Injuries are becoming a major cause of mortality and morbidity in less developed countries. The relative contribution of injuries to disability adjusted life years is expected to rise from 15% in 1990 to 20% in 2020 with the largest increase expected to occur in sub-Saharan Africa. Most studies on the incidence of injuries are based on health facility data. Self reported data obtained through community based surveys play an important part in the study of injury morbidity in less developed countries due to incompleteness and low utilisation of health facilities. However, one major limitation of such studies is recall bias.

A number of studies have investigated the effect of recall period on the estimates of injury rates for non-occupational and occupational injuries. A study in the United States examined the effect of recall in estimating injury rates among children and adolescents with a reference period of 12 months. The largest declines in injury rates were observed for the 0–4 year old children and for minor injuries. Similarly, Mock et al investigated the effect of recall bias on annual injury rates in a household survey in Ghana. They found a remarkable decline in injury rates from a one month recall to a 12 month recall, which was influenced by severity of injury but not by age, gender, and locality. A population based study in Brazil compared retrospective and prospective data collection methods among preschool children. Use of diaries prospectively resulted in five times as many injuries reported than the recall method, particularly for injuries not requiring medical care. In the United States, injury rates for farmers were compared using two months', 12 months', and 10 years' recall. The results showed that a recall period of more than two months was likely to underestimate injury rates. Most of the studies on effect of recall on injury rates have been conducted in developed countries. A review of literature produced only one study from sub-Saharan Africa on time effects in recall of injuries.

In this paper, we investigate the effect of recall on estimates of annual injury rates as an initial step in analysing data from a survey that measured injury morbidity in an urban and a rural location of Tanzania. The effects of recall are also examined for various subpopulations and by severity of injury.

**METHODS**

**Study site**

A community based survey was conducted within the Adult Morbidity and Mortality Project (AMMP) study areas in the United Republic of Tanzania. AMMP is a health and demographic surveillance system operating in six districts of Tanzania. Its aim is to measure rates and causes of morbidity and mortality. Since 1992, the areas are prospectively monitored through repeated censuses to ascertain the population at risk. Deaths are recorded through an active reporting system and cause of death is determined by verbal autopsy. The survey on injuries was conducted in Dar es Salaam city (an urban area) and Hai District (a rural area).

Dar es Salaam city lies on the east coast of Tanzania. The AMMP demographic surveillance population is situated in two of the three municipalities covering three areas: Ilala, Keko, and Mtoni. The three areas contain eight branches including approximately 63 330 persons in 15 269 households living in urban and periurban areas of the city. Hai District lies on the south western slopes of Mount Kilimanjaro in northern Tanzania. The AMMP demographic surveillance area in Hai covers 51 out of 61 villages in the district and around 62% of the total district population (159 906 persons in 40 238 households). Agriculture, livestock keeping, and commercial mining are the main economic activities. Details of the study population have been described elsewhere.

**Sampling procedure and participation rates**

**Urban area**

A cluster sample of 2000 households was drawn from eight branches of the urban area. Information was sought on all
The number of days with restricted activity or disability days to school.

Severity of injury

An injury was included in this study if it had occurred in the past one year and resulted in losing one or more days of ‘normal’ activity—for example, not being able to work or go to school.

Severity of injury

The number of days with restricted activity or disability days was considered as a measure of severity of injury. In this paper, we have used the groups <30 disability days and ≥30 days to represent minor and severe injuries respectively.

Data collection

The survey tool was translated into Swahili (the local language), back translated into English, and pre-tested for comprehension before use in the field. Data collection took place from September to December 2002. Two questionnaires were used in the study. Questionnaire 1 recorded information on whether an individual had an injury during the past one year. A list of injuries (broken bones, cuts or sprains, burns, dental, or other injuries) or injury events (transport accidents, falls, sports activities, snake or other animal bite, electric current, near drowning, struck by object, attempted suicide, or other injuries) was read out to the respondents. The head of household was interviewed to elicit information about the household members. When the head of household was not available, the spouse or any other responsible person was taken as an interviewee.

Questionnaire 2 was used to record information concerning the description of the injury, the circumstances in which the injury occurred, and whether the injury was intended or not. Variables included were month and year, cause of the injury, place of occurrence, length of disability, and health facility use. Efforts were made to interview the injured person if an adult, otherwise we interviewed an informed member of the injured person’s household.

Data analysis

Using the date in which the interview and injury took place, the time interval since the injury occurred was calculated in months. Since only the month and year were reported for the injury, the timing of the injury was assumed to be at the midpoint of the reported month. The calculated recall intervals range from one to 12 months. Injuries reported during the calendar month in which the interview took place were assigned an interval of 0 months. Assuming the interviews and injuries occurred at the midpoint of the month, then the intervals one to 12 cover an average period of one month whereas the interval 0 covers a period of two weeks. The intervals 0 and 1 were combined, resulting in a mean period of 1.5 months.

Going back in time, the estimated injury incidence rates were calculated for each recall month as the number of injuries reported for that recall period divided by the number of person-years. The person-years were calculated successively for more distant recall periods by multiplying the population at risk at each recall interval with a relevant proportion of a year. There were few individuals who had more than one injury episode in the preceding year. In such cases, only the most recent injury was included in the analysis.

Statistical analyses were performed using STATA (version 7, Stata Corporation, College Station, TX, USA). Incidence rates and their 95% confidence intervals were calculated assuming a Poisson sampling distribution. To assess the change in incidence rates by recall period, we used a Poisson regression model. Since the relationship between recall period and the estimated incidence rates was not linear, recall period was included in the model as a categorical variable with four categories: first recall month, second recall month, from three to seven months’ recall, and from eight to 12 months’ recall. Interactions between the effect of recall period and demographic characteristics such as area, education, age, and sex were examined to determine whether change in injury rates with recall period varied between the subpopulations. A separate analysis was carried out taking into account the clustered nature of the data in the analysis. However, the standard errors did not change very much, so we report results that did not include adjustments for clustering.

RESULTS

A total of 509 injuries occurred to 15,223 people during the year preceding the interview. Of these, 62% were to males, 40% to people from the urban area, and 64% were to individuals below 35 years of age.

Overall annual injury incidence was 72.0 per 1000 person-years for a one month recall period and 32.7 person-years using a one year recall period. Table 1 shows that for a one month recall period, the rates were significantly higher in the rural compared to urban area (p<0.001) and twice as high in males as in females (p<0.001). The estimated rates were highest among those aged above 59 years and also highest among those who had primary education only. Figure 1 shows the overall estimated annual injury incidence rates by rural area.
recall period. The largest difference was observed between the first and second recall month, where it dropped from 72 per 1000 person-years to 46 per 1000 person-years respectively.

In our study, there was an increase in recall events as having occurred more recently than they actually did. In surveys, there are two types of memory errors: loss of memory, that is failing to recall and therefore under-reporting events; and telescoping, the tendency to over-report events; and telescoping, the tendency to over-report events; and telescoping, the tendency to over-report events; and telescoping, the tendency to over-report events.

Studies using interviewing techniques to ascertain injuries retrospectively through self or proxy report may be subject to recall bias. In surveys, there are two types of memory errors. Injuries only whereas no consistent decline was seen for severe injuries. This has great implications when estimating the magnitude of non-fatal injuries in a population.

In this study, estimated annual injury rates varied with recall period, with shorter periods giving higher estimated rates than longer periods. This decline was observed for minor injuries only whereas no consistent decline was seen for severe injuries. This has great implications when estimating the magnitude of non-fatal injuries in a population.

Injuries by recall period for minor and severe injuries are shown in fig 1. The decline was seen to be stronger in minor injuries whereas for severe injuries there was no consistent pattern in injury rates for the different recall periods (p<0.001 for differences in rates of decline). For minor injuries resulting in fewer than 30 days of disability or restricted activity, the estimated annual injury rates declined by 81% from a one month to a eight to 12 month recall period. Variations in estimated rates by location for minor and severe injuries are indicated in table 2. The decline of minor injury rates from the one month to the eight to 12 month recall period was 84% and 75% for the rural and urban area respectively (p=0.21).

| Table 1 Annual non-fatal injury rates per 1000 person-years at different recall periods by demographic characteristics |
|-----------------|----------------|----------------|----------------|----------------|
| Variable        | Population     | Rate (95% CI)  | Rate (95% CI)  | Rate (95% CI)  |
| Age (years)     | Total 15223    | 137            | 72.0 (60.5 to 85.1) | 58            | 46.1 (35.0 to 59.7) | 190          | 30.5 (26.3 to 35.2) | 124          | 20.1 (16.7 to 23.9) |
| Setting         |                |                |                |                |                |                |                |                |                |
| Dar es Salaam (urban) | 8188      | 49            | 47.9 (35.4 to 63.3) | 17          | 25.1 (14.6 to 40.1) | 75          | 22.2 (17.5 to 27.9) | 65          | 19.4 (15.0 to 24.8) |
| Hai (rural)     | 7035          | 88            | 100.1 (80.3 to 123.3) | 41          | 70.8 (50.8 to 96.1) | 115         | 40.3 (33.3 to 48.4) | 59          | 20.9 (15.9 to 26.9) |
| Sex             | Male 7379      | 89            | 96.5 (77.5 to 118.8) | 37          | 60.9 (42.9 to 83.9) | 106         | 35.3 (28.9 to 42.7) | 81          | 27.3 (21.7 to 33.9) |
| Female          | 7844          | 48            | 48.9 (36.1 to 64.9) | 21          | 32.3 (20.0 to 49.4) | 84          | 26.1 (20.8 to 32.3) | 43          | 13.4 (9.7 to 18.1) |
| Education       |               |                |                |                |                |                |                |                |                |
| None            | 3546          | 27            | 60.9 (40.2 to 88.6) | 9           | 30.7 (14.0 to 58.3) | 35          | 24.0 (16.8 to 33.4) | 26          | 18.0 (11.8 to 26.4) |
| Primary         | 9674          | 100           | 82.7 (67.3 to 100.6) | 43          | 53.9 (39.0 to 72.6) | 136         | 34.5 (28.9 to 40.8) | 83          | 21.3 (16.9 to 26.4) |
| Secondary+      | 2001          | 10            | 39.9 (19.2 to 73.5) | 6           | 36.2 (13.3 to 78.7) | 19          | 23.1 (13.9 to 36.0) | 15          | 18.4 (10.3 to 30.3) |

DISCUSSION

In this study, estimated annual injury rates varied with recall period, with shorter periods giving higher estimated rates than longer periods. This decline was observed for minor injuries only whereas no consistent decline was seen for severe injuries. This has great implications when estimating the magnitude of non-fatal injuries in a population.

Studies using interviewing techniques to ascertain injuries retrospectively through self or proxy report may be subject to recall bias. In surveys, there are two types of memory errors: loss of memory, that is failing to recall and therefore under-reporting events; and telescoping, the tendency to recall events as having occurred more recently than they actually did. In our study, there was an increase in estimated rates in the 12th month of recall in comparison with the 10th or 11th month of recall. Possibly events that happened more than a year ago were being reported as occurring a year ago. However, the interviewers noted that the list of injuries and injury events was effective in aiding recall. Severe injuries will be under-represented in the first recall period, since reporting of injuries with disability duration of more than 30 days will be incomplete. This may explain the dip observed in the severe injury rate in the first recall period.

It is clear that sensitive events such as domestic violence, rape, or attempted suicide would be under-reported in such a study because of social stigma or fear of criminal implications. In many instances, an individual would be reporting for the other members of the household. There is a possibility
that the respondent would not be aware of all the injury incidents for the other members or would not report them accurately. In our study, information on type of respondent was not recorded from the whole study sample and therefore we could not assess the extent of memory decay by type of respondent.

Despite the limitations, our study still sheds some light on recall patterns of non-fatal injuries in a developing country. The overall estimated injury incidence was 72 and 32.7 per 1000 person-years for a one month and a 12 month recall period respectively, representing a decline of 55%, with the largest decrease being between the first and second month. Our findings differ from those reported from Ghana, where the rate of decline was 72%. However, it is not quite clear how the problem with injuries in the first recall month was handled in the study in Ghana. The 55% decline from our study is slightly higher than the 40% decline reported from the United States. As Mock and colleagues indicated, it might be assumed that there was greater memory decay in the African data due to a lower level of formal education. However, we found a similar decline in estimated annual injury rates among those with and without formal education.

Comparisons with other studies are difficult due to differences in injury definition and classification of injury severity. The overall estimated injury incidence was 72 and 32.7 per 1000 person-years for a one month and a 12 month recall period respectively, representing a decline of 55%, with the largest decrease being between the first and second month. Our findings differ from those reported from Ghana, where the rate of decline was 72%. However, it is not quite clear how the problem with injuries in the first recall month was handled in the study in Ghana. The 55% decline from our study is slightly higher than the 40% decline reported from the United States. As Mock and colleagues indicated, it might be assumed that there was greater memory decay in the African data due to a lower level of formal education. However, we found a similar decline in estimated annual injury rates among those with and without formal education.

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