Causes of death among Syrian children using verbal autopsy

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أسباب الوفاة بين الأطفال السوريين وفقا لاستبيان الصفة التشريحية الشفهية

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خلاصة : تمت دراسة أسباب الوفاة بين الأطفال دون الخامسة من العمر باستعمال استبيان معدّ للصفة التشريحية الشفهية بعد الوفاة . كما بُحثت كذلك العوامل الحاسمة التي يرجح أنها أفضت إلى الوفاة . وتبين أن حوالي 44% من الوفيات حدثت بين المواليد حديثي الولادة (أقل من 28 يوما من العمر) . وكانت أهم أسباب الوفاة بينهم ، الخداج (الولادة المبتسرة قبل الأوان) (33%) ، وعوامل متعلقة بالولادة (30%) . وكان السبب الرئيسي للوفاة بين الرضع (من شهر إلى أحد عشر شهرا من العمر) هو التشوهات الولادية (24%) . وكانت الحوادث مسؤولة عن وفيات ثلث الأطفال البالغين من العمر سنة إلى أربع سنوات . وتم بحث العوامل التي ربما تكون قد أسهمت في حدوث الوفاة . وفي هذه المقالة تم تقييم أهمية أسباب الوفاة من منظور الصحة العمومية ، ومناقشة ما يترتب عليها من مضامين .

ABSTRACT The causes of death in children under five years were studied using a structured verbal autopsy questionnaire. Possible determinants of death were also investigated. About 44% of deaths were among neonates (below 28 days of age); the major causes of death in neonates were prematurity (33%) and birth-related factors (30%). In infants (1–11 months of age), the leading cause of death was congenital malformations (24%). Accidents were responsible for one-third of deaths in children aged 1–4 years. Factors that might have contributed to death were investigated. The public health importance of causes of death was evaluated and its implications were discussed.

Causes de décès chez les enfants syriens d'après l'autopsie verbale

RESUME Les causes de mortalité chez les enfants de moins de cinq ans ont fait l'objet d'une étude utilisant un questionnaire structuré d'autopsie verbale. Les facteurs déterminants éventuels du décès ont été également étudiés. Environ 44% des décès survenaient chez des nouveau-nés (moins de 28 jours); les causes principales de mortalité chez les nouveau-nés étaient la prématurité (33%) et les facteurs liés à la naissance (30%). Chez les nourrissons (1–11 mois), la cause principale de décès était les malformations congénitales (24%). Les accidents étaient à l'origine d'un tiers des décès chez les enfants âgés de 1 à 4 ans. Les facteurs qui ont pu contribué au décès ont été examinés. L'importance sur le plan de la santé publique des causes de décès a été évaluée et ses implications ont été examinées.

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Introduction

During the past few years, many developing countries have made considerable progress in establishing good preventive and curative health services. The Syrian Arab Republic has been especially successful, and the rate of under-five mortality has dropped from 201 per 1000 live births in 1960 to 39 per 1000 live births in 1993. Infant mortality, which is a standard index for health, has also dropped from 136 per 1000 live births to 33 per 1000 in 1993 [*1*].

Accurate information on the cause of death is necessary for effective planning and evaluation of health care programmes [*2,3*]. In recent years, the verbal autopsy questionnaire has been widely used for collecting such information, mainly in situations where the medical certification of death in childhood is incomplete [*4,5*]. In this approach, trained field workers interview parents of the deceased child using a structured questionnaire in order to collect information on the symptoms the child experienced before death. This information is then summarized and interpreted to give a likely cause of death for that child [*4*]. Children who die in their homes may not appear in any health statistics or they may be reported by lay people.

This study was undertaken to find out more about the causes of death in Syrian children. The objectives were to determine the causes of death in under-fives in the Syrian Arab Republic using the verbal autopsy method, in order to assess the relative public health importance of those causes. It also aimed to describe some of the potential risk factors associated with death from a certain cause.

Materials and methods

Study population

The study covered a sample of 40 000 households all over the country. These households were chosen using the method of cluster sampling. The sample was drawn by the Central Bureau of Statistics, taking into consideration the estimates of the child mortality rate and also the distribution of the urban/rural population in different provinces in the country. Table 1 shows the distribution of the study population.

Field work

All households included in the study sample were visited by trained field workers during the period from 28 February to 10 March 1996 to collect information on the number of children under five years living in the house, and also to investigate whether any child had died during the year preceding the date of study. When a death was reported, trained physicians visited the household on the following day and interviewed one member of the family, preferably the mother, on the conditions and cause of death using a standardized questionnaire which followed the method of verbal autopsy.

Data collected

Data were collected on the circumstances of death and the respondents were asked to describe the history of death in their own

Table 1 Distribution of the study population

	Urban	Rural	Total
Number of clusters[a]	223	177	400
Number of children under 5 years	22 434	25 113	47 547

[a]Each cluster consisted of 100 households

words. Interviewers then read through a structured checklist which was used to question the family about the absence or presence of particular symptoms and signs during the week preceding the death, the duration of illness, and any relevant information. The checklist included: fever, cough and/or fast breathing, diarrhoea and/or vomiting, rash, loss of weight, convulsions, birth difficulty, congenital malformations, and "others" for any symptoms not listed. The final part of the questionnaire included information on the history of pregnancy and delivery, and also the characteristics of the child and his/her family. Information on variables such as birth weight, birth order, type of feeding, vaccination status, age and education of the mother, smoking habits of the parents, crowding index in the house, other deaths among siblings and living conditions in the house were collected.

Quality control

The first version of the questionnaire was field-tested and changes were made accordingly. A total of 96 field workers (paramedics) and 32 physicians were recruited for the study and attended training programmes. These individuals were chosen from all provinces and thus were familiar with the people they were serving. Each physician was responsible for supervising three field workers from the same region throughout the study.

Data processing and analysis

The first step of data analysis was classification of the cause of death. The completed questionnaires were reviewed by four physicians independently in order to derive a diagnosis which was assessed as the most probable cause of death. The cause of death was stated in light of mortality tabulation, list 4 for infant and child mortality in the World Health Organization (WHO) *International classification of diseases and related health problems* (ICD-10) [6].

All forms were coded and entered into a microcomputer. Data were processed and analysed using standard statistical packages.

Results

Mortality in the study population

The study recorded the deaths of 330 children under five years during the year from February 1995 to February 1996. Deaths in more than half of the cases occurred in rural areas (57%); 60% of the cases were boys; and 53% of the deaths occurred in hospital. Deaths in the neonatal period formed the largest group (44%). Deaths tended to cluster in some communities. A few clusters reported 5–8 deaths. This will be analysed and investigated in a further study. Mothers were the respondents to the questionnaires in 84% of cases.

Causes of death

Table 2 shows the most probable cause of death among different age groups. As can be seen, prematurity was the leading cause of death (32.6%) in neonates (below 28 days of age), followed by other causes which could be associated with low birth weight and/or short gestation period such as neonates affected by maternal complications of pregnancy or delivery, birth trauma or respiratory distress syndrome (29.9%). Congenital malformations were responsible for 15.3% of neonatal deaths. In infancy (1–11 months of age), congenital malformations were the leading cause of death (24.2%), followed by pneumonia (19.5%) and diarrhoeal diseases (15.6%). Accidents accounted for almost a third of deaths in children from 1–4 years, followed by pneumonia.

In total, 59 out of the 330 cases of death were diagnosed as congenital malformations. These included 22 cases of malformation of the circulatory system and 16 of encephalocele, and the rest were miscellaneous. The entity entitled "other" causes of death consisted of cases of malnutrition, sudden infant death, haemolytic diseases, malignancy, acute abdomen, etc. A diagnosis of the cause of death was not reached in 17 cases of death (5.2%) of the total reported deaths.

Relationship between child and family characteristics and cause of death

Table 3 describes the characteristics of the deceased children and their families. This includes a wide range of social, economic, demographic and environmental factors.

Potential risk factors were studied by comparing their distribution in children who died of a specified cause and those who died of other causes. Table 4 illustrates the factors that were associated with the

Table 2 **Most probable causes of death by age at death**

Cause of death[a]	Number	Percentage
Neonates (below 28 days of age) (n = *144*)		
Prematurity [4–026]	47	32.6
Birth-related causes [4–025, 4–027, 4–028, 4–029]	43	29.9
Congenital malformations [4–036 to 4–041]	22	15.3
Septicaemia [4–008]	10	6.9
Neonatal tetanus [4–004]	2	1.4
Other defined	13	9.0
Undefined	7	4.9
Infants (1–11 months of age) (n = *128*)		
Congenital malformations [4–036 to 4–041]	31	24.2
Pneumonia [4–022]	25	19.5
Diarrhoea [4–001]	20	15.6
Septicaemia [4–008]	12	9.4
Meningitis/encephalitis [4–007, 4–020]	11	8.6
Accidents [4–045 to 4–050]	7	5.5
Other defined	17	13.3
Undefined	5	3.9
Children (1–4 years of age) (n = *58*)		
Accidents [4–045 to 4–050]	18	31.0
Pneumonia [4–022]	7	12.1
Congenital malformations [4–036 to 4–041]	6	10.3
Septicaemia [4–008]	4	6.9
Diarrhoea [4–001]	2	3.4
Other defined	16	27.6
Undefined	5	8.6

[a] *Numbers in square brackets refer to disease classification in accordance with Morbidity Tabulation List 4 of ICD-10 [6]*

deaths from congenital malformations. Of these factors, association with older age of mother, drug administration during pregnancy and female sex of the child were statistically significant.

Only two factors were statistically significant regarding association with deaths from prematurity. These were the birth order ($P < 0.01$) and number of rooms owned by the child's family ($P < 0.01$). Children who died of prematurity had lower birth order (the first or second child) and their families owned one or two rooms (Table 5).

Deaths from diarrhoeal diseases were significantly associated with the area of living, level of sanitation, level of mother's education, and also with the type of feeding, being higher in rural areas, with low level of mother's education and with artificial feeding (Table 6). Deaths from accidents were more frequent in rural areas; the relationship was statistically significant

Table 3 **Characteristics of deceased children and their families**

Variable	Number	Percentage
Place of delivery		
Hospital	146	44.2
Home	156	47.3
Elsewhere	28	8.5
Birth order		
1–3	151	45.8
4–7	108	32.7
8 or more	71	21.5
Type of feeding[a]		
Breast-feeding	152	61.0
Artificial	97	39.0
Child visited well baby clinic		
Yes	228	69.1
No	102	30.9
Child was fully immunized		
Yes	75	36.2
No	132	63.8
Other deaths among siblings		
Yes	100	30.3
No	230	69.7
Family owns the house		
Yes	302	91.5
No	28	8.5
Level of sanitation in house		
Good	95	28.8
Moderate	133	40.3
Bad	102	30.9
Mother's level of education		
Low	156	47.3
Moderate	137	41.5
High	37	11.2
Number of rooms in the house		
1–2	189	57.3
3–4	107	32.4
5 or more	34	10.3
Size of family		
1–4	125	37.9
5–8	123	37.3
9 or more	82	24.8
Either parent is a smoker		
Yes	237	71.8
No	93	28.2
Mother and father are first cousins		
Yes	167	50.6
No	163	49.4

[a] *Children who died in the first hours of life were excluded*

Table 4 **Factors associated with death from congenital malformations**

Variable	Death due to malformations No.	%	Death due to other causes No.	%	*P* value
Mother and father are first cousins					
Yes	33	55.9	134	49.4	not significant
No	26	44.1	137	50.6	
Mother's age (years)					
<35	40	67.8	207	87.3	< 0.001
>35	19	32.2	30	12.7	
Mother had a disease during pregnancy					
Yes	31	52.5	108	39.9	not significant
No	28	47.5	163	60.1	
Mother was administered a drug during pregnancy[a]					
Yes	45	76.3	137	50.6	< 0.001
No	14	23.7	134	49.4	
Sex of child					
Female	33	55.9	109	40.2	< 0.05
Male	26	44.1	162	59.8	

[a]*Drugs included hormones, antibiotics, analgesics and multivitamins*

Table 5 **Factors which showed a statistically significant association with death from prematurity**

Variable	Death from prematurity No.	%	Death from other causes No.	%	*P* value
Birth order					
1–3	33	67.3	118	42.0	< 0.01
4–7	9	18.4	99	35.2	
8 or more	7	14.3	64	22.8	
Number of rooms					
1–2	35	71.4	154	54.8	< 0.05
3–4	7	14.3	100	35.6	
5 or more	7	14.3	27	9.6	

($P < 0.05$). It was also shown that the two deaths from neonatal tetanus occurred in cases which reported delivery in the house under the supervision of a traditional birth attendant.

Discussion

In this study, an attempt has been made to establish the cause of death in children who died in the year preceding the date of study,

Table 6 **Factors associated with death from diarrhoea**

Variable	Death from diarrhoea		Death from other causes		*P* value
	No.	%	No.	%	
Area of living					
Urban	5	16.7	137	45.7	< 0.01
Rural	25	83.3	163	54.3	
Level of sanitation					
Bad	15	50.0	87	29.0	< 0.05
Moderate	12	40.0	121	40.3	
Good	3	10.0	92	30.7	
Mother's education					
Low	23	76.7	133	44.3	< 0.01
Moderate	6	20.0	131	43.7	
High	1	3.3	36	12.0	
Type of feeding					
Breast	6	23.1	62	61.4	< 0.01
Artificial	20	76.9	39	38.6	

by means of verbal autopsy. There have been a few studies of the cause of death in the Syrian Arab Republic [*7,8*]. Our study, however, is the first which has used a structured verbal autopsy questionnaire. The method of verbal autopsy has been evaluated in many studies [*9,10*], and ours did not aim to validate this method. Nevertheless, review of completed questionnaires by the panel of physicians gave identical results in 97% of cases.

The results of the study showed very clearly the importance of prematurity and other conditions related to maternal complications of pregnancy and delivery as the leading causes of neonatal deaths (more than 60% of cases). A hospital-based study in Damascus Children's Hospital reported that infections, mainly septicaemia, were the leading cause of death: they were responsible for about 30% of cases reported in the year 1991–1992 [*11*]. Congenital malformations were found to be the third most frequent cause of death in neonates, while in infants they were the leading cause of death. Congenital malformations were also the leading cause of death in infants in the United States in 1993 [*12*]. A recent study has also drawn attention to the significant contribution of congenital malformations in perinatal death in the Eastern Mediterranean Region [*13*].

The predominance of factors contributing to neonatal and other infant death such as prematurity, causes related to birth or maternal complications, and also congenital malformations was shown in this study. This has great implications on the delivery of health services. It obviously suggests that much more attention should be paid to maternal health services. Many of the above-mentioned causes of death could be averted by implementation of adequate prenatal and delivery care. Diarrhoeal diseases and pneumonia were responsible for about a third of the deaths in infants. The support of the national programme for the control of diarrhoeal and acute respiratory diseases

is of paramount importance. Strategies for control of diarrhoeal diseases and acute respiratory infections are well known [*14*]. Furthermore, accidents were the major cause of death in children aged 1–4 years. It seems likely that enforcement of the national programme against accidents would have a positive effect on the reduction of child mortality.

In general, the factors revealed in this study as possible contributors to the death of children are not surprising. Significant associations were seen between congenital malformations and older age of mother, and the administering of drugs during pregnancy. These two factors are well known risk factors for congenital malformations. It was also noted that prematurity was related to small number of rooms owned by the family, reflecting low socioeconomic class. Factors associated with death from diarrhoeal diseases also have their implications. These factors were lack of breastfeeding, bad sanitation and low education of mothers. Low maternal education is strongly connected with infant mortality. Increase in the years of schooling of mothers is related to lower infant mortality rates [*15*]. Nevertheless, further well-designed epidemiological studies are needed to assess the risk factors of death from different causes in Syrian children.

It was also shown in this study that a large proportion of deaths occur at home. These deaths may go unreported or they may be diagnosed and reported by lay people. Routine statistics on child mortality should be looked at as an underestimation of the real figures, and they should be validated.

In conclusion, this study gave some clues as to where preventive and curative health services should be focused, and it has given suggestions for the sort of interventions that should be implemented.

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Note to our readers

Volume 3 of the EMHJ will include three issues, the first of which will be a special issue on noncommunicable diseases.