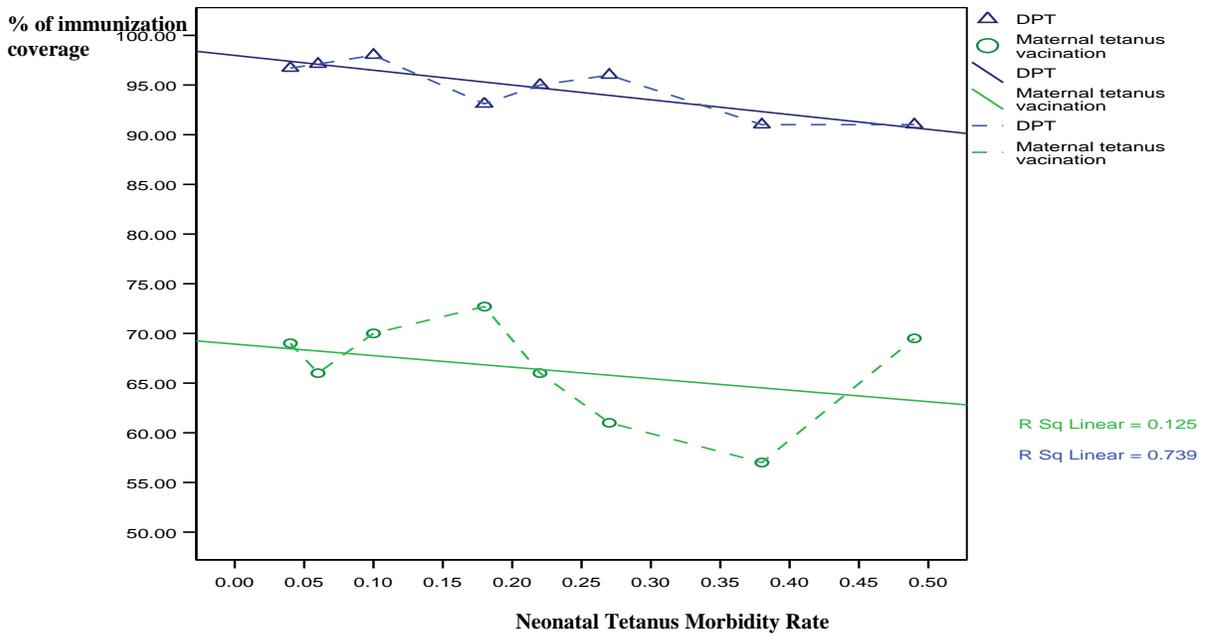


Fig. (5). The relationship between the morbidity rate of neonatal tetanus and the immunization coverage rates of maternal TT and child DPT.

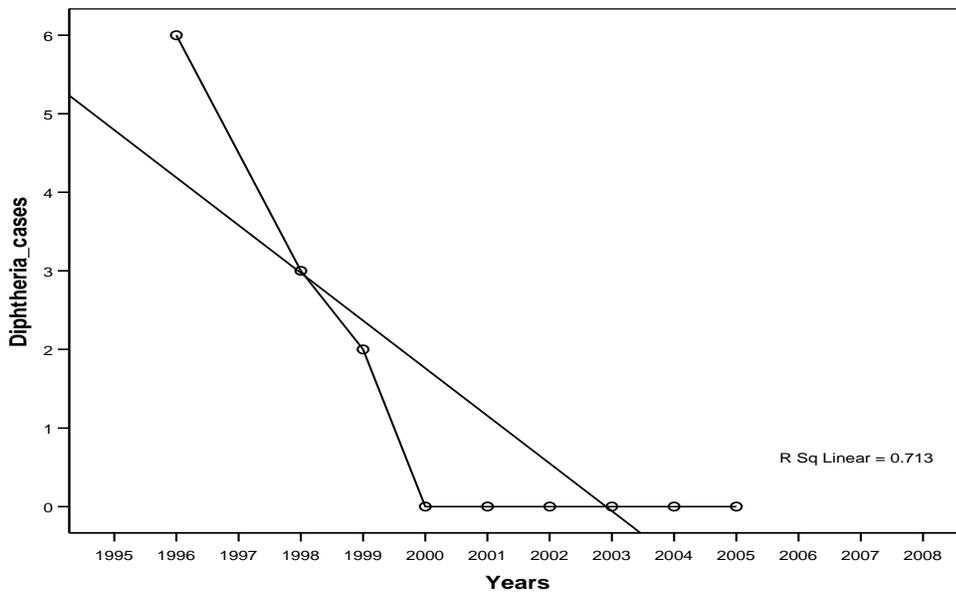


Fig. (6). Trend of diphtheria recorded cases in children under 5 years in Egypt during the period 1995-2005.

**DISCUSSION**

Active immunization is the most effective method for decreasing the burden of vaccine-preventable diseases. In Egypt, immunization coverage rate was found to improve the situation of the common childhood illnesses. The Ministry of Health and Population (MOHP) is a provider of therapeutic and preventive care for Egyptian children through a network of health centres, services and hospitals. It also provides national information and implements compulsory vaccination campaigns. It also offers medical advice and information to mothers and provides medical check-ups to families.

The present work analyzed the trend of mandatory immunization coverage rates of the most important vaccine-preventable childhood diseases, and its efficacy in decreasing

the burden of these diseases among children under 5 years in Egypt during the period 1995-2005, using statistical analysis of documented data.

Measles is one of the diseases that can be prevented mainly through vaccination. At present, a regional and global target for Eastern Mediterranean Region office is elimination of measles by 2010. Elimination of measles can be achieved with high sustainable immunization coverage. Measles vaccine which was introduced in the year 1977 is cost-effective. At a cost of US\$ 0.26 per dose, measles vaccine saves more lives per unit cost than any other vaccine [3].

The present study found that there was significant increase during the years 1995-2005 in the vaccination coverage rate of measles for children under 5 years in Egypt,

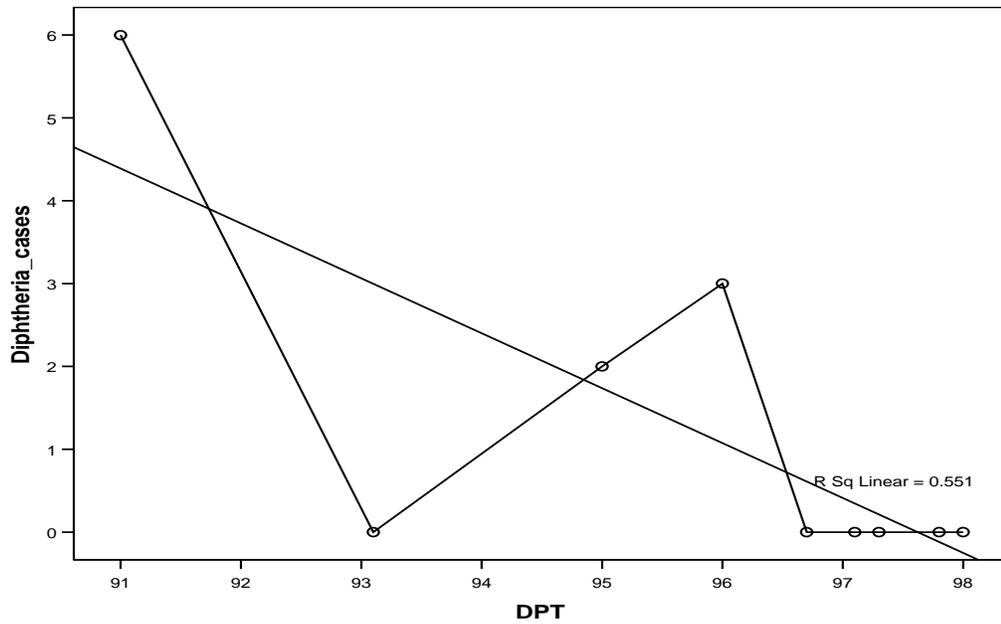


Fig. (7). The relationship between immunization coverage rate of DPT and the number of recorded diphtheria cases.

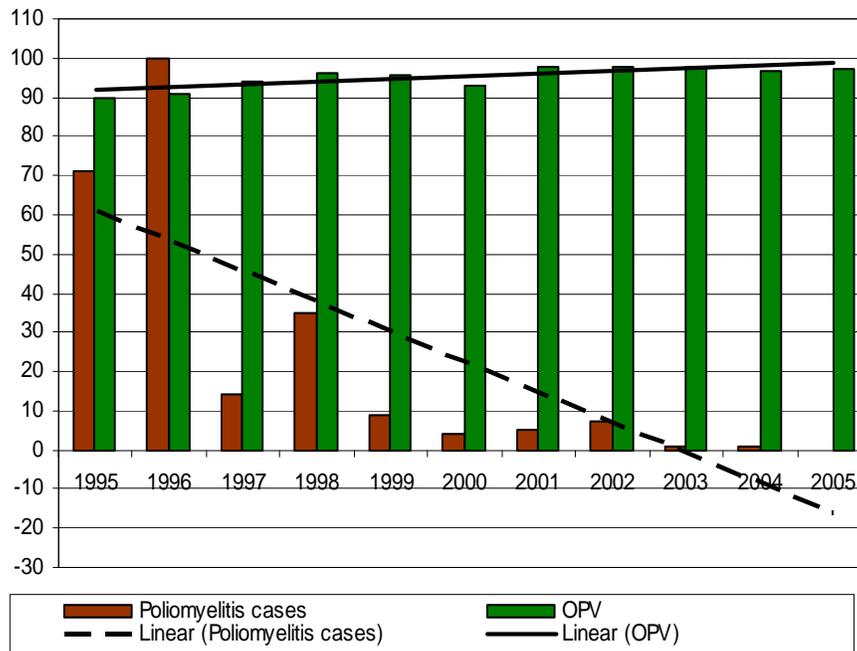


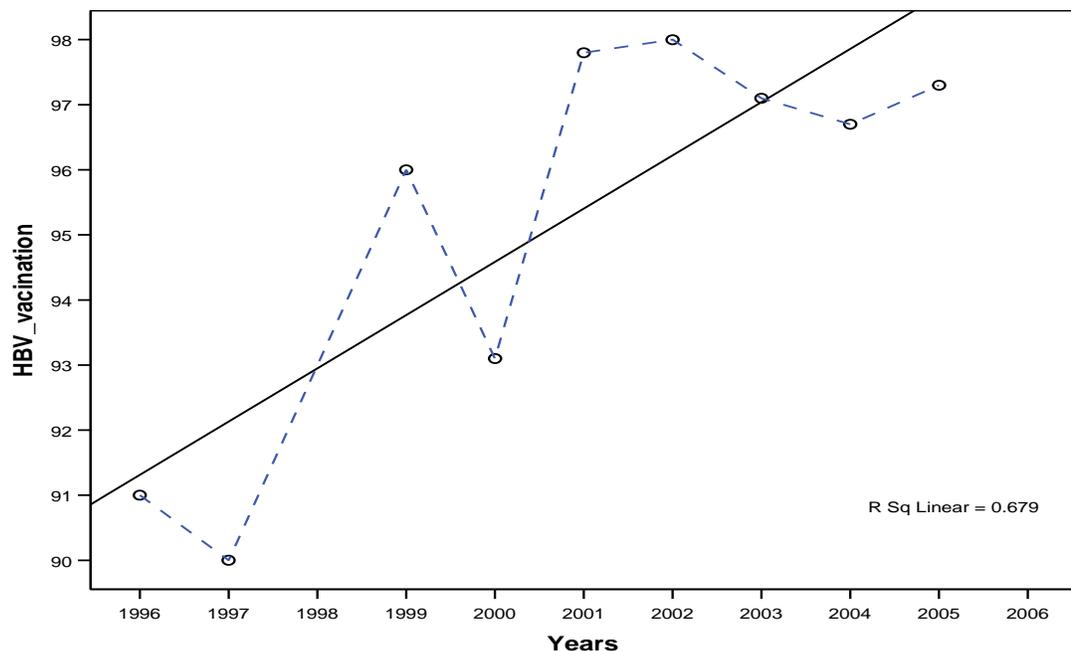
Fig. (8). The relationship between the recorded poliomyelitis cases and OPV3 immunization coverage rate among children under 5 years in Egypt during the period 1995-2005.

leading to a coverage 97.3% in the year 2005.. As a result of the successful immunization strategy, the morbidity rate significantly declined. WHO [3] indicated that Egypt has reported a decreasing number of measles cases in the past few years, and that eradication of measles is being attempted.

Tetanus is one of the vaccine-preventable diseases and can be almost completely eradicated through immunization. Following the introduction and widespread use of tetanus toxoid as a safe and effective vaccine, tetanus has become rare in developed countries, although it remains common in developing countries, particularly among neonates [4].

Globally, the main target is reduction of the incidence of maternal and neonatal tetanus (MNT) to less than 1 case per 1000 live births in each administrative district of every country by 2005. A regional multi-year plan was developed in 2001 and revised in 2003, in collaboration with UNICEF, which takes the lead in country support for MNT elimination under a WHO and UNICEF agreement.

Since that time, a substantial progress has been made, especially in Egypt, where the incidence of MNT is decreasing considerably. In 2004, 23 districts were targeted as high risk areas [3]. MOHP in Egypt is promoting social mobilization and encouragement for women to attend antenatal



**Fig. (9).** Trend of immunization coverage for HBV of children under 5 years in Egypt during the period 1996-2005.

clinics to receive tetanus toxoid (TT) immunization, especially in the high-risk districts [5]. However, this needs to be further developed since it contributes considerably to reduction in the mortality rate of neonatal tetanus.

Statistical analysis in the present work detected a significant decline in the morbidity rate of neonatal tetanus. This decline was found to be unrelated to the increase in the maternal immunization coverage, but was significantly correlated with the increase in childhood immunization coverage of DPT. This could be also attributed to the increase in the public awareness and to the improvement of sanitary measures. Thus, Egypt is very close to achieving the goal of neonatal tetanus elimination by 2010, since there were only 25 recorded cases of neonatal tetanus in 2005.

During the twentieth century, diphtheria evolved from being a major childhood killer to a clinical curiosity in developed countries because of the development and widespread use of an effective and safe toxoid vaccine.

In 1956, diphtheria toxoid was first included in the schedule of compulsory vaccination of Egyptian children. The global WHO recommendations for diphtheria immunization are for a primary series (three doses of a high antigenic-content preparation) in infancy, and maintenance of immunity with booster doses of diphtheria toxoid throughout life. Strategies vary by country depending on the capacity of immunization services and the epidemiological pattern of diphtheria [6].

Significant decline in diphtheria cases was detected in the present study, which is likely to be due to the significant increase in DPT immunization coverage rate

The first generation of pertussis vaccines was developed and tested in the 1940s, which consisted of formaldehyde treated whole-cell preparations of *B. pertussis* combined with diphtheria and tetanus toxoids (DTP). DPT vaccine

was introduced in 1968 in the schedule of compulsory vaccination for Egyptian children. These vaccines have been used worldwide since the 1950s and have substantially reduced pertussis morbidity and mortality [7].

The present study showed a significant positive trend in DPT immunization coverage rate during the period of the study (1995-2005). It was significantly correlated with the reduction in the number of recorded cases, and since 2003 there were no recorded cases in Egypt as reported by MOHP [2].

Poliomyelitis vaccine has been included in the schedule of compulsory vaccination for Egyptian children since 1968. The WHO recommended strategy for achieving global polio eradication has been followed in Egypt [8]. The Egyptian National Plan of Action for Polio Eradication was adopted in February 1990 and started to be implemented in August of the same year as a part of the National Expanding Programme for Immunization [5]. The strategy involves the recording of cases, routine immunization, implementation of Supplementary Immunization Activities (SIAs) targeting all children under 5 years, as well as establishment of an efficiently performing surveillance system to detect and investigate all cases of acute flaccid paralysis. As a result of these extensive efforts, a substantial progress was achieved nationwide with the last confirmed paralytic polio case reported in May 2004 in Assiut governorate. In the presence of a highly sensitive and efficiently performing surveillance system, wild poliovirus was last isolated from the environment in January 2005 from Sohag governorate [8].

The present work demonstrated a significant decline in the number of recorded poliomyelitis cases, attributed to the significant increase in poliomyelitis vaccination coverage rate during the period of the study (1995-2005). WHO [9]

declared Egypt as a poliomyelitis free country in a celebration held on 8 March 2006.

Hepatitis B vaccine (HB-vaccine) was first included in the schedule of compulsory vaccination for Egyptian children in the year 1992. The present work showed that HB-vaccine coverage rate was significantly increased from 91% in year 1996 to 97.3% by 2005. The use of HB-vaccine was probably responsible for the marked reduction in the reported cases of hepatitis B, although there was no definite recording of HBV infection among children in Egypt.

Combined vaccines have been advocated as an efficient method of pediatric vaccine delivery. Chunsuttiwat *et al.* [10] examined the performance and cost implications for the use of combined DTP-HB vaccine in Thai immunization program. Although they could not demonstrate that DTP-HB vaccine was more cost saving than the vaccines given separately, because baseline vaccine coverage was already high, in settings where coverage rates are much lower the increased cost-benefit of combined vaccines is more likely to be observed.

Similarly, two doses of measles-mumps-rubella (MMR) vaccine are recommended for elimination of these three diseases in countries with universal mass vaccination. A two dose program with varicella vaccination is also likely to be required for elimination of childhood varicella and has been recently provisionally recommended in the United States [11].

Given the overlap in MMR and varicella vaccination schedules (MMRV), development of a combined vaccine, is desirable and would facilitate the introduction of 2 doses of varicella vaccination in healthy children with no additional injections. This would lead to universal immunization against the four diseases, would improve compliance and immunization coverage rates and decrease the number of injections given to children and the number of visits to physicians' offices [12].

Vesikari *et al.* [11] showed that experimental tetravalent MMRV vaccine appears well suited for use in national immunization programs in place of a second dose of MMR or MMR plus varicella in children who have already received a first dose of MMR. Also, Schuster *et al.* [13] found that both after one dose and two doses, the MMRV vaccine was at least as immunogenic as concomitant MMR and varicella vaccination and they suggested that this could be implemented following the current vaccination schedules.

Bricks and his colleagues [14] found that varicella vaccine protects 70 to 90% of immunized children against any form of varicella zoster infection, and they found that the efficacy against severe forms is high (95 to 98%). It was also proved that combined vaccines for measles, mumps, rubella and varicella in a single product have high rates of sero-conversion [14, 15]. Moreover, administration of measles, mumps, rubella and varicella vaccines concomitantly at separate injection sites or 6 weeks apart was generally well-tolerated and immunogenic in healthy children 12

months to 6 years of age. Varicella vaccine administered with measles, mumps, and rubella vaccine induced persistent immunity and long-term protection against breakthrough varicella infection [16]. Therefore, it was strongly recommended to add varicella vaccine to the mandatory vaccinations of children in Egypt.

## CONCLUSION

In Egypt during the period 1995-2005, immunization coverage rate of mandatory childhood vaccination was significantly increased, and the morbidity rates of vaccine preventable childhood diseases were significantly decreased. Routine vaccination in Egypt has thus been highly successful in reducing the devastating burden of vaccine-preventable childhood diseases.

## REFERENCES

- [1] Division of Communicable Disease control (DCD). Future directions for achieving the communicable disease control targets of 2005. *DCD Newsl.*, **2005**, 5, 1-12.
- [2] Ministry Of Health and Population (MOHP). *Achievements of the Expanding Programme of Immunization 1996-2005*. MOHP/ EPI: Egypt, **2005**.
- [3] World Health Organization (WHO). *The Way Forward: Annual Report 2004*. Regional Office for the Eastern Mediterranean. WHO-EM/CDC/004/E/03.05/2000, <http://www.who.int/>
- [4] Vandelaer, J.; Birmingham, M.; Gasse, F.; Kurian, M.; Shaw, C.; Garnier, S. Tetanus in developing countries: an update on the maternal and neonatal tetanus elimination initiative. *Vaccine*, **2003**, 21, 3442-2445.
- [5] Ministry Of Health and Population (MOHP). *Ministry of Health and Population/Child Survival Project: The Expanding Programme of Immunization in Egypt; 1984-1994*. MOHP/ EPI: Egypt, **1995**.
- [6] Galazka A. *Diphtheria: The Immunological Basis for Immunization*. WHO document WHO/EPI/GEN/93.12: Geneva, **1993**.
- [7] Tanaka, M.; Vitek, C.; Pascual, F.B.; Bisgard, K.M.; Tate, J.; Murphy, T.V. Trends in pertussis among infants in the United States, 1980-1999. *JAMA*, **2003**, 290, 2968-2975.
- [8] Ministry Of Health and Population (MOHP). Ministry of Health and Population/The Expanding Programme of Immunization in Egypt (EPI) polio eradication programme: Manual for workers in acute flaccid paralysis (AFP) Surveillance system in Egypt. (In Arabic), MOHP/ EPI: Egypt, **2004**.
- [9] World Health Organization (WHO). *Egypt Pushed Poliomyelitis Back to History*. WHO-EMRO, PRESS REALSE, no. 2, **2006**. [www.emro.who.int/mei](http://www.emro.who.int/mei) (accessed March 2006)
- [10] Chunsuttiwat, S.; Biggs, B.; Maynard, J.E.; Thammapornpilase, P.; Prasertsawatf, M.O. Comparative evaluation of a combined DTP-HB vaccine in the EPI in Chiangrai Province, Thailand. *Vaccine*, **2002**, 21, 188-193.
- [11] Vesikari, T.; Baer, M.; Willems, P. Immunogenicity and safety of a second dose of measles-mumps-rubella-varicella vaccine in healthy children aged 5 to 6 years. *Pediatr. Infect. Dis. J.*, **2007**, 26, 153-158.
- [12] Shinefield, H.; Black, S.; Digilio, L.; Reisinger, K.; Blatter, M.; Gress, J.O.; Brown, M.L.; Eves, K.A.; Klopfer, S.O.; Schödel, F.; Kuter, B.J. Evaluation of a quadrivalent measles, mumps, rubella and varicella vaccine in healthy children. *Pediatr. Infect. Dis. J.*, **2005**, 24, 665-669.
- [13] Schuster, V.; Otto, W.; Maurer, L.; Tcherepnine, P.; Pfltschinger, U.; Kindler, K.; Soemantri, P.; Walther, U.; Macholdt, U.; Douha, M.; Pierson, P.; Willems, P. Immunogenicity and safety assessments after one and two doses of a refrigerator-stable tetravalent measles-mumps-rubella-varicella vaccine in healthy children during the second year of life. *Pediatr. Infect. Dis. J.*, **2008**, 27(8), 724-730.

- [14] Bricks, L.F.; Sato, H.K.; Oselka, G.W. Varicella vaccines and measles, mumps, rubella, and varicella vaccine. *J. Pediatr. (Rio J.)*, **2006**, *82*, S101-S108.
- [15] Zareba, G. A new combination vaccine for measles, mumps, rubella and varicella. *Drugs Today*, **2006**, *42*, 321-329.
- [16] Shinefield, H.R.; Black, S.B.; Staehle, B.O.; Matthews, H.; Adelman, T.; Ensor, K.; Li, S.; Chan, I.; Heyse, J.; Waters, M.; Chan, C.Y.; Vessey, S.J.; Kaplan, K.M.; Kuter, B.J. Kaiser Permanente Medical Team for Varivax. Vaccination with measles, mumps and rubella vaccine and varicella vaccine: safety, tolerability, immunogenicity, persistence of antibody and duration of protection against varicella in healthy children. *Pediatr. Infect. Dis. J.*, **2002**, *21* (6), 555-561.

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