

Risk Factors of Delay Proportional Probability in Diphtheria-tetanus-pertussis Vaccination of Iranian Children; Life Table Approach Analysis

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ABSTRACT

Despite success in expanded program immunization for an increase in vaccination coverage in the children of world, timeliness and schedule of vaccination remains as one of the challenges in public health. This study purposed to demonstrate the related factors of delayed diphtheria-tetanus-pertussis (DTP) vaccination using life table approach. A historical cohort study conducted in the poor areas of five large Iran cities. Totally, 3610 children with 24-47 months old age who had documented vaccination card were enrolled. Time of vaccination for the third dose of DTP vaccine was calculated. Life table survival was used to calculate the proportional probability of vaccination in each time. Wilcoxon test was used for the comparison proportional probability of delayed vaccination based on studies factors. The overall median delayed time for DTP3 was 38.52 days. The Wilcoxon test showed that city, nationality, education level of parents, birth order and being in rural areas are related to the high probability of delay time for DTP3 vaccination ($P < 0.001$). Moreover, child gender and parent's job were not significant factors ($P > 0.05$). Being away from the capital, a high concentration of immigrants in the city borders with a low socioeconomic class leads to prolonged delay in DTP vaccination time. Special attention to these areas is needed to increase the levels of parental knowledge and to facilitate access to the health services care.

Key words: Children, Immunization, Iran, life table, Survival time, Vaccine

INTRODUCTION

Vaccination is the most effective and economical means of combating the disease.^[1] Considerable progress has been made in increasing immunization coverage of children around the world through Expanded Immunization Program (EPI) of World Health Organization (WHO).^[2] Before the implantation of universal EPI by WHO in 1974, <5% of children were vaccinated against the vaccine-preventable diseases worldwide.^[3] Until 2013, global coverage with the four core vaccines especially diphtheria-

tetanus-pertussis (DTP), polio and measles has reached more than 84%.^[4] Therefore, a considerable success in eradication or noticeable reduction in the incidence and mortality of childhood diseases occurred.^[5-7]

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Despite good achievement and increasing immunization coverage, timely vaccination has become an important challenge in many countries.^[8,9] To achieve the highest level of immunity against the target diseases evermore, children should receive all recommended vaccines on the schedule.^[10] The only accomplished studies in Iran showed that 42-67.6% of children received vaccines out of time^[11] and this rate in outskirts of Iranian cities is 56.6-93.2% for hepatitis1 and measles, mumps, and rubella vaccines.^[12] Delayed administration of vaccination is a powerful risk factor for fatal childhood diseases and can create epidemic and menace international elimination disease programs.^[13,14] Therefore, after the high immunization coverage in Iran^[9,12] recognizing the predictor of delayed time vaccination is necessary due to little information about timely immunization. Delayed vaccination against the pertussis increases the risk of disease and up to four-fold increased the risk of hospitalization.^[15] Moreover, due to the importance of third dose of DTP vaccine (DTP3) as one of the most important indicators of public health,^[4] the current study aimed to evaluate the predictors of untimely DTP3 vaccination in children of suburbs of five big Iranian cities.

MATERIALS AND METHODS

A historical cohort study was conducted in suburbs of Iran's cities including Tehran, Isfahan, Mashhad, Zahedan, and Arak in June 2013. The target population was children 24-47 months old that lived in these areas at the time of the survey. The delay time in DTP3 vaccination was calculated according to the time of vaccination and national immunization schedule. Due to the excluding children without the vaccination card, 3610 were analyzed in study finally. Trained interviewers collected data using the WHO standard questionnaire and interviews conducted with the

child's mother or nurse. The more details about sampling schedule, study setting, and data collection described in another study.^[9]

The data were analyzed by the SPSS software (Chicago Inc.). Since DTP3 vaccine coverage is one of the most important indicators of the public health and for childhood immunization program,^[4,10] the delay time of third dose of DTP vaccine was considered as the outcome variable. Independent variables were demographic characteristics including child sex, parent's education and job, living city, prior rural residency, birth order, and nationality. Life table approach used for the survival analysis to estimate the median and proportional probability of vaccination in each month periods intervals of delay in DTP vaccination. Wilcoxon test (Gehan statistics) was used for overall and pairwise comparison. Significance level considered as 0.05.

RESULTS

A total of 3610 children was entered into the analysis, of which 1754 (48.6%) were female, and 1851 (51.3%) were male. The mean \pm standard deviation of children age was 36.02 ± 7.11 months. The overall delayed time for DTP3 was 38.52 days. The probability (cumulative incidence) of vaccination at the end of 1st, 2nd, and 3rd months after recommended age for DTP3 vaccination were 0.23, 0.07, and 0.02, respectively. The Wilcoxon test showed a significant difference, as presented in Table 1, in median delay time among under study living cities, nationality, education level of parents, birth order, and prior rural residency ($P < 0.001$). Nevertheless, there was no significant difference between the delay time of DTP3 vaccination in children based on parents' jobs and child gender. Figures 1 and 2 showed a higher probability of

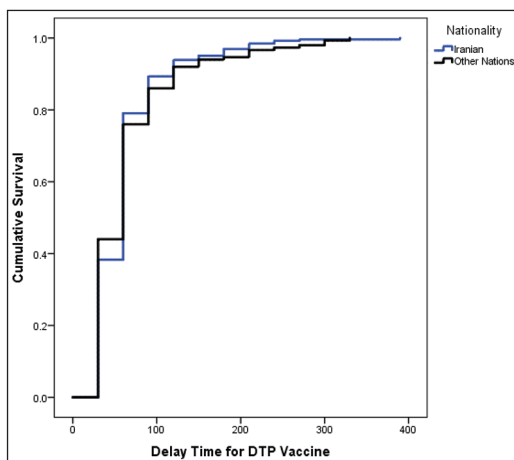


Figure 1: Life table approach of cumulative proportional probability of diphtheria-tetanus-pertussis 3 vaccination for nationality after recommended age of vaccination based on immunization schedule

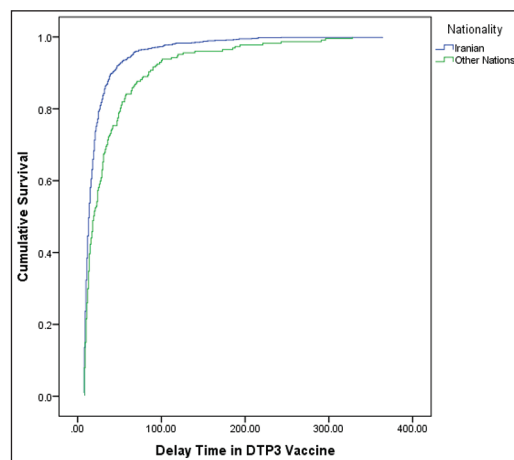


Figure 2: Kaplan-Mayer approach of cumulative proportional probability of diphtheria-tetanus-pertussis 3 vaccination for nationality after the recommended age of vaccination based on immunization schedule

Table 1: Median delay time and proportional probability (SE) of DTP vaccination at 1st, 3rd and 6th months after immunization schedule according to related factors

Variables	Survival				P
	1 st month	3 rd months	6 th months	Median of delay time	
City location					
Tehran	0.20 (0.02)	0.04 (0.01)	0.01 (0.01)	18.79	<0.001
Isfahan	0.24 (0.03)	0.07 (0.03)	0.02 (0.03)	20.16	
Mashhad	0.25 (0.03)	0.09 (0.06)	0.04 (0.05)	19.64	
Zahedan	0.23 (0.04)	0.11 (0.07)	0.04 (0.04)	27.69	
Arak	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	16.80	
Nationality					
Iranian	0.21 (0.01)	0.06 (0.02)	0.02 (0.01)	18.80	<0.001
Other nations	0.24 (0.03)	0.08 (0.03)	0.03 (0.04)	26.90	
Mother's education					
Illiterate	0.26 (0.03)	0.11 (0.04)	0.05 (0.05)	28.90	<0.001
Elementary	0.21 (0.02)	0.05 (0.02)	0.00 (0.00)	20.68	
Middle school	0.17 (0.02)	0.05 (0.03)	0.02 (0.02)	19.37	
High school	0.22 (0.03)	0.05 (0.02)	0.01 (0.01)	18.26	
College	0.10 (0.01)	0.00 (0.00)	0.00 (0.00)	17.49	
Father's education					
Illiterate	0.30 (0.04)	0.11 (0.04)	0.04 (0.05)	27.58	<0.001
Elementary	0.16 (0.01)	0.05 (0.03)	0.02 (0.02)	21.25	
Middle school	0.26 (0.04)	0.07 (0.03)	0.01 (0.01)	18.97	
High school	0.20 (0.02)	0.06 (0.04)	0.03 (0.05)	18.32	
College	0.18 (0.03)	0.04 (0.03)	0.00 (0.00)	18.00	
Mother's occupation					
Housewife	0.22 (0.01)	0.07 (0.01)	0.02 (0.01)	19.56	0.381
Employed	0.23 (0.06)	0.08 (0.08)	0.00 (0.00)	18.05	
Father's occupation					
Un-employed	0.14 (0.04)	0.00 (0.00)	0.00 (0.00)	21.80	0.289
Employed	0.23 (0.01)	0.07 (0.01)	0.02 (0.01)	19.41	
Birth order					
1	0.20 (0.02)	0.03 (0.01)	0.00 (0.00)	17.89	<0.001
2	0.23 (0.02)	0.08 (0.03)	0.02 (0.02)	19.29	
3	0.22 (0.03)	0.09 (0.04)	0.02 (0.03)	21.04	
4 or more	0.21 (0.03)	0.07 (0.03)	0.03 (0.03)	29.40	
Baby gender					
Female	0.19 (0.01)	0.05 (0.02)	0.02 (0.03)	19.58	0.833
Male	0.26 (0.02)	0.09 (0.03)	0.02 (0.02)	19.38	
Former residence					
City	0.22 (0.01)	0.07 (0.02)	0.02 (0.01)	19.33	<0.001
Rural	0.26 (0.06)	0.05 (0.03)	0.03 (0.04)	25.78	

DTP: Diphtheria-tetanus-pertussis, SE: Standard error

delayed vaccination in non-Iranian children based on life table and Kaplan-Mayer approaches.

DISCUSSION

According to the results, more than 95% of children are vaccinated 3 months after the recommended age for immunization according to the national schedule program. However, based on some related factors this rate was increased or decreased. Prior residency in the rural area, higher birth order, and more distance from the capital are the risk factors for increasing the delayed vaccination rate. Nevertheless, Iranian nationality and high parent's education are protective factors for delayed vaccination rate that caused earlier vaccination.

The results of our study showed a significant relationship among under study living cities and probability vaccination after recommended schedule time in specified intervals. Several studies have been shown that geographical variation is related factors of vaccination quality.^[16-18] It is due to the inequity in the distribution of health care facilities, socioeconomic, and cultural differences among different studied cities. So that, the pairwise comparison showed that the probability of delayed vaccination in children living in Zahedan is higher than other cities. Moreover, Arak had the lower probability of delayed vaccination. Zahedan is away from the capital with lower socioeconomic standards and more concentrated illegal immigrant, especially from Afghanistan. On the other hand, children in Arak have

the best condition with the lowest median of delayed vaccination time due to the small size of the town and easier access to health centers. In addition, according to the results, the probability of early vaccination in Non-Iranian children is lower than Iranian. Pavlopoulou *et al.* conducted a study on preschool children in Athens, Greece and showed that incomplete vaccination is more prevalent in immigrants and other minority. This factor leads to lower vaccination worldwide.^[19] Therefore, a special intervention on minorities and immigrants seemed to be necessary. Moreover, several studies similar to our study have shown that with increase family size, the timely vaccination decreases.^[16,20-23] Because usually in crowded families, parents' education level and socioeconomic status is low, and the attention of parent for immunization of children decreases. This study showed that the median of delay time for DTP3 vaccine in three intervals (1st month, 2nd to 3rd and 4th to 6th month) is longer in children that lived in the rural area. Similar results presented in another study in India.^[22]

It is shown that parent's education have a significant effect on the probability of un-time vaccination and low levels of education inversely related to the increasing probability of delayed vaccination. Pairwise comparison showed that illiterate parent had more delay time for DTP3 vaccination in all intervals. It has been shown in various studies that mother job and education is related to health care utilization and health disparities.^[21,24-31] Since, literate mothers have more knowledge about the childhood diseases and are oriented regarding the importance of vaccination at the recommended age. In addition, gender difference did not observe regarding earlier vaccination in boys, unlike some studies.^[23,32] Moreover, we did not find a significant association between parent job status and timely vaccination of children. It is similar to the studies conducted in Ethiopia, India, and Brazil.^[22,33,34] But the two studies showed that women's occupation related with vaccination status and children whose mothers work out of home were better vaccinated.^[18,23] However, in the view point of health policy, the probability of vaccination in each period after recommended age for DTP is calculated. Therefore, more attempts are needed for increasing the timeliness of vaccination as high immunization coverage.

CONCLUSION

The overall median time of children with delayed vaccination was 36.02 days. The delay time in DTP vaccination is increased with distance from the capital, lower levels of parent education, increasing foreign

population, and busy families. Therefore, increasing awareness of parents by educational intervention programs should be considered especially for mothers in crowded families. In addition, more attention should be taken for an increase of welfare of families in poor areas.

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Conflicts of interest

There are no conflicts of interest.

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