JHIDC Health Informatics in Developing Countries

www.jhidc.org
Vol.4 • No.1 • 2010

Insights into Data on Multiple Causes of Death Obtained from the Information System of a University Teaching Hospital, Al-Khobar, Saudi Arabia, 1998-2007

Sulaiman Bah and Hatem Qutub

College of Applied Medical Sciences
King Faisal University,
Dammam, Saudi Arabia

Abstract

The study explores the utility of a hospital information system in producing statistics on multiple causes of death. The study period is 10 years, from 1998-2007 and the study data were obtained from the University Teaching Hospital in Al-Khobar, Saudi Arabia. The study found the data rich in multiple causes of death, with the average causes per death being 6.2 for males and 6.3 for females. For the study period , diseases of the circulatory system had the highest number of mentions among males (29.6%) and among females (29.6%). This supports what is known about the epidemiologic transition in Saudi Arabia, that non-communicable diseases have now become the leading causes of death. However, this perspective does not emerge the national statistics system which is based on completed death certificates. According to that system, ill-defined causes were the leading causes of death in 2006. The study calls for an increase in the role of hospital information system in the production of national statistics on causes of death in Saudi Arabia.

Introduction

Many studies on multiple causes of death are based on completed death certificates duly submitted to the national office responsible for processing death statistics (Mannino et al.,1998; Wilkins et al.,1997; Wilkins et al 2000; Stallard, 2002). This source is national in scope, standardized in format and has been road-tested over several decades. Several studies have demonstrated the added utility of this source of deaths data when used for producing multiple-cause statistics. Wing and Manton (1981) used North Carolina multiple-cause data to confirm that the observed decline in mortality due to circulatory diseases over the period 1968-1977 was a real one and that this was largely attributable to the decline in contribution of hypertension to the overall decline. Goldacre et al. (2005) used British multiple-cause mortality data for the period 1979-2003 to refute the claim that increased survival from coronary heart disease would result in major increase in heart failure. However, in spite of their usefulness, some problems have been found in the completeness or accuracy of the causes of death data obtained from death certificates. This is specially the case in a situation wherein the deceased was not a regular patient in a hospital or is does not have health details in the hospital information system. In this regard, it was found that in an Emergency Department of a Scottish General Hospital, only for about a third of the cases was there strong evidence for the information put on the death certificates (Quigley and Burton, 2003). Part of the reason for this was that most of the patients presenting at Emergency Departments were not known to the physicians completing the death certificates.

Another set of studies on multiple causes of death are based on data obtained from hospital information systems (Penson et al., 2001; Johansson and Westerling, 2002; Goldacre et al, 2000; Gittelsohn and Senning, 1979). Different kinds of approaches have been used in these studies. In one approach, multiple causes of death data obtained from a hospital information system are used to independently arrive at underlying causes of death which are then compared with underlying causes of death obtained from death certificates, through either manual or automatic selection (Penson et al., 2001, Johansson and Westerling, 2002). In another approach, the trend for a specific disease is ascertained using both multiple-cause data (from death certificates) and multiple diagnoses data (from hospital records) (Goldacre et al., 2000). In yet another approach, computer record linkage is used to match death records (from death certificates) with hospital discharge abstracts. The matching is then used for comparing multiple causes of death from one system with multiple clinical diagnoses from the other system and the degree of agreement of the two systems is assessed (Gittelsohn and Senning, 1979). In general, the hospital information system have potential for usage in multiple-cause analyses in a variety of innovative and interesting ways. However, for a specific hospital information system to be put to such uses, one must first establish the feasibility of its usage. As such, this study had two primary goals; first to assess the potential that the study hospital has for multiple-cause analysis and second to analyse the resulting multiple-cause data obtained from the study hospital. Once these goals

Referencing this article

Bah, S., & Qutub, H. (2010). Insights into Data on Multiple Causes of Death Obtained from the Information System of a University Teaching Hospital, Al-Khobar, Saudi Arabia, 1998-2007 [Electronic Version]. *Journal of Health Informatics in Developing Countries, 4(1)*, 18-26, from http://www.jhidc.org/index.php/jhidc/issue/view/9

have been achieved, it is hoped that other research goals will be pursued depending on the appropriate problem areas identified. Some potential problem areas that have been identified so far are acute asthma, chest pain and accidents.

Methods and materials

The data used in the study were obtained from the Expired Patients Database of the hospital information system from the university teaching hospital in Al-Khobar, Eastern Saudi Arabia. Al-Khobar's population is under 200,000 according to the 2004 Saudi Arabian census. Al-Khobar is contiguous with two other cites, Ad-Dammam and Ad-Dhahran. The three cities altogether have a population of about 2 million inhabitants. Al-Khobar is served by several general, private and specialist hospitals. As the teaching hospital is a tertiary hospital, its catchment area is rather broad, catering for patients in Al-Khobar, its neighboring cities and other towns in the Eastern Region.

The study was ethically approved by the King Faisal University Local Committee of Biomedical Ethics (Ref: KFU-LEC-122). The study period is 10 years, from 1998 to 2007. In total, 20 variables were extracted from the database. Some of these variables were derived variables (eg age and adult/pediatric). Eight of the variables were dropped from the analysis and 12 were retained. Of these variables, two were administrative , medical record number and visit number. These are important variables in the data manipulation stage. Four of the variables pertain to the personal characteristics of the deceased: sex, age at death, nationality (Saudi/non-Saudi). The six remaining core variables are: the ICD-9 codes of the multiple causes of death for each deceased patient (ICD9), their descriptions (icd9desc), their positions (codenumber), whether or not the deceased had been converted from emergency (conv), whether or not procedure was performed on the deceased (icd9p) and the section of the hospital where the death took place (service). One additional variable, length of stay (los) was derived but not included in this analysis.

The data from the hospital information system was provided in 'episode format'. For each deceased, each cause of death was considered an episode and the information was placed on one record. There was no apparent order to the data. The data were sorted, cleaned, re-coded and reorganised into 'death format', with one record for each deceased. This reorganized data was the one used for the analysis, starting with basic diagnostics on the quality of the data.

All the ICD-9 numeric codes (from 001.0 to 999.9) were analysed and grouped into 18 standard categories, ranging from infectious and parasitic diseases (001.0-139.8) to injury and poisoning (800.0-999.9). The supplementary E and V codes were excluded in the multiple cause analysis. The V codes are not relevant for causes of death analysis as they refer to individuals accessing the health care system for preventive reasons or other reasons that do not require diagnoses. The E codes refer to the manner of injury, for example motor vehicle accident. While the manner of injury is excluded, the occurrence of the injury, falling under the codes 800.0 to 999.9, are included in the multiple-cause analysis.

Of the different multiple-cause measures, three were used; total mention (anywhere on the record, either as primary or secondary cause), the ratio of secondary cause to primary cause for specific causes of death and the average number of multiple cause per death. The last measure was calculated for the different background and hospital variables and comparisons were made between them.

Results

The total number of deaths over the 10-year study period was 2034 of which 1200 were males, 829 were females and five were of unspecified sex. Those of unspecified sex were dropped out of the analysis. Basic tabulations showed that most of the variables used for the analysis had valid entries and were within plausible ranges. Of all the causes of death codes reported, only 3 cases had values out of the valid ICD-9 range of 001.0 to 999.9 (for numeric codes) and the E and V codes. All the service (department) areas were reported but some with different multiple spellings. The ages were reported in alphanumeric format (for age in years, 10Y instead of 10 and for age in months, 6M instead of 6) and the ages ranged 1 day to 120 years .

Table 1 shows that over the study period, there was no record with only one cause of death stated. All the deaths had multiple causes. The model frequency is for five mentioned multiple causes of death (k=5). Of the total records, 11.2% had 11 or more multiple causes recorded on them. The highest number of causes per record was 38.

For the study period, Table 2a shows that the Diseases of the circulatory system had the highest mention among males (29.6%), followed by infectious and parasitic diseases (18.3%) and Endocrine, nutritional and metabolic diseases and immunity disorders (8.7%). For females, Table 2b shows that the ranking of the top three groups of causes of death was the same as that of males and the corresponding percentages were 29.6%, 16.4% and 8.8%, respectively. For the causes of death for which the numbers reported as primary cause were more than 10, the highest ratio of secondary to primary cause among males was for Diseases of the endocrine and Immunity disorders (ENDO) (16.4), followed by Certain diseases originating in the perinatal period (PERI) (16.3) and Diseases of the genitourinary system (GENI) (10.4). The least ratio was for Neoplasm (NEO) (0.8). For females, the ratio was highest for PERI (24.5), followed by GENI (14.6) and by ENDO (12.3) and was least for NEO (1.0).

The average number of multiple causes per death was 6.2 for males and 6.3 for females. The breakdown of average number of causes of death by department (service section) and gender is shown in Table 3. For males, the service section

with the highest average number of multiple causes per death is Gastroenterology (8.2), followed by Nephrology (7.8) and then by Internal medicine (7.0). For females, the three leading service areas were the same as those for males but the ranking were different. The highest average number of multiple causes per death was for Nephrology (7.8), followed by Internal medicine (7.5) and then by Gastroenterology (7.0).

For the age and sex breakdown of the average number of multiple causes per death, Table 4 shows that for males, the values range from 4.8 in ages 0-9 years and 30-39 to 7.6 in ages 80+. For females, the values range from 4.9 in age 0-9 to a 7.7 in age 60-69 years. Tables 5 to 10 show, for different subgroups, the same age and sex breakdown of the average number of multiple causes per death as shown in Table 4. Tables 5 and 6 show the breakdowns for those transferred to Emergency department and those not transferred, respectively. Table 7 and 8 show the breakdowns for those upon whom surgery was performed and those upon whom it was not performed, respectively. Lastly, Table 9 and 10 show the breakdowns for Saudi and non-Saudis, respectively. With the exception of Table 6 which had several small numbers, less than 10, the rest of the age-sex tables all show that the average number of multiple causes per death were higher in the ages over 50 years than those under 50 years.

Discussion

The hospital data analysed in the study was found to be surprisingly rich in multiple cause information. All the deaths (100%) had multiple causes and over 10% of the records had 11 or more causes. In an Italian study on multiple causes of death reported in death certificates, only 23.7% of the deaths had multiple causes of death and 84.1% of the deaths had three or less multiple causes (D'Amico et al, 1999). In a Canadian study using death certificates, while 79.2% of the deaths had multiple causes, 76.6% had three or less causes (Wilkins et al., 1997). Further, the average number of multiple causes per death in the study (of over 6) is much higher than the averages found in studies elsewhere, 2.68 in Canada (1990-1993) and 2.65 in the United States (1991) (Wilkins et al., 1997). It must be noted however, that multiple causes of death obtained from hospital information system are not strictly comparable with those obtained from death certificates (processed through the national statistics system). Further, the level of coding in the Al-Khobar data is clearly very detailed and was done at the five-digit level. Of all the ICD-9 codes in the data, only three codes were out of the ICD-9 range. This is possibly due to mistyping of the codes. The percentage of multiple causes due to 'Symptoms, signs and ill-defined conditions' was 5.8%. Again, although the comparison is not strictly similar, in the above mentioned Italian study, the percentage of deaths due to ill-defined causes was 7.0% (D'Amico et al, 1999).

The analysis of the multiple-cause data confirms at least one observation that are already known. Namely, that the epidemiologic transition that is underway in Saudi Arabia has changed from one in which infectious diseases were the leading health problems in the past to one in which non-communicable diseases have become the leading health problems since over a decade ago (Al-Nuam et al., 1996, Hazmi and Kurashi, 2006). For both males and females, the highest proportion of multiple causes is for diseases of the circulatory system. This would not have been found out if the analysis had only been considering primary causes since for both males and females, the highest proportion of primary causes is for neoplasms. Whilst the highest number of deaths take place in the Internal medicine department, the highest average number of multiple causes per death were observed in the Gastroenterology department for males and in the Nephrology department for females.

There is some remarkable similarities between the male and female results. First, the percentage of multiple causes due to circulatory disease is 29.6% for males as well as for females. Second, the overall the average number of causes per death is 6.2 for males and 6.3 for females and for Saudis it is the same for both males and females (6.4).

Conclusion

Through the extraction and data manipulation of the data, the study's first aim has been achieved. The study has shown that the hospital information system used in the study is very rich in multiple-cause data and that data is usable. The preliminary indication is that the quality of the data is good.

As a way of recommendation, there is need for a few changes. First there is need to change ICD-9 to ICD-10 coding in order to increase specificity of the codes and to conform to the national standard, as Saudi Arabia routinely publishes national health statistics using ICD-10. Second, there is need to modify the data capture template in the hospital information system as well as the data storage format in order to ease data manipulation for users. If 'pull-down' lists can be added to the data capture template it would eliminate spelling mistakes for standard options, for example, 'department.' The system can be programmed to automatically calculate age in numeric format instead storing the age information as an alphanumeric variable which it is not. Third, as the Saudi Arabian epidemiologic profile has changed to one in which non-communicable diseases have become the leading causes of death, analysis of causes of death should now be based on the multiple-cause perspective. This applies to the national as well as sub-national statistics on causes of death.

The national report on health statistics makes no mention of multiple causes of death but rather publishes statistics on reported deaths by 'disease group'. It is not clear if this is referring to 'primary diagnosis' or to 'underlying cause of death'. At any rate, the 'disease group' with the highest number of reported deaths in 2006 was 'Symptoms, signs and ill-defined causes', making up 21.1% of total reported deaths of 27 282 (Min. of Health, n.d).

A high proportion of deaths in this category is generally taken as an indication of poor quality of cause-of-death data. But going by the Al-Khobar data, this should not have been the case. There is need then for further research on the linkages and data flow between Saudi Arabian national statistics on causes of death and causes of death in hospital information systems. This is one step towards integrating the morbidity sub-systems from hospitals and the mortality sub-system of national statistics.

References

Al-Hazmi, A. and Kurashi, N. (2006). The profile of long-term care patients in Al-Khobar and Dammam, Saudi Arabia. *Journal of Family and Community Medicine* 2006; 13(1). Pp 25-30.

Al-Nuam, A. et. al. (1996). Prevalence of obsesity, diabetes mellitus, and hypercholesterolemia in Saudi Arabia. *Saudi Epidemiology Bulletin,* Oct-De 1996, Vol. 3, No. 4.

D'Amico, M., Agozzino, E. Biagino, A. Simonetti, A. and Marinelli, P. (1999). Ill-defined and multiple causes on death certificates- A study of misclassification in mortality statistics. *European Journal of Epedmiology* 15: 141-148.

Gittelsohn, A. and Senning, J. (1979). Studies on the reliability of vital and health records: I. Comparison of cause of death and hospital record diagnosis. *AJPH* July 1979, Vol. 69,7:680-689.

Goldacare, M., Mant, D., Duncan, M. and Griffith, M (2005). Mortality from heart failure in an English population, 1979-2003: study of death certification. *J. Epidemiol. Community Health*, 59:782-784.

Goldacre et al. (2000). Hospital admission and mortality rates for venous thromboembolism in Oxford region, UK, 1975-1998. *The Lancet*. Vol 355, June 2000.

Johansson, L.A. and Westerling, R. (2002). Comparing hospital discharge records with death certificates: Can the difference be explained? *J. Epidemiol Community Health* 2002;56:301-308

Mannino D.M,, Ford E., Giovino G. A., Thun M., (1998). Lung cancer deaths in the United States from 1979 to 1992: an analysis using multiple-cause mortality data. *International Journal of Epidemiology*, 27, 159-166.

Ministry of Health (n.d.). Health Statistical Year Book, 2006/1427. Ministry of Health, Riyadh.

Penson, D. et al (2001). Determining cause of death in prostate cancer: Are death certificates valid? *Journal of the National Cancer Institute*, Vol 93 No. 23, December 2005, Pp 1822-1823.

Stallard E., (2002), Underlying and multiple cause mortality at advanced ages: United States 1980-1998, *North American Actuarial Journal*, 6, 64-87.

Wilkins K., Wysocki M., Morin C., Wood P. (1997), "Multiple causes of death", *Health Reports* (Statistics Canada), 9, 19-29.

Wilkins, K., Parsons G.F., Gentleman J.F., Forbes W.F. (2000), Deaths due to dementia: An analysis of multiple–cause-of-death data", *Chronic Diseases in Canada*, 20, 3.

Table 1
Percentage distribution of the number of multiple causes per death record

Number of multiple causes, k	frequency of multiple causes	Percentage distribution of multiple causes (%)
1	0	0.0%
2	61	3.0%
3	205	10.1%
4	301	14.8%
5	352	17.3%
6	271	13.3%
7	207	10.2%
8	182	8.9%
9	119	5.9%
10	108	5.3%
11+	228	11.2%
Total	2034	100.0%

Table 2a
Any mention of cause of death, breakdown according primary and secondary mention and the ratio of secondary to primary mention, males

ICD-9 code and cause-of-death group	Any mention	Percentage of any mention	Primary	Secondary	Secondary / primary
001-139:Infectious and parasitic diseases	1361	18.3%	176	1185	6.7
140-239:Neoplasms	433	5.8%	235	198	0.8
240-279:Endocrine, nutritional and metabolic diseases, and immunity disorders	644	8.7%	37	607	16.4
280-289:Diseases of the blood and blood-forming organs	156	2.1%	17	139	8.2
290-319:Mental disorders	56	0.8%	1	55	55.0
320-359:Diseases of the nervous system	194	2.6%	21	173	8.2
360-389:Diseases of the sense organs	47	0.6%	1	46	46.0
390-459:Diseases of the circulatory system	2196	29.6%	202	1994	9.9
460-519:Diseases of the respiratory system	228	3.1%	51	177	3.5
520-579: Diseases of the digestive system	443	6.0%	62	381	6.1
580-629:Diseases of the genitourinary system	343	4.6%	30	313	10.4
680-709: Diseases of the skin and subcutaneous tissue	99	1.3%	2	97	48.5
710-739:Diseases of the musculoskeletal system and connective tissue	39	0.5%	7	32	4.6
740-759:Congenital anomalies	206	2.8%	22	184	8.4
760-779:Certain conditions originating in the perinatal period	311	4.2%	18	293	16.3
780-799:Symptoms, signs, and ill-defined conditions	305	4.1%	51	254	5.0
800-999:Injury and poisoning	359	4.8%	132	227	1.7
Total	7420	100.0%	1065	6355	6.0

Table 2b
Any mention of cause of death, breakdown according primary and secondary mention and the ratio of secondary to primary mention, females

ICD-9 code and cause-of-death group	Any mention	Percentage of any mention	Primary	Secondary	Secondary / primary
001-139:Infectious and parasitic diseases	854	16.4%	131	723	5.5
140-239:Neoplasms	312	6.0%	153	159	1.0
240-279:Endocrine, nutritional and metabolic diseases, and immunity dis	455	8.8%	33	422	12.8
280-289:Diseases of the blood and blood-forming organs	127	2.4%	20	107	5.4
290-319:Mental disorders	39	0.8%	2	37	18.5
320-359:Diseases of the nervous system	132	2.5%	18	114	6.3
360-389:Diseases of the sense organs	50	1.0%	0	50	-
390-459:Diseases of the circulatory system	1536	29.6%	132	1404	10.6
460-519:Diseases of the respiratory system	194	3.7%	44	150	3.4
520-579: Diseases of the digestive system	225	4.3%	27	198	7.3
580-629:Diseases of the genitourinary system	249	4.8%	16	233	14.6
630-676:Complications of pregnancy, childbirth, and the puerperium	20	0.4%	5	15	3.0
680-709: Diseases of the skin and subcutaneous tissue	72	1.4%	4	68	17.0
710-739:Diseases of the musculoskeletal system and connective tissue	75	1.4%	12	63	5.3
740-759:Congenital anomalies	231	4.4%	31	200	6.5
760-779:Certain conditions originating in the perinatal period	281	5.4%	11	270	24.5
780-799:Symptoms, signs, and ill-defined conditions	264	5.1%	39	225	5.8
800-999:Injury and poisoning	80	1.5%	29	51	1.8
Total	5196	100.0%	707	4489	6.3

Table 3
Sex breakdown of deaths, number of multiple causes and the average number of multiple causes per death (service section)

Service section	Deaths		Number of multiple causes		Average no. of multiple causes per death	
	Male	Female	Male	Female	Male	Female
Cardiology	187	140	1210	855	6.5	6.1
Neurosurgery	119	26	539	139	4.5	5.3
Pediatrics	77	77	430	438	5.6	5.7
Gastroenterology	57	53	454	371	8.0	7.0
General Surgery	78	37	520	235	6.7	6.4
Hematology/oncology	88	54	477	296	5.4	5.5
Internal medicine	289	205	2021	1535	7.0	7.5
Neonatology	113	102	493	450	4.4	4.4
Nephrology	65	38	510	287	7.8	7.6
All others	127	97	769	590	6.1	6.1
Total	1200	829	7423	5196	6.2	6.3

Table 4
Sex and age breakdown of deaths, number of multiple causes and the average number of multiple causes per death (all deaths)

Age group	Deaths		Number of multiple causes		Average no. of multiple causes per death	
	Male	Female	Male	Female	Male	Female
0 – 9	226	230	1079	1116	4.8	4.9
10-19	48	35	267	203	5.6	5.8
20 – 29	70	35	352	230	5.0	6.6
30 – 39	99	53	478	316	4.8	6.0
40 – 49	148	62	875	352	5.9	5.7
50 – 59	159	80	1098	529	6.9	6.6
60 – 69	191	120	1327	924	6.9	7.7
70 – 79	160	109	1192	781	7.5	7.2
80+	99	105	755	745	7.6	7.1
Total	1200	829	7423	5196	6.2	6.3

Table 5
Sex and age breakdown of deaths, number of multiple causes and the average number of multiple causes per death (conversion from ER- Yes)

Age group	Deaths		Number of multiple causes		Average no. of multiple causes per death	
	Male	Female	Male	Female	Male	Female
0 – 9	100	117	508	602	5.1	5.1
10-19	45	33	249	194	5.5	5.9
20 – 29	69	32	349	211	5.1	6.6
30 – 39	93	49	426	293	4.6	6.0
40 – 49	135	55	796	319	5.9	5.8
50 – 59	143	72	971	481	6.8	6.7
60 – 69	171	110	1208	837	7.1	7.6
70 – 79	154	106	1159	765	7.5	7.2
80+	95	101	709	724	7.5	7.2
Total	1005	675	6375	4426	6.3	6.6

Table 6
Sex and age breakdown of deaths, number of multiple causes and the average number of multiple causes per death (conversion from ER- No)

Age group	Deaths		Number of multiple causes		Average no. of multiple causes per death	
	Male	Female	Male	Female	Male	Female
0 – 9	126	113	571	514	4.5	4.5
10-19	3	2	18	9	6.0	4.5
20 – 29	1	3	3	19	3.0	6.3
30 – 39	6	4	52	23	8.7	5.8
40 – 49	13	7	79	33	6.1	4.7
50 – 59	16	8	127	48	7.9	6.0
60 – 69	20	10	119	87	6.0	8.7
70 – 79	6	3	33	16	5.5	5.3
80+	4	4	46	21	11.5	5.3
Total	195	154	1048	770	5.4	5.0

Table 7
Sex and age breakdown of deaths, number of multiple causes and the average number of multiple causes per death (procedure performed- Yes)

Age group	Deaths		Number of multiple causes		Average no. of multiple causes per death	
	Male	Female	Male	Female	Male	Female
0 – 9	50	36	300	190	6.0	5.3
10-19	20	8	127	55	6.4	6.9
20 – 29	32	11	172	83	5.4	7.5
30 – 39	35	20	177	123	5.1	6.2
40 – 49	66	18	418	103	6.3	5.7
50 – 59	57	31	450	241	7.9	7.8
60 – 69	60	36	433	324	7.2	9.0
70 – 79	48	33	406	271	8.5	8.2
80+	23	26	219	220	9.5	8.5
Total	391	219	2702	1610	6.9	7.4

Table 8
Sex and age breakdown of deaths, number of multiple causes and the average number of multiple causes per death (procedure performed- No)

Age group	Deaths		Number of multiple causes		Average no. of multiple causes per death	
	Male	Female	Male	Female	Male	Female
0 – 9	176	194	779	926	4.4	4.8
10-19	28	27	140	148	5.0	5.5
20 – 29	38	24	180	147	4.7	6.1
30 – 39	64	33	301	193	4.7	5.8
40 – 49	82	44	457	249	5.6	5.7
50 – 59	102	49	648	288	6.4	5.9
60 – 69	131	84	894	600	6.8	7.1
70 – 79	112	76	786	510	7.0	6.7
80+	76	79	536	525	7.1	6.6
Total	809	610	4721	3586	5.8	5.9

Table 9
Sex and age breakdown of deaths, number of multiple causes and the average number of multiple causes per death (Saudi citizen-Yes)

Age group	Deaths		Number of multiple causes		Average no. of multiple causes per death	
	Male	Female	Male	Female	Male	Female
0 – 9	161	148	766	715	4.8	4.8
10-19	35	27	201	161	5.7	6.0
20 – 29	42	30	215	192	5.1	6.4
30 – 39	38	38	200	234	5.3	6.2
40 – 49	59	43	374	248	6.3	5.8
50 – 59	89	57	664	391	7.5	6.9
60 – 69	127	97	882	741	6.9	7.6
70 – 79	132	91	999	635	7.6	7.0
80+	87	90	665	637	7.6	7.1
Total	770	621	4966	3954	6.4	6.4

Table 10
Sex and age breakdown of deaths, number of multiple causes and the average number of multiple causes per death (Saudi citizen-No)

Age group	Deaths		Number of multiple causes		Average no. of multiple causes per death	
	Male	Female	Male	Female	Male	Female
0 – 9	65	82	313	401	4.8	4.9
10-19	13	8	66	42	5.1	5.3
20 – 29	28	5	137	38	4.9	7.6
30 – 39	61	15	278	82	4.6	5.5
40 – 49	89	19	501	104	5.6	5.5
50 – 59	70	23	434	138	6.2	6.0
60 – 69	64	23	445	183	7.0	8.0
70 - 79	28	18	193	146	6.9	8.1
80+	12	15	90	108	7.5	7.2
Total	430	208	2457	1242	5.7	6.0