

Analysis of the Underlying and Multiple Causes of Death for the Kuwaiti Population 40 years and over in Kuwait; Part I: Demographics

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Abstract: Background: Improved health care brought about major changes in mortality pattern; life expectancy has increased and the causes of death are more likely to result from chronic diseases, death rarely result from a single cause and the use of the underlying cause of death (UCD) will overlook many of the contributing diseases that are highlighted by multiple cause of death (MCD) analysis. **Objective:** The paper addresses the demographic and non-clinical variables related to the number of causes recorded in the death certificates notification (DCN). **Methods:** All the DCN for the Kuwaiti population, 40 years or over for the period 1993-2001 were compiled and all the causes up to five additional causes were recorded. A total of 13960 cases (7966 males and 5994 females), reported in the period 1993-2001, were analyzed. The causes of death were provided according to the WHO ICD9. **Results:** A single cause (UCD) was reported in 5.6% of the cases, 27.1% had 3 causes and 12.5% had 6 causes. The mean number of causes amounted to 3.64 and 3.8 for the males and females. Variability according to the year was not marked. Those dying in the hospitals had a relatively higher mean number of causes compared to those dying in other places, and this was common to the 2 gender groups. A rising trend was seen with age; with the males the 60-, 70- or 80+ age groups had higher mean number of causes compared to the younger groups. With females the means for the 60- and 70- groups were relatively higher than the other groups, the group 40+ was having lower means compared to the other groups and this was common to the 2 gender groups, particularly with the males. **Conclusion:** The UCD alone was reported for less than 7% of the causes of death among the Kuwaiti population 40 years or over. Use of multiple cause of death will add a lot of useful information that can be used to highlight several disease conditions not shown by the UCD.

Key words: Kuwait; UCD; MCD; Death Notification.

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INTRODUCTION

The socioeconomic development of industrialized countries in the 20th century has brought about a change in the pattern of mortality; first, life expectancy at birth has increased, and second, the major causes of death are currently chronic and long-term diseases with which normally co-exist other diseases.⁽¹⁾ Death rarely results from a single cause and it can be caused by a variety of factors.⁽²⁾ Causes of death are defined as all the diseases, morbid conditions or injuries, which either resulted in or contributed to death. The underlying cause of death (UCD) is defined as the disease or injury, which initiated the train of events leading eventually to death.⁽³⁾ By convention UCD is selected as the one that initiated the death process.⁽⁴⁾ The multiple causes of death (MCD) are defined as all causes of death mentioned on the death certificate.⁽⁵⁾

This model of selection of the UCD presents certain limitations, the major one being that of the arbitrariness of selection of the underlying cause of death if more than

one sequence of logical causes exists.⁽³⁾ Analysis based on UCD is useful and relatively simple to tabulate and interpret. It remains the primary tool for many researchers and is adequate for examining many conditions, however, it provides a limited picture of mortality and health of the population.⁽⁵⁾ Various authors began to point out that deaths due to chronic diseases were inadequately described by the single UCD statistics, consequently, increasing the difficulties of the epidemiologist. In addition, death certificates include a greater quantity of information, which, as a consequence of the selection of only one cause, is lost, thus, wasting much valuable information provided by the death certificates.⁽⁶⁾

Israel et al.⁽⁷⁾ gave a sort of rallying call for researchers to consider the analytical potential of multiple causes of death. The Australian Bureau of Statistics points out that using multiple cause of death allows researchers to comprehensively understand and track deaths due to other diseases which do not often appear as the underlying cause

of death; it provides better documentation on multi-morbid associations and the strength of the association between conditions which led to death,⁽⁵⁾ MCD, by considering all diagnosis mentioned in the death certificate, highlights conditions that are underestimated by the UCD, that has traditionally been used in mortality statistics.⁽⁹⁾ Certain chronic diseases often increase the risk of other associated long term conditions.⁽¹⁰⁾

Today, statistical support provides epidemiologists with the possibility of completing these statistics by additionally counting all the causes which appear in the death certificate (multiple coding). The coding of multiple causes of death adds information about interaction of diseases, number of deaths in which a disease acts as a contributory factor, nature of the lesions in deaths from external causes, and validity of the mortality statistics.⁽¹⁾ MCD can rectify inconsistency of UCD. Bah⁽¹¹⁾ used a MCD approach to rectify inconsistency between 2 sets of data about maternal mortality in South Africa. MCD can assist in identifying

problems with the process of recording and coding cause of death.⁽¹²⁾ MCD analysis was also used to look at trends in certain diseases.⁽¹³⁾ Mannino *et al.*⁽¹⁴⁾ noted that death certificates rarely record tobacco use disorder (ICD9 305.1) on certificates which list lung cancer despite the established link. It should be taken into account that the data refer to the causes which contribute to the death, and therefore do not necessarily reflect the prevalence of the conditions in the population.

AIM OF THE STUDY: The paper will address the demographic and non clinical variables related to the number of causes recorded in the death certificate notification (DCN) in Kuwait.

MATERIAL AND METHODS:

To provide better insight into the magnitude of the specific causes of death and their contribution to the mortality pattern in a holistic manner, all the DCN for the Kuwaiti population, 40 years or over were compiled and all the causes up to five additional causes were recorded. The DCN

in Kuwait normally show the day, month and year, together with the sex, nationality, age, residence and place of death. A total of 13960 cases (7966 male and 5994 female), which were all those reported in the period 1993-2001, for the nationals 40 years or over were analyzed. The causes of death were provided according to the ICD9. The coding of the cause of death for those who die in the hospitals is done by the attending physician in charge. The physicians are trained by the staff of the Vital and Health Statistic Department at MOH. The coding is done according to WHO rules. Only one cause is mentioned as the UCD. A single person at the Vital and Health Vital Statistics Department is in charge of verifying the DCN and their coding.

Statistical manipulations were done by SPSS version 14 for windows. The ratios were computed as percentages and the differences tested by χ^2 , for continuous variable the means \pm the SD were computed. Significance was tested by the t or F values as appropriate; a $P < 0.05$ was considered

significant.

RESULTS:

The present study summarizes the MCD for the total Kuwaiti population, 40 years or over who died during 1993-2001; the number of causes according to sex is summarized in table (1). Males (7966) amounted to 57.1% and females (5994) accounted for (42.9%). In 5.6% of the sample a single cause was reported, and this was slightly more frequent for males (6.7%) compared to females (4.0%). In 13.6% two causes were reported, 3 causes were reported in 27.1% of the males and 27.0% of the females. A fourth cause was reported in 23.9% of the males and 25.2% of the females. The group having five causes amounted to 16.5% of the males and slightly more with females (17.4%). In a smaller proportion representing 11.6% of the males and 13.7% of the females six causes, that is five causes in addition to the UCD, were recorded on the death certificate.

The effect of the age at death, if any, is also shown for the males and females in table 1. Among males, the youngest mean

age was reported for the group in which 2 causes were reported (66.0 ± 13.1 years), the highest age at death was reported for the group in which 6 causes were entered into the death certificate (70.1 ± 11.6 years). The group for which five causes were reported was the second on the list with a mean age at death of 69.6 ± 12.0 years. The distribution was different from a random distribution. With females, the lowest mean age at death (68.2 ± 12.0) years was reported for the group having 5 entries on the death certificate. The highest mean age was found for the group having a single entry (70.9 ± 17.9 years). The mean for the group having 6 causes (69.96 ± 11.7) was the second highest. It can be concluded that there are more causes for death reported for older patients at their time of death.

The mean number of causes according to the year in the period of the study is summarized in table 2. For males, the over all mean amounted to 3.64 ± 1.39 causes; the lowest was reported for 1996 (3.37 ± 1.32), and the highest mean was seen for 2000.

Higher means were also seen with the years 1994 and 2001. For females the distribution was similar; here the lowest mean was for 1996 and the highest was for 2000. The distribution was significantly different from what is expected from a random distribution; the F ratio was 10.24 and 6.949 for the males and females, respectively. However, the means were quite close; the difference between the lowest and highest means was 0.40 causes for males and 0.46 causes for the females. The distribution was not consistent and no rising or diminishing trend was seen.

The distribution of the number of causes according to the place of death is summarized in table 3. The cases were grouped into those who died in the hospital and those who died in another place, including a primary care facility or abroad. The proportion dying in the hospitals was appreciably higher than that dying elsewhere, and this was consistent with the males (71.0%) and females (75.3%). The distribution differed according to the number

of causes, the groups having a single, 2 or 3 causes were higher in those dying elsewhere, and this was consistent with males and females. Starting with the 4 cause group, the pattern was reversed with the proportion appreciably higher among those dying in the hospitals. The pattern was similar for the 2 gender groups.

The distribution of the number of causes according to the age at death is summarized for the males and females in table 4. With the single or the UCD, the proportion was higher than the group value (6.7% and 4.0% respectively) with the groups 40-, 50- and 80+ years for both males and females. The pattern persisted with the males to include the 2, and 3 causes. A lower proportion was seen with the 2 youngest age groups for males in which the proportions came from 10.7 with a single cause to 5.8% for the group having 6 causes. With females the pattern was similar, however, compared to the males a lower proportion was seen for the 2 youngest age groups which were 10.7% and 9.0% for the males and 7.0 and 5.1% for

females. The highest proportion (27.1 and 27.0%) was seen for the 3 cause group. A clear diminishing trend was seen for the groups having larger number of causes. With the age groups 60 years or older a higher proportion was seen with the groups having 3 or 4 causes and dropped thereafter for males and females. The distribution was preserved for the female starting from the group having 3 and 4 causes of death. The pattern though similar was however more consistent with the males compared to the females.

The mean number of causes reported for each age group is also shown for males and females in the table 4. The overall mean number of causes amounted for males to 3.64 ± 1.39 ; the highest mean was for the 70- age group (3.80 ± 1.35), and the lowest mean was for the 40 years age group (3.18 ± 1.33). The means for the 60, and 70 age groups were significantly higher than that for 40 and 50 groups. As for females, the overall mean (3.80 ± 1.35) was slightly higher than that for the males. The lowest means were those for the 40- and 50 years groups. The mean for

the 40 years was significantly lower than that for the 70- and 60- years age groups.

DISCUSSION:

Policies and programs to combat disease and injuries should be based on current timely information about the nature and extent of health problems, their determinants and how the impact of such diseases is changing with respect to both magnitude and distribution in populations.⁽¹⁵⁾ Despite their limitations mortality statistics are the most readily available sources of information on long term trends for many diseases.⁽¹⁶⁾ Swain *et al.* stressed the importance of proper filling up of the death certificate; especially in the era of increasing reliance on evidence-based medicine.⁽¹⁷⁾

The modal number of causes (3) was the same, and the means (3.64) for males and (3.80) females was identical to that reported for Sanitaria in Spain.⁽¹⁸⁾ The mean number of causes of death per certificate was slightly higher than that reported for Brazil ⁽¹⁹⁾ where the mean number was 2.81 with an overall range from 2.07 to 3.5, for the whole of the

state. Data from Canada (20) are generally in line with the present study, however, a single cause was reported in 18.8% of the total; almost triple the proportion for Kuwait. The modal group was 2 contributing 31.5%, but 3 causes were reported for 26.3%; these would be compared to 13.6 and 27.1% found for Kuwait. The percentage of the 3 cause group was however identical with the 2 studies (26.3 for Canada and 27.1 for Kuwait). The overall means for Canada amounted to 2.68 (20), that for the US was 2.65 (21) both were slightly lower than that for Kuwait.

A different pattern was reported for South Africa (SA), the first African country to publish multiple causes of death and make them available on the net. ⁽⁸⁾ The modal number for 2003 and 2004 was one; that is a single cause⁽²²⁾, the mortality is governed by HIV/AIDS. The UCD amounted to over 60% of the cases. Two causes were reported in around 27%, and 3 causes in 9% of the cases. The modal group in Kuwait was 3 accounting for 27.1 %,

the group 4 causes, the 2nd modal in Kuwait (24.4%) was reported in 2.5% in SA. The distribution for SA for 2003-2004 was not different from that reported for SA in the period 1997-2001; the ratios in SA in the same period were 1.59 for males and 1.68 for females.⁽⁸⁾

The trend of lower reporting of the causes of death seen in the study period in the US⁽¹³⁾ was not seen in the present study. The mean number of multiple causes according to the sex was almost equal or slightly higher with females. This was in line with reports from Canada,⁽²⁰⁾ the higher life expectancy with females in Canada may explain the difference. However, the finding in the present study was somewhat different from that reported by Wall et al.⁽¹³⁾ who found a slightly higher ratio for males, though the difference was quite small (1%). The rising trend with age was similar to the study by Wall et al. though the highest mean was reported for the 70- and 80- years ages groups. The mean number of causes computed according to the age at the time of

death in the present study gave a consistent pattern with steadily rising trend with males. The lowest mean was that found for the group reported to have 1 or 2 causes at death, that mean was significantly lower than any other. Those reported to have 6 causes had a significantly higher mean compared to the group having 3 causes. The data were biased towards chronic diseases, the age selected was 40 years and over, this is in line with the method used by Rezende et al.⁽⁹⁾ though they put the line at 20 years. The pattern of larger number of mentions with older age was generally in line with that reported for Canada.⁽²⁰⁾ This was also seen for the United States⁽⁷⁾ and Spain.⁽¹⁾ Increased reporting of non underlying causes with older age is likely due to the actual differences in the cause of death.

Hospital inpatients, 71.0% for males and 75.3% for females, had the highest probability of reporting multiple cases of death, dying at home or elsewhere was associated with a lower mean number of causes of death and this was common to both the males and

females; the differences between the means were highly significant. The higher mean number of causes of death for those dying in the hospitals is similar to that reported by Wall *et al.*,⁽¹³⁾ possibly due to a better documentation of disease history, and the more familiarity of the certifier with the dead.⁽¹³⁾

The coding in the present study was done manually; computer algorithms has been developed to confirm the UCD according to WHO rules and to eliminate redundant

causes within DCN and are being used by many governments and investigators.^(13,16,20,23-25)

CONCLUSIONS: Although the UCD of death is still essential to analyze historical trends, compare countries and guide the health programs, MCD offer a new insight into the study of mortality. The combination of the 2 methods is more useful than the isolated use of either approach. Further development in Kuwait would require acquiring appropriate software to do the selection of the UCD and MCD.

Table 1: Number of causes of death according to gender (Kuwait 1993-2001)

| No. of Causes | Males | | | | Females | | | | Total | |
|---------------|----------|------|----------|--------|---------|------|----------|-------|-------|------|
| | No. | % | Mean age | SD | No. | % | Mean age | SD | No. | % |
| Underlying | 536 | 6.7 | 66.534 | 15.879 | 242 | 4.0 | 70.89 | 17.88 | 778 | 5.6 |
| Two | 1136 | 14.3 | 66.011 | 13.102 | 758 | 12.6 | 69.06 | 13.2 | 1894 | 13.6 |
| Three | 2157 | 27.1 | 68.134 | 13.411 | 1621 | 27.0 | 69.42 | 13.2 | 3778 | 27.1 |
| Four | 1904 | 23.9 | 68.439 | 12.491 | 1509 | 25.2 | 69.09 | 12.8 | 3413 | 24.4 |
| Five | 1311 | 16.5 | 69.623 | 12.013 | 1040 | 17.4 | 68.23 | 12 | 2351 | 16.8 |
| Six | 922 | 11.6 | 70.113 | 11.573 | 824 | 13.7 | 69.96 | 11.7 | 1746 | 12.5 |
| Total | 7966 | 100 | 68.381 | 12.983 | 5994 | 100 | 69.21 | 12.9 | 13960 | 100 |
| χ^2 | 67.826 | | | | | | | | | |
| F ratio | 15.724** | | | | 2.745* | | | | | |
| F Probability | 0.0000 | | | | 0.0177 | | | | | |

* < 0.05 ** < 0.01

Table 2: The number of causes of death according to the year (Kuwait 1993-2001)

| Year | Male | | | Female | | | Total | | |
|-------|---------|------|------|---------|------|------|----------|------|-------|
| | Mean | SD | No. | Mean | SD | No. | Mean | SD | Total |
| 1993 | 3.62 | 1.36 | 744 | 3.85 | 1.37 | 577 | 3.72 | 1.37 | 1321 |
| 1994 | 3.70 | 1.43 | 773 | 3.90 | 1.41 | 564 | 3.79 | 1.42 | 1337 |
| 1995 | 3.66 | 1.38 | 859 | 3.82 | 1.35 | 613 | 3.73 | 1.37 | 1472 |
| 1996 | 3.37 | 1.32 | 819 | 3.51 | 1.26 | 617 | 3.43 | 1.30 | 1436 |
| 1997 | 3.60 | 1.39 | 855 | 3.78 | 1.33 | 681 | 3.68 | 1.36 | 1536 |
| 1998 | 3.60 | 1.39 | 994 | 3.82 | 1.34 | 736 | 3.67 | 1.37 | 1730 |
| 1999 | 3.54 | 1.43 | 976 | 3.67 | 1.37 | 741 | 3.59 | 1.40 | 1717 |
| 2000 | 3.88 | 1.39 | 1008 | 3.97 | 1.30 | 726 | 3.92 | 1.36 | 1734 |
| 2001 | 3.77 | 1.39 | 938 | 3.90 | 1.37 | 739 | 3.83 | 1.38 | 1677 |
| Total | 3.64 | 1.39 | 7966 | 3.8 | 1.35 | 5994 | 3.68 | 1.37 | 13960 |
| F | 10.24** | | | 6.949** | | | 16.417** | | |

** < 0.01

Table 3: Number of causes of death according to the place of death(Kuwait 1993-2001)

| Number of Causes | Male | | | | Female | | | |
|------------------|----------|------|-------|------|----------|------|-------|------|
| | Hospital | | Other | | Hospital | | Other | |
| | No. | % | No. | % | No. | % | No. | % |
| One | 131 | 2.4 | 405 | 16.3 | 96 | 2.1 | 146 | 10.0 |
| Two | 576 | 10.5 | 560 | 22.6 | 455 | 10.0 | 303 | 20.8 |
| Three | 1338 | 24.4 | 819 | 33.0 | 1090 | 24.0 | 531 | 36.4 |
| Four | 1515 | 27.6 | 389 | 15.7 | 1238 | 27.3 | 271 | 18.6 |
| Five | 1107 | 20.2 | 204 | 8.2 | 897 | 19.8 | 143 | 9.8 |
| Six | 817 | 14.9 | 105 | 4.2 | 758 | 16.7 | 66 | 4.5 |
| Total | 5484 | 71.0 | 2482 | 29.0 | 4534 | 75.3 | 1460 | 24.7 |
| χ^2 | 1132.387 | | | | 548.94 | | | |
| Mean | 3.97 | | 2.896 | | 3.1096 | | 3.804 | |
| SD | 1.3 | | 1.317 | | 1.257 | | 1.351 | |
| F | 1171.879 | | | | 557.308 | | | |

Table 4: Causes of death according to the age and sex (Kuwait 1993-2001)

| | Age | Male | | | | | | Female | | | | | |
|------------------|-----|-----------|------|------|------|------|-------|----------|------|------|------|------|-------|
| | | 40- | 50- | 60- | 70- | 80+ | Total | 40- | 50- | 60- | 70- | 80+ | Total |
| Underlying Cause | No. | 68 | 126 | 149 | 97 | 96 | 536 | 30 | 44 | 50 | 43 | 75 | 242 |
| | % | 10.6 | 9.7 | 6.6 | 4.6 | 5.8 | 6.7 | 7.0 | 5.1 | 3.1 | 2.5 | 5.5 | 4.0 |
| Two | No. | 133 | 219 | 337 | 246 | 201 | 1136 | 57 | 125 | 188 | 217 | 171 | 758 |
| | % | 20.7 | 16.9 | 14.8 | 11.6 | 12.2 | 14.3 | 13.2 | 14.4 | 11.5 | 12.8 | 12.4 | 12.6 |
| Three | No. | 204 | 363 | 560 | 576 | 454 | 2157 | 120 | 238 | 413 | 455 | 395 | 1621 |
| | % | 31.7 | 28.1 | 24.7 | 27.3 | 27.6 | 27.1 | 27.8 | 27.4 | 25.4 | 26.9 | 28.7 | 27.0 |
| Four | No. | 131 | 287 | 562 | 540 | 384 | 1904 | 113 | 220 | 407 | 430 | 339 | 1509 |
| | % | 20.3 | 22.2 | 24.8 | 25.6 | 23.3 | 23.9 | 26.2 | 25.3 | 25.0 | 25.4 | 24.7 | 25.2 |
| Five | No. | 70 | 170 | 405 | 373 | 293 | 1311 | 72 | 143 | 321 | 303 | 201 | 1040 |
| | % | 10.9 | 13.1 | 17.8 | 17.7 | 17.8 | 16.5 | 16.7 | 16.4 | 19.7 | 17.9 | 14.6 | 17.4 |
| Six | No. | 38 | 128 | 257 | 281 | 218 | 922 | 39 | 100 | 250 | 242 | 193 | 824 |
| | % | 5.9 | 9.9 | 11.3 | 13.3 | 13.2 | 11.6 | 9.0 | 11.5 | 15.3 | 14.3 | 14.0 | 13.7 |
| Total | No. | 644 | 1293 | 2270 | 2113 | 1646 | 7966 | 431 | 870 | 1629 | 1690 | 1374 | 5994 |
| | % | 100.0 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| χ^2 | | 166.572** | | | | | | 64.489** | | | | | |
| Mean | | 3.18 | 3.42 | 3.67 | 3.8 | 3.75 | 3.64 | 3.6 | 3.68 | 3.93 | 3.86 | 3.73 | 3.8 |
| SD | | 1.33 | 1.42 | 1.4 | 1.35 | 1.39 | 1.39 | 1.34 | 1.35 | 1.34 | 1.32 | 1.38 | 1.35 |
| F ratio | | 36.282 | | | | | | | | | | | |
| F prob | | 0.0000 | | | | | | | | | | | |

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