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United Nations Expert Group Meeting on Mortality Crises: Conflicts, Violence, Famine, Natural Disasters and the Growing Burden of Non-communicable Diseases

New York, 14-15 November 2011

Report of the Meeting

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Department of Economic and Social Affairs
Population Division

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DESA

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Note

PREFACE

The Population Division of the Department of Economic and Social Affairs (DESA) of the United Nations Secretariat is charged with estimating levels and trends of mortality for all the countries of the world. In producing its mortality estimates, the Population Division relies on empirical data and on models to fit the mortality data for countries with deficient or incomplete information. Models are also important for the preparation of projections of future mortality. Yet, as of the date of this report, none of the models used had taken into account the effect of unexpected crises that change mortality levels and patterns in significant ways, partly because the empirical information on the effects of those crises was generally weak. One exception relates to the effects of the ongoing HIV/AIDS pandemic. However, less attention has been accorded to the modelling of the effects of other crises, including those caused by endemic violence or outright conflict, different types of natural disasters and epidemics of shorter duration. Yet all such events can lead to major, even if temporary, deviations in the trend of mortality decline that is considered typical of the demographic transition.

On 14-15 November 2011, the Population Division convened an Expert Group Meeting (EGM) to address issues associated with mortality estimation and projection in contexts affected by different types of mortality crises, such as conflicts, violence, famine, natural disasters and the growing burden of non-communicable diseases. The main objective of this EGM was to review the state of the art in regard to evidence and understanding of crises that cause significant rises in mortality levels and to initiate a discussion on how current knowledge on this issue can inform the preparation of the United Nations mortality estimates. The EGM also considered trends in mortality from non-communicable diseases with the objective of informing assumptions about future mortality trends. Therefore, several experts gathered at the Headquarters of the United Nations Secretariat in New York to share their experience in estimating mortality in crisis contexts and to advise the Population Division on strategies to model the impact of crises on past and future mortality levels and trends. The issues and recommendations discussed during the meeting are reflected in this report.

This report as well as other population information can be accessed via the Internet on the official website of the Population Division, www.unpopulation.org. For further information concerning this publication, please contact the Director of the Population Division, Department of Economic and Social Affairs, United Nations, New York, NY 10017, USA; telephone number +1 212-963-3179; fax number +1 212-963-2147.

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Explanatory Notes

The following acronyms are used in the report:

BMI	Body Mass Index
CIESIN	Center for International Earth Science Information Network
CRA	Comparative Risk Assessment
CRED	Centre for Research on the Epidemiology of Disasters
DESA	Department of Economic and Social Affairs
DHS	Demographic and Health Surveys
EGM	Expert Group Meeting
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GIS	Geographic Information Systems
ICD	International Classification of Diseases
ICTY	International Criminal Tribunal for the former Yugoslavia
IHME	Institute for Health Metrics and Evaluation
IRC	International Rescue Committee
MHAS	Mexican Health and Ageing Survey
MICS	Multiple Indicator Cluster Surveys
NCD	Non-communicable Diseases
NGO	Non-Governmental Organization
SABE	Salud Bienestar y Envejecimiento
UNICEF	United Nations Children's Fund
UNFPA	United Nations Population Fund
UNPD	United Nations Population Division
WHO	World Health Organization
WHS	World Health Surveys

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UNITED NATIONS EXPERT GROUP MEETING ON MORTALITY CRISES: CONFLICTS, VIOLENCE, FAMINE, NATURAL DISASTERS AND THE GROWING BURDEN OF NON-COMMUNICABLE DISEASES

A. OPENING OF THE MEETING

Ms. Hania Zlotnik, Director of the Population Division, welcomed participants and outlined the two main priorities of the Population Division in convening the Expert Group Meeting (EGM). First, the Division aimed to gather insights into improving mortality estimates for countries that had experienced crises associated with conflicts, violence, famine and natural disasters. Second, the Division hoped that the experts would provide guidance into the types of mortality variants that could be incorporated into projections to reflect changes in risks associated with non-communicable diseases (NCDs).

With those priorities in mind, Ms. Zlotnik invited participants to: 1) review the state of the art of mortality measurement in crisis contexts; 2) discuss how available evidence could inform the preparations of the United Nations mortality estimates; and 3) consider the implications of trends in NCD risk factors and NCD mortality for future trends longevity.

PART 1: MORTALITY ESTIMATION IN THE CONTEXT OF CONFLICTS, VIOLENCE, FAMINE AND NATURAL DISASTERS

Mr. Francois Pelletier, Chief of the Mortality Section of the Population Division, introduced Part 1 of the meeting, which was to address issues surrounding mortality estimation in the context of conflicts, violence, famine and natural disasters. He asked participants to address six key issues in their presentations: 1) the availability of data for mortality estimation in specific crisis contexts; 2) approaches to translate the impact of localized mortality crisis mortality into country-level mortality estimates; 3) the mortality impact of crises due to causes directly related to the crisis, such as injuries resulting from the conflict or disaster, as well as indirect causes, such as those related to the destruction of infrastructure or the disruption of critical services, including water, sanitation, health care and the production and distribution of food; 4) good practices for assessing an appropriate "background or baseline" level of mortality for populations affected by crisis; 5) distinctions between mortality estimation in acute versus prolonged crisis contexts; and 6) the age- and sex-patterns of crisis mortality. Mr. Pelletier stressed the importance of developing age- and sex-patterns for the different types of crisis as a way to provide more consistent and reasonable mortality estimates for countries that lack data enabling such an assessment.

B. MORTALITY ESTIMATION IN THE CONTEXT OF CONFLICTS AND VIOLENCE

A series of six presentations addressed mortality estimation in the context of conflicts and violence. First, Mr. Gregg Greenough of the Harvard School of Public Health delivered a presentation on the various challenges to collecting reliable data for mortality estimation among populations experiencing conflict. He began by defining the two metrics most commonly used in the estimation of crisis mortality: the crude mortality rate, defined as the total number of deaths divided by the total population, and the under-5 mortality rate, defined here as the total number of deaths to children under five years of age divided by the population of children under five years of age (which differs from the probability of dying between birth and exact age five, *5q0*). Mr. Greenough noted that several factors common to conflict-affected contexts complicated the estimation of mortality rates, including the breakdown of death registration systems, disincentives among Governments to accurately report mortality, and a lack of

recent censuses from which to estimate the baseline population. In addition, conflict settings were often affected by migration patterns that could introduce bias to mortality estimates.

Mr. Greenough reviewed the weaknesses associated with several epidemiological approaches to assessing mortality in crisis contexts. Prospective mortality surveillance was often disrupted during conflict, was not representative and was limited in its utility for calculating death rates because the method did not establish a population denominator. Retrospective mortality surveys were costly in terms of time and money, subject to recall bias, often suffered from sampling errors, and yielded limited validity with respect to causes of death. The community-based exhaustive method involved taking a network sample to identify all deaths in a population and while the method had been validated against capture-recapture methods, it was found to count only around 65 per cent of conflict-related deaths, and had not yet been tested in highly insecure environments.

Mr. Greenough stressed that it was increasingly important to place conflict mortality estimates in context, for example by assessing the causes of death arising in conflict settings. Verbal autopsy was used to investigate cause of death, but obtaining a valid classification with direct and indirect causes of deaths related to the conflict was hampered by a lack of standard definitions. Mr. Greenough closed by noting that establishing conflict mortality estimates with uncertainty bounds surrounding them remained a challenge, and that adequately conveying those concepts to policymakers could be difficult.

The second presentation to address mortality estimation in conflicts was given by Mr. Les Roberts of Columbia University who reviewed the strengths and weaknesses of multiple sources of data available to estimate mortality due to the conflict in Iraq. Advantages associated with some of the household surveys included good sampling frames, large sample sizes, and the participation of medical doctors in the review of death certificates. However, it had been difficult to achieve population representative samples in violent settings, and some surveys had been criticized for their lack of stratification and use of cluster sampling designs. The mortality estimates of some household surveys had proved unreliable through follow-up surveys. Survey estimates of the number of violent deaths occurring in Iraq over the period from March 2003 through April 2004 ranged from around 36,000 to 60,000. Estimates of the number of violent deaths from the first 18 months of the conflict ranged from 60,000 to close to 130,000.

Mr. Roberts also reviewed other sources of data on conflict-related mortality in Iraq that relied on case finding methods. The NGO Coordination Committee recorded 30,000 violent deaths by 2004. Iraq Body Count, the longest-running case finding source, counted between 104,000 and 113,000 violent deaths up through 2011. A third source, the Wikileaks Iraq War Logs, had counted 66,000 violent civilian deaths between 2004 and October 2010.

Mr. Roberts concluded by noting that there was little disagreement between the data sources with respect to non-violent deaths: the central estimates fell within the confidence intervals of the other surveys, indicating at least 400,000 excess deaths by mid-year 2006. However, large differences in estimates were noted in the numbers of violent deaths depending upon the source cited.

The third presentation on mortality estimation in conflict contexts was delivered by Mr. Andrew Mack of Simon Fraser University. He began by noting the growing interest among the international community in measuring indirect conflict-related deaths in addition to deaths associated with combat. He then presented two of the main challenges for measuring direct and indirect mortality due to the conflict in the Democratic Republic of the Congo: 1) obtaining an accurate assessment of under-five mortality during the conflict years; and 2) identifying an appropriate baseline or background level of mortality.

Mr. Mack highlighted the discrepancies between child mortality levels estimated through International Rescue Committee (IRC) surveys and those from Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) during the conflict in the Democratic Republic of the Congo. While the IRC estimates suggested a sharp increase in the rate of under-five mortality during the conflict period, estimates obtained from DHS and MICS were relatively flat. Mr. Mack suggested that overall child mortality levels may have been less affected by the conflict in the Democratic Republic of the Congo compared to other conflict settings because of protective effects of public health interventions that had taken place during peacetime, such as measles vaccination.

Mr. Mack also stressed the difficulty of identifying an appropriate baseline mortality rate to represent the counterfactual level of mortality that would have occurred in the absence of conflict. He showed that increasing the baseline mortality estimate from 1.5 deaths per 1,000 persons per month to 2.0 deaths per 1,000 persons per month had a substantial impact on the estimation of excess mortality in the Democratic Republic of the Congo. He suggested that since it was not possible to know the baseline level of mortality with certainty, attempts to measure excess deaths were flawed. As an alternative to presenting excess deaths estimates, Mr. Mack advocated comparing the conflict mortality rates to an average death rate in the region or to the death rate threshold that classified an emergency situation.

Mr. Jon Pedersen of FAFO then led participants in a discussion of the challenges to mortality estimation in conflict settings. He agreed with the presenters that achieving a representative sample was difficult. Mr. Pederson expressed that, in general, conflict mortality surveys were hindered by small sample sizes and selection biases. He suggested adaptive cluster sampling, whereby a neighbouring cluster was visited if high mortality was detected in a given cluster, as a promising way forward.

Mr. Pedersen urged analysts to make use of all the available data, such as the age distribution of a population, in assessing the potential impact of crises. He observed that since the Democratic Republic of the Congo seemed to have a relatively smooth age-sex distribution of the population compared to a country like Eritrea, which had many distortions, the idea that the age groups were evenly affected by changes in mortality during the crisis was plausible. Exploring alternative time frames for mortality estimates from surveys had also been helpful for crisis mortality estimation in acute crisis contexts: re-estimating DHS under-five mortality rates for 1-year periods revealed the mortality impact of the genocide in Rwanda that had been disguised when estimates were produced for the 5-year period.

The ensuing discussion addressed several concerns that participants had with the conflict mortality estimates presented for Iraq and the Democratic Republic of the Congo, including those pertaining to sampling bias and the quality of supervision of interviewers in the field. Participants noted the extreme difficulty of carrying out household surveys in violent and unstable environments and recognized the hard work of those who undertook data collection in crisis contexts. Through the discussion, it became clear that the various institutions represented among the participants of the meeting used the conflict mortality data for different purposes. For its part, UNPD sought to obtain mortality estimates by age and sex in crisis contexts so that the excess deaths could be accounted for in historical population estimates, yielding a time series of the age- and sex- distribution of the population that was internally consistent. This process required careful review of all sources of data, with adjustments as necessary and appropriate. Other institutions were using the data to enact a timely and appropriate humanitarian response during acute crises: a process that necessitated rapid data collection and immediate analysis and dissemination of survey results.

In a final point of discussion, participants noted some inconsistencies in the definition of under-5 mortality—whereby some investigators employed the crude rate as defined by Mr. Greenough while others favoured the life table value *5q0*— that impeded comparisons of estimates across sources.

The next two presentations reviewed the approaches taken by the presenters to estimate conflict mortality in two specific contexts: Bosnia and Herzegovina and Cambodia. Mr. Helge Brunborg of Statistics Norway presented work that he had conducted during his tenure with the International Criminal Tribunal for the former Yugoslavia (ICTY) for the purposes of prosecuting the persons responsible for killings and other war crimes that occurred during the siege of Sarajevo from 1992 to 1995 and the fall of Srebrenica in 1995.

Mr. Brunborg explained that the approach to measuring conflict mortality entailed amassing data on victims, including those registered as dead or missing, those buried or exhumed, and those displaced from their homes or living outside the country as refugees. Information on the pre-war population obtained from the 1991 population census was compared to information on the post-war population of survivors acquired from voter registries and lists of displaced and refugee populations. Lists of victims were assembled to include the victim's full name, sex, father's name, date and place of birth, personal identification number, place of residence and ethnicity, as well as information on the circumstances surrounding the death, including the type of event and the date and place of the event. Great care was taken in matching records across data sources to ensure that reported victims actually existed prior to the war and to verify that reported victims were not alive after the war.

Mr. Brunborg reported that estimates of conflict-related mortality during the fall of Srebrenica indicated that victims were mostly males of military ages. A total of 7,427 males and 48 females were reported as missing following the incident. DNA testing on exhumed bodies was continuing over time and by April 2009 5,274 of the missing had been confirmed dead. Record matching analysis of mortality for Bosnia and Herzegovina over the period 1992 to 1995 yielded estimates of 103,000 dead, of which about 46 per cent were military deaths. Mr. Brunborg closed by emphasizing that data availability through the Bosnia and Herzegovina conflict was good relative to many other conflict contexts, but that because data were assembled as evidence in court proceedings, the estimates of deaths were necessarily conservative.

Mr. Patrick Heuveline of the University of California, Los Angeles, shared his work estimating mortality that occurred during the fall of Phnom Penh and the duration of the Khmer Rouge regime from 1975-1979 in Cambodia. Mr. Heuveline identified three broad causes of excess mortality during that period: 1) homicide and war violence; 2) infectious diseases; and 3) famine and exhaustion related to forced labour. At the time Mr. Heuveline began his study of mortality in Cambodia, other estimates had placed the death toll between 740,000 and 3 million. Not wanting to merely add another number to the pool of estimates, Mr. Heuveline said he aimed to comment on a plausible range of mortality for the period.

Mr. Heuveline explained that data from survivors' interviews, DHS from the 1990's, and satellite imagery of mass graves were analysed to arrive at estimates of mortality related to the conflict. Among males, the highest death rates were estimated among those aged 10 to 19 years. Both males and females above age 50 also experienced high death rates, which, according to Mr. Heuveline, presumably reflected excess mortality among those affiliated with the earlier regime and therefore targeted by the Khmer Rouge.

Mr. Heuveline used an age pattern of death due to each of the three cause groups, together with a model of the typical age-pattern of mortality in order to estimate the number of deaths that occurred during the period. Mortality rates due to violence were highest among adults 20 to 60 years of age, while persons aged 0 to 20 years or 60 years or over experienced lower mortality rates. For famine and infectious diseases, the mortality curve followed a j-shape, with mortality rates among those 0 to 10 years of age higher than among those 10 to 50 years of age, while the highest famine mortality rates were estimated to occur among those 50 years and over. Mr. Heuveline explained that while uncertainty

estimates in his past analysis had been obtained using low, medium, and high projection variants, his present work was exploring the use of Monte Carlo simulations to get alternative estimates of uncertainty.

Shifting the focus of the meeting from acute crisis contexts to endemic violence, Mr. Roberto Briceño-León of the Woodrow Wilson International Center for Scholars made a presentation on the impact of low-intensity violence on levels and trends of mortality in Latin America and the Caribbean. He began by noting that worldwide more people were killed each year by interpersonal violence than in wars. On a more local level, Venezuela's streets had experienced a similar number of deaths in January 2008 as had occurred in the Gaza Strip over the same period. Similarly, deaths due to homicide in Mexico in 2010 exceeded the number killed by terrorism in Iraq over the period 2003-2010. Accordingly, Mr. Leon urged that more attention be paid to the demographic impact of endemic low-intensity violence.

Mr. Briceño-León defined low-level violence as interpersonal violent confrontations between individuals or groups that fell below the level of civil war or conflicts related to social uprising, but above the level of ordinary routine violent conflicts that occur among individuals in democratic societies. He explained that one challenge was to identify what level of violence could be considered routine or ordinary. It was not obvious what level of violence could be considered normal, since homicide mortality rates were not correlated with common indicators of development, such as the Human Development Index, the Gini coefficient, or the poverty gap. According to WHO estimates for Latin America and the Caribbean in 2008, crude rates of mortality due to homicide in the region were lowest in Peru, Bolivia, Haiti and Cuba with less than 5 homicide deaths per 100,000 persons, and highest in Guatemala, El Salvador and Jamaica with more than 50 homicide deaths per 100,000 persons.

Mr. Briceño-León proposed a few alternative approaches for selecting a model of mortality due to homicide to serve as a threshold for the identification of populations affected by low-level violence. He said that models based on patterns of mortality due to violence in selected reference countries such as Chile or Uruguay facilitated discussion on the impact of low-level violence in the context of social development. Alternative models that utilized a regional average level of violence-related mortality as the reference point were deemed more useful for comparing the impact of low-level violence across countries. Mr. Briceño-León noted that it was important to look at sex-disaggregated estimates of mortality due to violence, since there were large differences between countries in the homicide rates' gender-gap. For example, in Cuba males were three times more likely than females to have been killed by homicide, while in Venezuela the male homicide rate exceeded the female homicide rate by a factor of 19.

In terms of data quality, Mr. Briceño-León noted that persistent problems in data reliability and comparability impeded the measurement and assessment of low-level violence in Latin America and the Caribbean. There were three main sources of information on homicides in the region: national police, health authorities, and non-governmental organizations. In some countries, like Mexico, estimates obtained from police were similar to those provided by health authorities, but in other countries such as Colombia, Guatemala and El Salvador, important differences were observed between the two sources. Mr. Briceño-León explained that deaths due to homicide were often incorrectly classified as due to "other external sources", a catch-all code for ill-defined or undetermined causes of death in the International Classification of Diseases (ICD). Mr. Briceño-León advocated for an international effort to improve and standardize the measurement of mortality due to violence.

During the discussion, participants shared their perspectives on the estimation of violent deaths, noting that forensic investigation concluded that a death was due to homicide often only well after the death certificate was filed and that adequate mechanisms were not in place to ensure that the official causes of death were updated in vital registration systems. Participants also noted the various external

pressures on police and doctors to avoid classifying deaths as homicides or suicides, the extent of which likely varied across countries.

C. Mortality estimation in the context of Famine and Natural Disasters

In the second substantive session of the meeting, participants considered mortality estimation in the context of famine and natural disasters. Mr. Tim Dyson of the London School of Economics opened the session with a presentation on famine mortality. He noted that a number of challenges faced demographers trying to estimate famine mortality. For instance, competing political interests had the potential to either downplay or exaggerate mortality in contexts affected by famine, thus it could be difficult to obtain reliable data. In addition, vital registration systems, where they existed, could be compromised during periods of crisis and often the only source of mortality data available came from small surveys that were unlikely to be representative of the affected population. Furthermore, migration, especially movement out of the affected area, complicated the estimation of famine mortality. In light of the many limitations on the quality of the evidence available to assess famine, Mr. Dyson described the approaches taken to measure famine mortality as *bricolage*.

Mr. Dyson said that some of the best data on demographic trends during famine came from the Greek island of Syros, which had good vital registration and no migration before and during its crisis period in the 1940s. The data, analysed by Violetta Hionidou, showed a sharp increase in mortality and a decline in the rate of conceptions during the 1941 famine as well as a sharp decline in conceptions but no simultaneous spike in mortality during what could possibly have been a second famine in 1944. Mr. Dyson explained that in some cases overall mortality did not increase with famine, such as when famine was the result of a drought that also suppressed the transmission of malaria or when humanitarian intervention prevented mortality. In light of this observation, he recommended that fertility reduction receive greater attention in the detection of historical famines and estimation of their demographic impact. From a demographic perspective, Mr. Dyson noted that as famine mortality prevention efforts improved, the fertility impact of future famines could become more important than the mortality impact.

Mr. Dyson identified the question of the counterfactual level of mortality as an additional challenge for estimating mortality due to famine. Post-famine mortality rates were often used, but their utility was hindered by changes in the age structure of the population mainly due to selection effects. Also, estimates of famine mortality were sometimes biased by a failure to account for changes in fertility. An analysis using published data derived for West Bengal conducted by Amartya Sen had assessed mortality during the 1943-44 famine against two alternative baselines and showed a long tail of excess deaths following the famine. However, when Mr. Dyson re-estimated mortality due to that famine using data for the whole of Bengal, no evidence of a long tail was found.

Mr. Dyson described the evidence on sex differences in famine mortality. Most evidence indicated that male mortality increased more than female mortality, especially among adults, which may have been attributable to biological vulnerabilities of males due to lower body fat percentages. Exceptions to this pattern, however, were observed in China and India where female infant mortality increased more than male infant mortality during periods of famine. In closing, Mr. Dyson said that in light of climate change projections, famines could likely not be consigned to the past.

The ensuing discussion addressed the link between food availability and famine. Mr. Dyson questioned an argument that had previously been put forth in the literature by Amartya Sen that three of five large famines in the twentieth century were not associated with a decline in the availability of food, but rather stemmed from a failure to deliver food to those who needed it. Mr. Dyson cited the work of

Mark Tauger and others which he said provided strong evidence that food availability decline played an important role in all five famines addressed in Sen's research.

Turning the focus of the meeting to natural disasters, Ms. Shannon Doocy of Johns Hopkins University described for participants the results of her research into mortality patterns during the 2004 tsunami in the Indian Ocean. She began with an overview of tsunami events between 1900 and 2009, noting that these crises caused relatively few deaths, with a median of 50 deaths per event. The 2004 Indian Ocean tsunami, which caused approximately 227,500 deaths, accounted for 89 per cent of all reported tsunami mortality between 1900 and 2009. Populations residing in the Western Pacific, Southeast Asia and the Americas were most at risk for tsunamis, and low- and lower-middle income countries were more likely to report high mortality from tsunamis compared to high-income countries.

Ms. Doocy explained that the original aim of the 2004 Indian Ocean Tsunami Study was to provide information on the population displaced by the tsunami in Aceh, Indonesia. It consisted of surveys among displaced populations between February and August 2005 conducted in conjunction with Mercy Corps, a non-profit organization that was providing humanitarian assistance. Ms. Doocy noted that because the surveys had been done in an acute crisis setting they had received less scrutiny than the conflict mortality studies discussed earlier. Survey results indicated higher mortality among females, perhaps because women were not taught to swim, and among the youngest children and older adults. Sex differences in mortality were smallest among children and older adults.

Ms. Doocy then described a second approach to assessing the impact of the tsunami that incorporated a geographic information systems (GIS) framework for evaluating public health data. Baseline population estimates from the Center of International Earth Science Information Network (CIESIN) that used satellite imagery of night-time lights and road infrastructure to develop proxy measures of urbanization and population density were overlaid with a GIS vulnerability model, which used slope, aspect (orientation of the land with respect to the wave) and elevation to estimate risk associated with a given location. When evaluated together, these two sources provided an estimate of the population at risk.

In the case of disasters like tsunamis, mortality was likely to affect entire households who would then be omitted from household survey results based merely on the reporting of survivors. To assess the impact of survivor bias within their own survey, Ms. Doocy and her team interviewed village heads as key informants to arrive at village level survival rates which could then be compared to individual survival rates. Adjustment for survivor bias increased the mortality rate from 14 per cent to 24 per cent. In Aceh Jaya, the area most heavily affected by the tsunami, the adjustment increased the estimated mortality rate from 24 per cent to 44 per cent. Ms. Doocy closed with the caveat that the surveys were limited in that they collected data only among the displaced population, thereby missing deaths that occurred to households that were not displaced. She advised that future surveys consider surveying the non-displaced population as well, although it was unclear whether such efforts would have been cost-effective.

Participants suggested that Ms. Doocy examine the results of a study conducted by Elizabeth Frankenberg and colleagues, that also sought to examine tsunami mortality in Indonesia. That analysis had found that the presence of a prime aged male in the household lowered the death rate of children and prime aged women, whereas there was no protective effect associated with the presence of a prime aged woman.

Continuing with the natural disaster theme, Mr. Greenough delivered a presentation on behalf of Ms. Debarati Guha-Sapir of the Centre for Research on the Epidemiology of Disasters (CRED) on patterns in injuries and mortality caused by earthquakes. Mr. Greenough began his presentation with

some background about CRED, which had been founded in the mid-1970's. CRED's disaster database, called EM-DAT, had been initiated in 1988. He cautioned that in examining time trends in disasters, one should keep in mind that much of the trend reflected improvements in reporting, which increased significantly during the 1980s. Mr. Greenough detailed three criteria for a disaster to be recorded in EM-DAT: 1) 10 or more deaths recorded or more than 100 people affected; 2) the Government declared a state of emergency; or 3) the Government issued a request for international assistance. The disasters were classified into five categories: climatological, hydrological, meteorological, biological and geophysical.

In examining the EM-DAT data on earthquakes, Mr. Greenough observed that the number of deaths per event seemed to have increased for the period 2000-2009 compared to the period 1980-2009, which he hypothesized could have been due to deaths from the 2004 tsunami or because more people were living in vulnerable urban settings. Nearly 65 per cent of the earthquakes recorded over the period 1970-2010 occurred in Asia. Another 18 per cent occurred in the Americas, while Europe, Africa and Oceania each accounted for less than 10 per cent of earthquakes over the period. China had experienced the greatest number of earthquakes (106), followed by Indonesia (87) and Iran (81).

Mr. Greenough then described the most common immediate causes of earthquake mortality as due to head and neck injuries, severe crushing, haemorrhage and drowning. Asphyxia, dehydration and hypovolemia (low body volume) and environmental hazards such as fire also played a role. Participants observed that the level and distribution of mortality due to an earthquake depended on many circumstances surrounding the context and the event itself, such as the day of the week, the time of day and the type of building structures.

Participants noted the difficulty of counting the number of earthquake events since it was unclear how to account for aftershocks. Furthermore, because the database excluded events with no human impact, increases in the numbers of events over time could have been interpreted to reflect, in part, population growth and dispersion. Ms. Doocy mentioned that her research had found decreasing odds of earthquake mortality with time and that higher Gross Domestic Product (GDP) was associated with decreasing odds of medium- and high-mortality earthquake events.

D. The WHO Approach for Assessing Mortality Shocks: Estimating Additional Deaths Caused by Conflicts and Disasters

The final presentation of Part I of the meeting was delivered by Mr. Colin Mathers of the World Health Organization. He detailed the WHO's approach for assessing mortality shocks, including those due to conflicts, famine and natural disasters. Mr. Mathers said the WHO's mortality database amassed estimates of deaths by cause dating back to the 1950s for countries that provided data. Some of these series, which came from vital registration systems, captured mortality due to crises. In Chile, for example, death registration had indicated 2,000 conflict-related deaths in 1973. In Croatia, registration data indicated 5,000 excess deaths during the Balkans War from 1991-92. The civil war in Tajikistan and earthquake and state violence-related deaths in Guatemala were also detectable through vital registration records, although the levels of mortality indicated by these sources was well below that estimated in CRED's EM-DAT database. In general, death registration data for countries that had experienced conflict were incomplete.

Mr. Mathers listed the multiple sources of data WHO relied upon to estimate crisis mortality in the absence of death registration data. Databases of conflict deaths were accessed from Project Ploughshares, the Center for Systemic Peace, the Heidelberg Institute of International Conflict Research, the Stockholm International Peace Research Institute, CRED/EM-DAT, the Correlates of War Project, and the United States Department of Defense Statistical Information Analysis Division. Once an estimate

of conflict-related deaths was obtained by triangulating from the various sources, deaths were allocated by age and sex according to a distribution that drew largely on Eastern European country registration systems and information from selected specific studies.

Mr. Mathers explained that the WHO category of deaths related to injury included all direct injury deaths, a definition that did not always correspond well to the data collected by the various database projects. For example, some databases focused on battlefield deaths only. In terms of ICD coding, a landmine death that occurred 20 years following a conflict would still be counted as a direct injury death related to the conflict. Mr. Mathers described the results of an analysis conducted by Obermeyer and colleagues that estimated that for every battle death recorded by Uppsala there were three deaths estimated due to injury from World Health Survey (WHS) sibling survival histories. Thus an adjustment factor of three was proposed to translate Uppsala battle deaths into an estimate of total conflict mortality. However, a recent and unpublished reanalysis of the WHS data had derived an adjustment factor of 2.21, which was moderately close to the upper bound of the death estimates provided by Uppsala. The WHO had used these scaling factors in producing its estimates for countries that experienced conflicts that were associated with relatively small increases in mortality.

For countries with severe conflicts, the WHO attempted to utilize information of mortality obtained from household surveys when possible. The Iraq Family and Health Survey of 2006-07 was one such survey. It estimated that one third to one half of all violent deaths went unreported. In Afghanistan, the WHO was collaborating with Macro and Johns Hopkins to assess the results of the 2010 Afghanistan Mortality Survey. There was concern about bias given that high-violence clusters in the southern part of the country could not be visited by interviewers. Preliminary results from household deaths and sibling survival histories had given lower levels of mortality than seemed plausible. The injury proportion of reported deaths (around 4 per cent) seemed implausibly low as well.

To estimate mortality due to natural disasters, the WHO relied on the EM-DAT database. Only large disasters considered to be outside of the mortality envelope were taken into account. In the context of the Global Burden of Disease (GBD) project there had been debate about whether to represent the single-year mortality estimates as what actually occurred in a given year, or to show the average experience of a country, thereby smoothing out acute mortality spikes. The WHO had moved toward representing actual deaths in a given year. Mr. Mathers noted that the WHO did not include the impact of epidemics in its estimates of the mortality impact of natural disasters.

Participants cautioned Mr. Mathers that some of the databases he mentioned drew heavily on each other and therefore it would not be appropriate to triangulate between them. It was also noted that Uppsala's estimates could have been considered a lower bound since a death was not counted until the perpetrator had been identified. Participants described Uppsala's process used to allocate deaths to the different sides of war as complex.

Discussion ensued on the different types of data collection efforts participants hoped to see implemented in the future. A suggestion was made for the Security Council to mandate that a population survey be performed following every peace agreement in order to achieve a baseline measure against which to assess future progress and to provide information for addressing the specific development and security challenges faced by fragile states and post-conflict countries. Others expressed concern that surveys requiring long recall periods, such as the DHS, were ill-suited to the estimation of crisis mortality. Participants suggested that given the experience of the United Nations in working in volatile environments and with politically-sensitive information, the organization might have been in a good position to field long interview surveys with short recall periods immediately following a conflict. Mr. Mathers clarified that the WHO was engaged in primary data collection, especially when Governments requested technical assistance.

E. Brainstorming Session on Methodological Issues

Participants engaged in a brainstorming session aimed at defining best practices for a more standardized approach for estimating mortality in crisis-affected populations. Mr. Pedersen, who moderated the discussion, opened the session by sharing his own thoughts about the road ahead. He said that given the limited data available, and because an *ad hoc*, piecemeal approach was still required to obtain crisis mortality estimates, the field remained far from establishing sound guidelines. He expressed his frustration at the continued use of cluster sampling when there was a growing amount of information available with which to improve samples, such as information on the geographic distribution of conflict.

Mr. Pedersen noted that while common patterns in mortality might have been generalisable for certain types of crises, other types needed to be analysed on a case by case basis. In the case of war, some age-sex patterns were predictable: classic war affected mortality mostly among young men, while the effect of civil war expanded somewhat to other population groups as well. In general, conflict mortality seemed to impact males more than females. Common patterns among other types of crises, such as earthquakes or tsunami, were more difficult to ascertain. Also, the impacts of crises such as famine were likely to have been changing over time. Mr. Pedersen also noted the need to take better account of crisis impact on migration and fertility when assessing the mortality impact. He recalled that in mortality estimation for the Democratic Republic of the Congo, migration was disregarded as unimportant, while in Iraq it was recognized as important but with no practical solution for accounting for it in mortality estimation. Mr. Pedersen further invited participants to consider the difficulties involved in defining the affected population and in assessing the large differences across conflicts in the ratios of direct to indirect deaths.

Participants urged the Population Division to engage in developing guidelines for the collection and analysis of mortality data in conflict and post-conflict settings, perhaps in collaboration with the Statistics Division. The World Food Programme was suggested as a potential source of data on population size and distribution in crisis contexts. Participants suggested that technical cooperation for data collection include enhancing vital registration capacities or advising NGOs such as *Médecins Sans Frontières* as to what data collection efforts could be incorporated into their humanitarian response efforts. It was noted that the ultimate responsibility for death registration lay with Governments. Mr. Mathers mentioned an ongoing pilot programme in Kenya using mobile phones to help build data registration where it did not already exist. WHO was collaborating on the project through the Health Metrics Network with funding from the Bill and Melinda Gates Foundation, among others. Following up on the earlier discussion, participants stressed the distinction between UNPD's need for retrospective estimation and the priority of humanitarian organizations for data to inform rapid response.

Participants also offered suggestions for how population projections could incorporate the possibility of crises. Discussion ensued around the trade-off between the impossibility of accurately predicting a given crisis for a country and the risk of over-projecting the populations of regions and the world if there was no accounting for periodic mortality shocks. One option was to have an aggregate projection of crisis mortality for large groups of countries, such as by region or level of development, without assigning the crisis to a particular country. A drawback to this approach would have been that the country-level estimates would not sum to the world total. An additional suggestion was made to incorporate the implications of climate change projections into the population projections.

Some participants presumed that there were relatively few countries for which revisiting historical estimates of crisis mortality would make a difference in the country-level mortality estimates since 1950. They suggested that the Population Division handle these on a case-by-case basis, borrowing information from countries that had experienced similar crisis situations when data were not available.

Participants also urged the Population Division to use caution not to give the impression that crisis mortality was known with certainty.

Participants suggested that modelling mortality from epidemics other than HIV/AIDS would be a useful avenue in the pursuit of crisis mortality estimation. However, it was also noted that low quality of cause-of-death reporting required a number of assumptions to be made. Participants urged the Population Division to make use of a large literature on epidemic modelling to assess whether it was worthwhile to incorporate such information into the historical population estimates.

Mr. Pelletier closed the brainstorming session with two main areas identified for follow-up on the part of the Population Division. First, the Division was to develop models of the age-sex pattern of mortality from excess deaths in various types of crisis contexts. Those models were to be distributed to members of the expert group for comment. Second, the Division was to perform a simulation analysis of crisis mortality for certain countries, employing alternative baseline mortality scenarios.

PART 2: THE GROWING BURDEN OF NON-COMMUNICABLE DISEASES

Part II of the Expert Group Meeting focused on assessing the growing burden of NCDs and its impact on future trends in mortality, especially in the less developed regions. Ms. Cheryl Sawyer introduced the session by conveying the high profile the NCDs had recently been afforded on the global health agenda, especially with the convening in September 2011 of the High-Level Meeting of the General Assembly on the Non-Communicable Diseases. She asked participants to consider whether the transition to NCDs as the predominant cause of mortality would take a different course in the less developed regions than had already been observed in the more developed regions. In particular, participants were invited to address the implications of NCD risk factors, morbidity and mortality for future mortality projections.

F. THE WORLD HEALTH ORGANIZATION'S ESTIMATES

Mr. Mathers gave two presentations to brief participants on the WHO methods for estimating the incidence, prevalence and mortality from NCDs as well as the prevalence and population attributable risk of NCD risk factors at the global, regional and country levels. He reiterated that vital registration with causes of death was the gold standard for measuring NCD mortality. While about 50 per cent of the world's countries had provided the WHO with death registration data, the quality of death certification remained problematic. He blamed, in part, a lack of training among the persons responsible for coding the cause of death, which resulted in both misclassification and the coding of deaths into so-called "garbage codes" when the cause was ill-defined. This problem affected the quality of mortality statistics even in countries with good vital registration coverage. In Poland, for example, as many as 20 per cent of deaths were coded in NCD or injury "garbage codes".

Mr. Mathers described that in order to estimate the number of deaths by cause on a country-level for 2008, the WHO ranked countries that provided vital registration data into three categories based on the quality of their cause of death coding. The top category included 23 countries with complete vital registration and less than 10 per cent of deaths assigned to ill-defined codes. The bottom category included 28 countries with death registration less than 70 per cent complete or with greater than 20 per cent of deaths assigned to ill-defined codes. The remaining 55 countries fell into the middle category. The WHO adjusted vital registration for completeness and used the CODMOD model to distribute deaths by cause.

Mr. Mathers explained that for countries without death registration, alternative approaches were used to estimate mortality by cause. For countries where survey data provided estimates of under-five or adult mortality, the modified logit procedure was used to generate a life table, which served as the mortality envelope, and models were utilized to distribute deaths by cause. For two countries, India and China, sample registration was used to estimate the mortality envelope and distribute deaths by cause. The 2008 update had also incorporated data from the Million Death Study in India and information on cancer deaths for both India and China from Globocan 2002. For countries without cause of death information available through vital registration or surveys, the WHO employed a modelling strategy implemented through the CODMOD software, developed specifically for this purpose to distribute deaths by cause using information about the region and overall level of mortality, among other characteristics of the country. In Africa, estimates of deaths due to NCDs were mostly modelled using CODMOD.

Mr. Mathers informed participants that while the WHO had updated its estimates of deaths by cause for 2008, no accompanying updates had been made to the morbidity estimates. Incidence, prevalence, and time trends in causes of death for the world and 21 regions were being developed through the Global Burden of Disease Project (GBD), which was led by the Institute for Health Metrics and Evaluation with some input from the WHO. The project had commissioned teams of experts to develop estimates of morbidity and mortality due to the various causes. Mr. Mathers pointed out that the quality of the evidence varied by cause. The MONICA studies conducted in the 1980s had provided a good basis for the estimation of ischaemic heart disease, but other causes such as angina and coronary heart disease had not been measured well at the population level. Similarly, the data on morbidity and mortality due to stroke were not very high quality. Obtaining estimates of cancer incidence had been easier since patients generally received a pathology examination at the time of diagnosis. For the previous GBD study that produced morbidity estimates for 2004, WHO had used software entitled DISMOD to model the relationships between incidence, remission, case fatality and mortality.

In a departure from the earlier GBD studies, Mr. Mathers said that the GBD 2010 project would not use natural history models that related deaths by cause to rates of disease incidence and remission, but would instead run covariate models on a large dataset of observed causes of death. Models were to be run for each cause separately and then fit into the overall mortality envelope. Rather than pre-selecting the covariates to include in the models, the new strategy entailed using all possible covariates, selecting the best models based on out-of sample predictive ability, and taking an average of those to obtain the final estimates. Mr. Mathers noted that this process necessitate huge amounts of computing power and presented major challenges in explaining to Member States how estimates were obtained and why they may have changed compared to earlier GBD revisions.

Mr. Mathers closed by sharing some of his work on projecting deaths by cause. Age-specific mortality due to cardiovascular diseases was projected to decline, but population growth and ageing were anticipated to counter this trend such that the annual number of deaths due to cardiovascular diseases would continue to grow. Mr. Mathers noted that projected declines in death rates due to non-communicable diseases were premised on the assumption that developing countries would continue to adopt the public health and medical interventions that had contributed to similar declines in developed countries.

Participants expressed concern about the WHO strategy for presenting its estimates on morbidity and mortality due to NCDs, suggesting that it was not well-aligned with priorities for intervention. They urged greater nuance in the presentation of data, such as by identifying avoidable or preventable mortality. Mr. Mathers called attention to an earlier analysis from the WHO that focused on the notion of preventable mortality, such as mortality associated with tobacco use. He also noted that there was some resistance in global health circles to highlighting the role of ageing in elevating NCD mortality risks at the population level.

Mr. Mathers next turned to describe the WHO procedure for estimating the prevalence and population attributable risk of NCD risk factors at the global, regional and country levels. He said that the WHO comparative risk assessment framework (CRA) began with the GBD estimates for 2000, assessing the risks associated with 26 risk factors. For the 2004 GBD estimates, 28 risk factors were assessed and the results were published in the WHO'S *Global Health Risks* report of 2009. The CRA 2010 was being updated with the GBD 2010 through a number of expert groups led by Majid Ezzati of Imperial College. Mr. Mathers called participants' attention to the metabolic risk factor exposures estimated at the country level for the years 1990-2010, which were already available on the WHO website for the CRA 2010.

The leading risk factors contributing to mortality worldwide were high blood pressure, tobacco use, and high blood glucose. In terms of disability-adjusted life years, a metric that captures both morbidity and mortality, the leading risk factors were childhood underweight, unsafe sex, and alcohol use. Mr. Mathers said that the study had revealed that low fruit and vegetable intake, lack of exercise, alcohol and tobacco use, high body mass index, high cholesterol, high blood glucose, and high blood pressure were together responsible for more than half of deaths due to heart disease. Tobacco use alone was responsible for almost one in eight deaths of adults over age 30. Overweight and obesity was identified as the fifth leading risk factor for mortality, responsible for 7 per cent of deaths globally, including 8 per cent of deaths in high income countries and 7 per cent of deaths in middle income countries. An advantage of the CRA approach was that deaths could be attributable to more than one risk factor, thus the fraction of deaths attributed to a given cause, a metric known as the "population attributable fraction" could sum to more than 100 per cent over the risk factors.

Mr. Mathers explained the population attributable fraction of deaths due to a given risk factor as a function of the current exposure to the risk factor, a counterfactual level of exposure to the risk factor, and the relative risk of disease associated with the exposure. Continuous measures of risk factors such as blood pressure, cholesterol and body mass index were evaluated against the risk of disease. Mr. Mathers described how the choice of an appropriate counterfactual exposure presented a challenge: for some risks, such as tobacco, zero exposure was an obvious counterfactual, but for others such as alcohol, zero exposure may not have represented the lowest risk and for others still, such as cholesterol, zero exposure was not definable. The decision as to whether estimates of relative risks needed to be population-specific also presented a challenge in estimating the population attributable fractions. Mr. Mathers said that evidence increasingly supported that the proportional hazards were similar across different populations so that reliance on meta-analyses for detailed information by age, sex and disease endpoint was considered to be a sound approach and population-specific estimates of relative risks were unnecessary. The meta-analyses drew on over one million subjects in 61 prospective cohorts in Asia, Europe and the United States to estimate age- and sex-specific relative risks of mortality associated with the various risk factors.

Mr. Mathers described how assessments of the population's exposure to the various risk factors provided critical inputs to the CRA. For the 2010 update, estimated trends in four major risk factors had already gone through country consultations and had been adopted as the WHO official numbers. These included: body mass index, systolic blood pressure, total cholesterol, and blood glucose. According to these estimates, body mass index was rising globally, at a faster pace in developed regions compared to developing regions. Systolic blood pressure had been declining in most of the world's regions, with the exception of East Africa where it was increasing. The trend in total cholesterol was declining in high income countries, rising in Asia, and flat in Latin America and the Caribbean. Fasting plasma glucose was estimated to be rising in many regions of the world and diabetes prevalence was rising as well in both developed and developing regions.

Mr. Mathers concluded his presentation with some comments on the utility of incorporating risk factor trends into mortality projections. He shared his impression that tobacco was likely the one risk factor that was worth considering in mortality projections. The quality of the evidence linking the other

risk factors to NCD incidence and mortality was less certain. He noted that total cholesterol was not well linked to mortality and that trends in physical inactivity and the association with disease processes had proven very difficult to assess. He closed by noting that one area of intervention that had seemed promising based on CRA 2010 findings was the evidence showing omega 3 fatty acid consumption as protective against the risk of cardiovascular disease.

G. LINKING NCD RISK FACTORS TO MORTALITY

In the following session, the EGM turned to consider the evidence linking three major risk factors— alcohol consumption, tobacco use, and overweight and obesity—to the risks of mortality associated with NCDs. Mr. David Leon of the London School of Hygiene and Tropical Medicine presented the evidence linking the impact of alcohol use to mortality. He noted that there was substantial variation in alcohol consumption across the world's regions. Residents of Eastern Europe and the Russian Federation consumed the most alcohol, on average, while residents of Northern Africa and the Middle East and Southern Asia consumed the least.

Mr. Leon explained that alcohol-associated deaths could be classified in four ways. First were those deaths classified as alcohol-related via the ICD code recorded on the death certificate as, for example, due to alcoholic liver disease, acute alcohol poisoning, or alcoholic cardiomyopathy. Second were those deaths in which alcohol was implicated as a necessary and sufficient cause of death, as in the subset of road traffic deaths that were attributable to alcohol use. Third were the deaths in which alcohol was established as a risk factor for the disease, such as with tuberculosis or cancer of the oesophagus, but not demonstrable in any individual case. The fourth classification included deaths due to causes that were associated with alcohol, such as ischaemic heart disease, but for which causality had not been established.

Mr. Leon described that since deaths in the latter two of the four classifications could not be definitively identified as due to alcohol use, researchers had measured levels and trends in conditions that were definitively the result of excessive alcohol consumption as a marker of the levels and trend in mortality associated with alcohol overall. The risk of morbidity and mortality associated with liver cirrhosis showed a strong dose-response association with alcohol consumption among both men and women and was often used by researchers as a marker of alcohol-related mortality. The association between alcohol consumption and risk of death due to liver cirrhosis had been demonstrated across Canada's provinces and temporal changes in alcohol consumption were reflected in changes in cirrhosis mortality in Paris during a period of wine rationing from 1942-1948, and in England and Wales following alcohol licensing restrictions during World War I. Mr. Leon also showed that cirrhosis death rates tracked temporal trends in alcohol consumption in Poland and Russia, while the trends seemed less closely correlated in Hungary.

Mr. Leon explained that death from cirrhosis was usually the result of 15 to 20 years of consistent heavy drinking. There was evidence that the risk of cirrhosis fell off immediately upon ceasing drinking. Mr. Leon related the progression toward cirrhosis and death to a treadmill that could be stopped if alcohol consumption stopped, but that would resume upon continued exposure to alcohol.

Liver cirrhosis mortality rates in females were about half those in males in Europe in 2004-2009 and there was fairly strong evidence that mortality rates from liver cirrhosis were correlated with mortality rates from other alcohol-related causes of death, such as alcoholic psychosis, alcoholic cardiomyopathy, and acute alcohol poisoning among males ages 15-44 years. At older ages, however, the correlation between cirrhosis and these other causes was not as strong. Based on this evidence, Mr. Leon

concluded that while cirrhosis was an adequate proxy for alcohol-related mortality, the association was not as tight as between tobacco use and lung cancer.

Mr. Leon continued his presentation with an analysis of the links between alcohol consumption and mortality in Russia. He noted that many decades of political, economic and social change in Russia had been accompanied by stalled improvements, and even some reversal, in levels of life expectancy at birth among men and women. Plotting trends in life expectancy at birth along with trends in the standardized death rate for alcohol poisonings suggested a strong relationship between alcohol use and reduced longevity in Russia. Liver cirrhosis mortality seemed to increase about one year behind mortality due to acute alcohol poisoning. Evidence indicated that circulatory disease mortality closely tracked trends in mortality due to acute alcohol poisoning as well.

Mr. Leon considered the findings for Russia in the context of a growing literature that suggested protective effects of alcohol on the risk of cardiovascular disease incidence and mortality. He noted that at least one study concluded that when occasional heavy drinking occurred among people whose consumption of alcohol was otherwise moderate, the cardioprotective effect of moderate alcohol consumption disappeared. Mr. Leon considered the role of heavy drinking in producing the alcohol-associated mortality trends in Russia. Surveys had revealed a high prevalence of heavy drinking, with excessive or continuous drunkenness reported by more than 10 per cent of men in Izhevsk. There was also a high frequency of consumption of high-proof alcohols. That study concluded that hazardous drinking accounted for 43 per cent of all deaths among men aged 25 to 54 in Izhevsk which, if extrapolated to the whole population of Russia, implied 170 thousand excess male deaths per year.

Mr. Leon concluded with a summary assessment of the state of current knowledge on the links between alcohol and mortality for its implications for future projections of mortality trends. He noted that given the inadequate understanding of the causal link between alcohol use and cardiovascular disease, any projection predicated on such a link would have been subject to a high degree of uncertainty. Even the use of a proxy measure, such as cirrhosis mortality, could have proven misleading given that the association between cirrhosis and other alcohol-related deaths varied according to the style of drinking practiced. Lastly, persistent challenges to obtaining reliable and complete data on alcohol consumption hindered establishing a baseline measure of exposure to alcohol from which to generate projections.

Participants inquired as to why interventions to regulate alcohol use had not been as successful as those aimed at regulating tobacco use. Mr. Leon replied that in some countries, particularly in the case of Russia, a large quantity of alcohol moved through illegal channels and was thus less affected by regulation.

Mr. Samuel Preston of the University of Pennsylvania presented on the impact of tobacco use on mortality. He began with a focus on the results of an analysis conducted for the United States which broke down the dimensions of the association between cigarette smoking and mortality by sex, age, period and cohort. For currently smoking males in 1987-1996, the risk of death was about 2.6 times that of never smokers and that risk grew over time so that in 1997-2006, smokers' risk of death was more than 3.1 times that of never smoking males. For females, the relative risk of death for smokers compared to never smokers was somewhat smaller at 2.3 in 1987-1996, growing to 2.5 in 1997-2006.

Mr. Preston said that despite a common notion that selection effects were driving the increases in relative risk overtime, whereby smoking behaviour was increasingly concentrated among the less educated members of the population, a multivariate analysis that controlled for selection had revealed that that was not the case. He suggested that the explanation instead lay in longer smoking durations and perhaps an increased risk associated with smoking styles of low nicotine cigarettes (e.g., deep inhaling).

Mr. Preston said that the impact of tobacco use was clearly visible while examining the sex differences in trends in mortality in the United States over the period 1948 to 2003. Among men in the United States, the heaviest smokers were born around World War I. Women began smoking somewhat later and among them, the heaviest smokers were born around World War II. With the addition of a smoking parameter to the Lee-Carter model for projecting mortality in the United States, Mr. Preston demonstrated that smoking trends explained why there was a faster decline in the level of mortality for males relative to females. Given the recent trends in declining smoking prevalence, mortality rates for both sexes were projected to fall more than had been projected by the U.S. Social Security Administration.

Mr. Preston then described the results of a separate study that had sought to explain why improvements in longevity in the United States had lagged behind those in other developed countries, such as in Europe and Japan. The approach incorporated trends in lung cancer mortality as a marker of trends in smoking prevalence into the mortality projections. The approach differed from earlier studies that used lung cancer to proxy for smoking prevalence for the purposes of estimating all cause mortality in that it sought to estimate mortality disaggregated by age, sex, period, and country. The results showed that differences in smoking prevalence explained much of the differences between the countries in longevity beyond age 50. Among males in most countries, the percentage of all deaths that were attributable to smoking increased between 1955 and 1980, but then declined between 1980 and 2003. For females, however, the period between 1980 and 2003 continued to see increases in the percentage of deaths due to smoking, reflecting later initiation of smoking among women compared to men. Even with the increases to 2003, the fraction of deaths attributable to smoking among women was substantially lower than that among men.

Participants shared their views on the role of smoking in suppressing life expectancy in various populations. It was suggested that smoking might account for the relatively low life expectancy observed among Scottish women, for example, and that smoking behaviour may account for the lower life expectancy among Danish women compared to women in other Nordic countries. Participants also expressed their concern about how smoking patterns would influence mortality trends in developing countries, such as India and China.

The expert group then heard from Ms. Katherine Flegal of the United States Centers for Disease Control and Prevention, who spoke about the impact of obesity on mortality. She began with a description of trends in the United States. The prevalence of obesity had begun to increase in the 1980s and appeared to have levelled off more recently at around 35 per cent. Over the same period life expectancy at birth had risen and the death rate attributable to ischaemic heart disease had declined.

Ms. Flegal explained that body mass index (BMI; calculated as weight in kilograms divided by height in metres squared) was the metric commonly used to identify weight categories. In general, a BMI of less than 18.5 was considered to be underweight; a BMI between 18.5 and 25 was considered to be normal weight; a BMI of between 25 and 30 was considered to be overweight; and a BMI greater than 30 was considered to be obese. A 2005 study that used improved data and methods estimated 112,000 deaths due to obesity in the United States, which was substantially lower than earlier estimates. A particularly important finding from the study was that mortality rates were lower among those classified as overweight compared to those in the normal weight range.

Ms. Flegal urged participants to exercise caution in estimating and interpreting estimates of attributable mortality. She warned that the simple formula for population attributable fraction was invalid when hazard ratios were adjusted for confounding. The three main confounding factors in obesity-mortality relations were age, sex and smoking. Older age, male sex and smoking were each associated with both lower obesity and higher mortality. Failure to account for these relationships in calculating the

attributable fraction led to overestimation of the obesity-associated mortality, as had occurred in the earlier studies.

Ms. Flegal emphasized the importance of distinguishing between disease incidence and mortality in assessing the association between body weight and health and survival. Analyses that used hazard ratios for the incidence of obesity-related conditions to estimate mortality from those conditions were likely flawed. There was some evidence that for obesity-related conditions, such as coronary artery disease, higher BMIs were associated with better survival, an association referred to as the "obesity paradox". As a result, the hazard ratios for disease incidence could overestimate the hazard ratios for mortality from obesity-related conditions, thereby leading to an overestimate of the effect of high BMI on mortality. There was some evidence of an obesity paradox for non-obesity related conditions as well.

Ms. Flegal showed the results of her analysis of the National Health and Nutrition Examination Survey. The fraction of deaths due to cardiovascular disease, obesity-related cancers and diabetes that was attributable to obesity was around 5 per cent, but the fraction of all other mortality due to obesity was negative, such that the overall percentage of mortality attributable to obesity was only 0.9 per cent. The results were robust to the choice of anthropometric measure of body weight such as waist circumference instead of BMI. Given the lack of a strong association between obesity and mortality, Ms. Flegal concluded that there was little to gain in incorporating estimates and projections of trends in obesity into mortality projections.

Discussion focused on the BMI measure and whether it was a useful metric for drawing comparisons across populations or population sub-groups. Ms. Flegal agreed that there were differences in body composition for the same weight across different racial groups, but she said that the various anthropometric measures of body weight and adiposity were highly correlated. She agreed that it was important to think about whether the standard classifications of overweight and obesity were defined in a way that translated into risk differences. Mr. Mathers clarified that the CRA used a continuous measure of BMI in defining the relative risks and used BMI cut points to define overweight and obesity only for reporting purposes.

H. Country-level Trends in NCDs and Risk Factors

The final substantive session of the EGM sought to examine the evidence on country-level trends in non-communicable diseases and risk factors. Two different presentations addressed trends in obesity in China and diabetes in Latin America and the Caribbean, respectively. Mr. Youfa Wang of Johns Hopkins University presented the evidence of obesity trends in China. He described the growing concern among the international public health community about the increasing prevalence of obesity, which had been estimated to kill more people than underweight in 65 per cent of the world's populations. Obesity had been identified as a risk factor in a host of serious health concerns, such as diabetes, cardiovascular diseases, metabolic syndrome, certain cancers, osteoarthritis, and pregnancy complications among others.

Mr. Wang described the rising prevalence of obesity in China as coinciding with a period of rapid economic development, urbanization and social change, which had included a proliferation of fast food restaurants. There were large increases in animal source food consumption as well. In 2002, an estimated 30 per cent of China's population was overweight or obese, up from 20 per cent in 1992. In China's major cities, the percentage overweight or obese was around 50 per cent. One in five adults experienced high blood pressure and one in ten had type 2 diabetes.

Mr. Wang said that great concern surrounded the increase in overweight and obesity among children in China. One study in Beijing indicated that the prevalence of overweight and obesity among urban boys at around 35 per cent was similar to that in the United States. The rising tide of overweight and obesity was projected to bring increases in the prevalence of obesity-related illnesses through 2020. The prevalence of high blood pressure in China rose from 18.8 per cent in 2002 to 26.9 per cent in 2007-08 and was projected to rise further to 45.3 per cent in 2020. Similarly, diabetes prevalence rose from 2.6 per cent in 2002 to 9.7 per cent in 2007-08 and was projected to rise to 25.8 per cent by 2020.

Mr. Wang emphasized that the trends in overweight and obesity in China were rooted in changes in lifestyle, whereby people were adopting more sedentary lifestyles and a "Westernized" diet. These, in turn, were driven by socioeconomic and technological development, international trade and cultural exchanges with other regions, among other factors. Mr. Wang concluded by predicting continued increase in obesity and related non-communicable diseases in China and advocating the scale-up of population-based interventions and national policies.

Ms. Flavia Andrade of the University of Illinois at Urbana-Champaign then presented on recent trends in diabetes morbidity and mortality in Latin America and the Caribbean. Since the mid-20th century as rates of infectious disease mortality had been falling across most countries of the region, death rates due to diabetes had been increasing. One study indicated that the increasing rates of diabetes mortality had produced losses in the expectation of life in the region of about 0.5 years between 1950 and 2000. Among countries in South America and Central America, diabetes accounted for about 10 per cent of all mortality among males aged 50-59 and about 17 per cent of mortality among females in that age group.

Ms. Andrade showed participants the results of a study based on data from the Salud Bienestar y Envejecimiento (SABE) survey of adults over 60 residing in seven major cities throughout Latin America and the Caribbean, and also from the Mexican Health and Aging Study (MHAS) of adults aged 50 or over. Estimates of the diabetes-free life expectancy indicated that a man aged 60 without diabetes could expect to live around 15 years longer than a man with diabetes in cities such as Buenos Aires, Santiago, Havana, Mexico City and Montevideo. The gaps between life expectancy with and without diabetes were even larger for women. In Mexico, diabetes was estimated to reduce total life expectancy at age 50 by about 10 years and was also associated, on average, with close to 10 fewer years of life in good health.

Ms. Andrade drew parallels between the growing burden of diabetes in Latin America and the Caribbean and the rising prevalence of overweight and obesity in the region. In Mexico, the prevalence of overweight and obesity exceeded 70 per cent in women and topped 60 per cent in men. Ms. Andrade cautioned that data on trends in overweight and obesity in the region were limited and based primarily on small sub-national, mostly urban samples. In general, prevalence tended to be higher in urban areas compared to rural areas.

Ms. Andrade presented the results of assessments of obesity prevalence by socioeconomic status. In Brazil, prevalence of obesity had increased among men of all wealth quintiles between 1975 and 2003, with the highest prevalence of obesity observed among the wealthiest men. A positive relationship between wealth and obesity prevalence was observed among women in the lower three wealth quintiles as well, but prevalence in the highest wealth quintile was lower than that in the middle quintiles, which Ms. Andrade hypothesized may have been due to a higher value attached to thinness among Brazil's wealthier women. A separate analysis across 45 low- and middle-income countries had shown that as per capita GDP rose, BMI increased among all socio-economic groups, but that the pace of increase was slower among the richest quartile compared to the other three quartiles.

Ms. Andrade closed by considering the utility of incorporating diabetes prevalence estimates and projections into projections of mortality. She noted the high degree of uncertainty associated with projections of diabetes prevalence. She said that the extent to which mortality was affected by increasing incidence and prevalence of diabetes would depend on the success of interventions that aim to prevent and treat the disease.

Discussion centred on the soundness of evidence linking overweight and obesity to the risk of mortality associated with diabetes and other NCDs. Mr. Mathers of WHO noted that mortality related to diabetes was often miscoded to cardiovascular disease or renal failure, and thus, it was difficult to establish correlations between diabetes prevalence and mortality rates. Both Mr. Wang and Ms. Andrade said that the association between obesity and diabetes had been well-established in the scientific literature.

I. CONCLUDING REMARKS

Mr. Pelletier thanked participants for their active engagement and concluded the meeting with some comments on plans for future work. He said that the Population Division was to continue to work towards estimating mortality in crisis contexts by developing models of typical age-sex patterns of mortality to better assess the different types of historical crises, such as international wars, civil wars, famines, and natural disasters. He described plans to simulate the demographic impact of mortality in the different contexts.

With respect to mortality due to NCDs, Mr. Pelletier gathered that the presentations had indicated that it was worthwhile to develop mortality projection variants that took into account estimated levels and trends in smoking prevalence. There seemed to be less to gain in simulating mortality associated with other risk factors, such as alcohol use and overweight and obesity.

Mr. Pelletier said that he looked forward to further engaging the participants by inviting their comments on the work of the Division in this regard.

UN/POP/EGM-MC/2011/INF.1
14-15 November 2011
English only

UNITED NATIONS EXPERT GROUP MEETING ON MORTALITY CRISES: CONFLICTS, VIOLENCE, FAMINE, NATURAL DISASTERS AND THE GROWING BURDEN OF NON-COMMUNICABLE DISEASES

United Nations Secretariat
Department of Economic and Social Affairs
Population Division
New York, 14-15 November 2011

Venue: Danny Kaye Visitor's Centre (located in the lobby of UNICEF House building)
Three United Nations Plaza
44th street (between 1st and 2nd Avenues)
New York, N.Y. 10017

ORGANIZATION OF WORK

MONDAY, 14 November 2011

9:00-9:30 Registration

Morning session: 9:30-13:00

1. **OPENING OF THE MEETING:** Hania Zlotnik, Director, Population Division

2. **INTRODUCTION TO MORTALITY CRISES:** François Pelletier, Population Division

PART 1: MORTALITY ESTIMATION IN THE CONTEXT OF CONFLICTS, VIOLENCE, FAMINE AND NATURAL DISASTERS

3. **MORTALITY ESTIMATION IN THE CONTEXT OF CONFLICTS AND VIOLENCE**

(a) *Challenges in collecting reliable data from areas in conflict and measuring mortality*

Gregg Greenough, Harvard School of Public Health

(b) *Mortality due to the conflict in Iraq*

Les Roberts, Columbia University

(c) *Mortality due to the conflict in the Democratic Republic of the Congo*

Andrew Mack, Simon Fraser University

Discussant: Jon Pedersen, FAFO

(d) *Mortality due to the conflict in Cambodia*

Patrick Heuveline, University of California, Los Angeles

(e) *Mortality due to the conflict in Bosnia and Herzegovina*

Helge Brunborg, Statistics Norway

(f) *Mortality due to violence in Latin America*

Roberto Briceño León, Woodrow Wilson International Center for Scholars (WWICS)

Discussion and questions

Lunch break: 13:00-14:30

Afternoon session: 14:30-17:30

4. MORTALITY ESTIMATION IN THE CONTEXT OF FAMINE AND NATURAL DISASTERS

(a) *Famine mortality*

Tim Dyson, London School of Economics

(b) *Mortality patterns during the 2004 Tsunami in the Indian Ocean*

Shannon Doocy, Johns Hopkins University

(c) *Patterns in injuries and mortality caused by earthquakes: evidence from the EM-DAT database*

Gregg Greenough, Harvard School of Public Health

Discussion and questions

5. *The WHO approach for assessing mortality shocks: estimating additional deaths caused by conflicts and disasters*

Colin Mathers, World Health Organization

6. Brainstorming session on methodological issues: *There is a need to define best practices, harmonise tools and adopt a more standardised approach for estimating mortality in crisis-affected populations. Discussion will aim at providing a set of guidelines to develop consistent methods to generate country-level mortality estimates considering a variety of crisis contexts*

Moderator: Jon Pedersen, FAFO

7. CONCLUDING REMARKS: François Pelletier, Population Division

TUESDAY, 15 November 2011

PART 2: THE GROWING BURDEN OF NON-COMMUNICABLE DISEASES (NCDs)

Morning session: 9:00-13:00

8. INTRODUCTION: Cheryl Sawyer, Population Division

9. THE WORLD HEALTH ORGANIZATION'S ESTIMATES

(a) *WHO data and methods for estimating incidence, prevalence, and mortality for non-communicable diseases at the global, regional and country levels*

Colin Mathers, World Health Organization

(b) *The WHO procedure for estimating the prevalence and population attributable risk of NCD risk factors at the global, regional and country levels*

Colin Mathers, World Health Organization

Discussion and questions

10. LINKING NCD RISK FACTORS TO MORTALITY

(a) *The impact of tobacco use on mortality*

Samuel Preston, University of Pennsylvania

(b) *The impact of alcohol use on mortality*

David Leon, London School of Hygiene and Tropical Medicine

(c) *The impact of obesity on mortality*

Katherine Flegal,
United States Centers for Disease Control and Prevention

Discussion and questions

Lunch break: 13:00-14:30

Afternoon session: 14:30-17:30

11. COUNTRY-LEVEL TRENDS IN NCDS AND RISK FACTORS

(a) *Obesity in China*

Youfa Wang, Johns Hopkins University

(b) *Diabetes in Latin America and the Caribbean*

Flavia Andrade, University of Illinois at Urbana-Champaign

Discussion and questions

12. CONCLUDING REMARKS: François Pelletier, Population Division

UNITED NATIONS EXPERT GROUP MEETING ON MORTALITY CRISES: CONFLICTS, VIOLENCE, FAMINE, NATURAL DISASTERS AND THE GROWING BURDEN OF NON-COMMUNICABLE DISEASES

United Nations Secretariat
Department of Economic and Social Affairs
Population Division
New York, 14-15 November 2011

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