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Department of Economic and Social Affairs
Population Division

United Nations Expert Group Meeting on Health, Mortality and Development

DESA

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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. The work of the Population Division in this area has encompassed both the preparation of estimates of mortality indicators and the development of methods to estimate mortality, particularly when the data available are incomplete or deficient. As the number and diversity of data sources for the estimation of adult mortality levels increase, it is important to adjust or improve currently available methodologies to obtain accurate estimates. In addition, as the AIDS epidemic continues, accounting for its effect on adult mortality is essential. For these reasons, the Population Division has been devoting more attention to the evaluation and improvement of the methods used to estimate adult mortality.

The Population Division serves the Commission on Population and Development of the Economic and Social Council of the United Nations, which each year considers a special theme within the scope of population affairs. In its Decision 2008/101, the Commission decided to consider at its forty-third session in April 2010 the special theme "Health, morbidity, mortality and development." To assist the Commission in its preparations for the forty-third session, the Population Division has compiled recommendations to improve global health.

As a part of these ongoing efforts, the Population Division organized an Expert Group Meeting on Health, Mortality and Development that was held at the United Nations Headquarters in New York from 10 to 12 November 2009. The purpose of the meeting was twofold. First, in preparation for the forty-third session of the Commission on Population and Development, the meeting brought together experts and officials of inter-governmental organizations to discuss the challenges in combating the major causes of death and improving health, including consideration of how to strengthen health systems. Second, building upon earlier United Nations Coordination Meetings on the Estimation of Adult Mortality held in 2006 and 2008, the meeting focused on methodological issues in the estimation of adult mortality and initiated a comparison and review of adult mortality estimates for selected countries as produced by different institutions. 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 at www.unpopulation.org. For further information concerning this publication, please contact the Director, 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.

Explanatory Notes

The following acronyms are used in the report:

ACT	Artemisinin Combination Therapies
AMI	Acute Myocardial Infarction
DALY	Disability-adjusted Life Year
DCPP	Disease Control Priorities Project
DDM	Death Distribution Methods
DESA	Department of Economic and Social Affairs
DHS	Demographic and Health Surveys
DOTS	Directly Observed Treatment Shortcourse
GBD	Global Burden of Disease
GGB	General Growth Balance
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IGME	Inter-agency Group for Child Mortality Estimation
IHME	Institute for Health Metrics and Evaluation
LF	Lymphatic Filariasis
MDA	Mass Drug Administration
MDGs	Millennium Development Goals
MVA	Manual Vacuum Aspiration
NTDs	Neglected Tropical Diseases
ORT	Oral Rehydration Therapy
SEG	Synthetic Extinct Generations
TB	Tuberculosis
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
UNPD	United Nations Population Division
VR	Vital Registration
WHO	World Health Organization
WHS	World Health Statistics

UNITED NATIONS EXPERT GROUP MEETING ON HEALTH, MORTALITY AND DEVELOPMENT

A. OPENING OF THE MEETING

Ms. Hania Zlotnik, Director of the Population Division, welcomed the participants and emphasized the importance of the Expert Group Meeting in the context of preparations for the upcoming forty-third session of the Commission on Population and Development, which was to be held on 12-16 April 2010. The theme of the Commission was to be "Health, morbidity, mortality and development," marking the first time in over a decade that the Commission had taken up these topics.

Ms. Zlotnik noted that in recent years, most consideration of health on the United Nations agenda had occurred in the context of the Millennium Development Goals (MDGs). Yet the MDGs highlighted only a small part of the total health burden in the world. At the upcoming Commission, she wished to bring focus to other diseases that constituted a major portion of the disease burden, namely the neglected tropical diseases (NTDs) and noncommunicable diseases. She highlighting the fact that professionals in the health sector were extremely busy and in very high demand for the many different conferences focusing on health-related matters, Ms. Zlotnik commented on how difficult it had been to gather participants for this Expert Group Meeting as compared to meetings on fertility and migration.

In the context of declining mortality and fertility, increasing survival to older ages, and the changing epidemiological profile of the burden of disease from primarily infectious diseases to primarily noncommunicable diseases, health systems would have to adapt to new challenges. The Population Division looked forward to the input of the gathered experts, particularly on policy advice to put before the Commission in its report. Guidance was needed particularly on how to advise Governments on the means to influence behaviours that affected health, of the decisions that had the largest impacts on health were taken in spheres outside of health ministries.

Ms. Zlotnik urged that amid the current intense focus on global health, it remained imperative to keep the importance of reproductive health and fertility in mind. The forty-second session of the Commission on Population and Development had examined the contribution of the Programme of Action of the International Conference on Population and Development to the internationally agreed development goals, including the MDGs. It found that family planning had a large impact on the survival of mothers and children, particularly by lengthening intervals between births. In 2011, the Commission was to take up the issue of reproductive health more generally.

Lastly, Ms. Zlotnik commented briefly on the second segment of the meeting that focussed on the estimation of adult mortality. She was very grateful that representatives from both the World Health Organization and the Institute for Health Metrics and Evaluation were able to participate in this process.

PART 1: HEALTH

B. GLOBAL BURDEN OF DISEASE AND DISEASE CONTROL PRIORITIES

The first substantive session of the meeting focused on the initiatives that aimed to quantify the burden of disease globally and to identify cost-effective interventions to address that burden. Mr. Colin Mathers, Department of Measurement and Health Information Systems of the World Health Organization (WHO), described the Global Burden of Disease project (GBD), a standardized framework for integrating all available information on mortality, causes of death, individual health status, and condition-specific epidemiology to provide an overview of the levels of population health and the causes of loss of health.

The original GBD 1990 study was undertaken from 1991-1996[1]. From 2000-2004, WHO carried out updates and extensions of the GBD, including morbidity and mortality estimates for the WHO member States. The most recent updates included estimates of morbidity and mortality for 2004[2], burden of diseases projections to 2030[3], a volume on global health risks[4], and a report on causes of death among children, expected to be published in 2010[5]. Meanwhile, between 2007 and 2010 a complete update of the GBD for 2005 was being undertaken by a team led by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington, with funding from the Bill and Melinda Gates Foundation.

Mr. Mathers described the disability-adjusted life year (DALY), which was the primary metric of the GBD and provided a common measure of population health for each member State. For each country and health condition, the DALY summarized both the years of life lost due to mortality and the equivalent years of healthy life lost due to disability from that condition. Based on analysis of more than 10,000 datasets, the GBD estimated that while ischaemic heart disease and cerebrovascular disease were the two leading causes of death worldwide in 2004, they ranked only fourth and sixth respectively in terms of burden of disease (DALYs) because they tended to affect people at older ages, thereby causing fewer years of life lost compared to other fatal conditions that tended to affect young people. Accordingly, lower respiratory infections and diarrhoeal diseases, which caused large numbers of child deaths, were the two leading causes of DALYs in 2004. The third leading cause of DALYs, depression, was non-fatal but was responsible for many years of healthy life lost to disability, and thus inflicted a large burden of disease globally. In addition to numbers of deaths and DALYs, the GBD produced internally consistent estimates of incidence, prevalence, remission and case fatality for each health condition.

Controversies surrounding the GBD project included the uncertainty of the estimates given the gaps in knowledge and information, as well as criticisms of the methods of disability weighting, age weighting, and health state valuation. While earlier critics had questioned whether DALYs were the proper metric for setting health priorities, in general the method had become widely accepted. Mr. Mathers emphasized that while the GBD project strove to take all data sources into account—including vital registration, child and adult mortality information from surveys, and epidemiologic data sources such as disease registries—data for many countries and health conditions remained inadequate. There was a need for long-term improvec .1ITIES

data, information on the burden of non-fatal conditions, such as mental disorders, was often problematic. As a result, there was a large degree of uncertainty surrounding the estimates produced for the GBD.

A complete revision of the GBD was underway that would utilize additional data and improved methodologies to generate new estimates of disease, injury, and risk factors for 1990 and 2005. Research teams were working on overall mortality estimates, cause-of-death estimates, estimates of years lived with disability, disability weights, and comparative risk assessments. In addition, the lists of causes and risk factors were being expanded for the new version. In response to earlier criticisms surrounding the DALY methodology, the new GBD would focus on loss of health, rather than goodness of health, and probably would drop age weighting.

Mr. Mathers explained that in order to project selected indicators of the global burden of disease to 2030, mortality trends were modelled as functions of national income per capita, education, smoking intensity, time (as a proxy for technological progress), and trends in body mass index. Separate models were used for HIV/AIDS, tuberculosis, lung cancer, diabetes mellitus, and chronic respiratory diseases. The numbers of deaths from cancer, cardiovascular disease, and stroke were projected to continue to increase through 2030, even though the death rates for these causes would decline somewhat. Deaths from infectious causes were projected to decline with the exception of HIV/AIDS, for which numbers of deaths were expected to peak between 2010 and 2015.

Mr. Mathers then presented results of the recently published report *Global health risks*, which assessed the proportions of global mortality and DALYs that were attributable to 28 common risk factors. Estimates of the prevalence of each risk factor and the risk of disease associated with each risk factor were collected in a thorough review of the literature and input to an epidemiological equation to estimate the proportion of disease incidence that could be attributed to a given risk factor in a population. More complex calculations were required for exposures such as smoking, which had a long lag time between the initial exposure and the outcome. The study concluded that the six leading causes of attributable mortality—high blood pressure, tobacco use, high blood glucose, physical inactivity, overweight and obesity, and high cholesterol—all were related to cardiovascular disease. In fact, 75 per cent of deaths from ischaemic heart disease were attributable to only eight risk factors. The leading causes of attributable burden of disease (DALYs), on the other hand, were more diverse: childhood underweight; unsafe sex; alcohol use; unsafe water, sanitation and hygiene; and high blood pressure. In all, 44 per cent of deaths and 35 per cent of DALYs were attributable to the combined effects of 24 avoidable risk factors. These 24 risk factors were responsible for loss of nearly 10 years of life expectancy globally.

Mr. Mathers concluded his presentation by recalling the importance of the GBD project for influencing global and national health policies. By measuring the average health of populations and loss of health by causes, the results of the GBD were among the many inputs into health priority setting and resource allocation processes. Indeed, the GBD supplied crucial inputs to the Disease Control Priorities Project (DCPP), which was to be explained in a subsequent presentation.

Mr. Prabhat Jha, Director of the Centre for Global Health Research, Li Ka Shing Knowledge Institute at the University of Toronto, made a presentation entitled *The disease control priorities project*, in collaboration with Mr. Dean Jamison, Professor of Global Health at the Institute for Health Metrics and Evaluation, University of Washington, who was unable to attend the meeting. Mr. Jha began with a brief history of the DCPP. The first wave of the project was initiated by the World Bank in 1989-1993 to provide the background documentation for the 1993 World Development Report, *Investing in health*. The second wave of the project was conducted over the period 2002-2007, supported by the National Institutes of Health, the World Bank, the WHO and the Bill and Melinda Gates Foundation. With a budget of US$6 million over four years, this wave produced a two-volume report with inputs from 500 contributors. The

third wave of the DCPP, called the DCPNetwork, was to take place over 2009-2016 and was also to be financed by the Bill and Melinda Gates Foundation.

DCPP aimed to develop an evidence base and inform decision making by providing estimates of cost-effectiveness and impact of single interventions and packages of interventions. Project outputs suggested the best and worst buys for health and provided guidance for prioritizing interventions in a given health context. To illustrate, Mr. Jha posed the question, what would US$1 million buy in terms of health in a developing country setting? DCPP analysis indicated that prevention and treatment of noncommunicable diseases through taxation of tobacco products could avert between 24,000 and 330,000 DALYs annually at a cost of between US$3 and US$50 per DALY. Treatment of acute myocardial infarction (AMI) with inexpensive drugs or a daily polypill, a single pill containing multiple drugs to treat risk factors for cardiovascular disease, were also deemed cost-effective in developing country settings. In contrast, bypass surgery for less severe coronary artery disease was not very cost effective, averting only a very small number of DALYs at a very high cost per DALY.

Mr. Jha summarized that, overall, the main messages to have emerged from the DCPP thus far were that immunizations and treatment of childhood diseases, tuberculosis, and AMI were all "good buys" for health in terms of their cost-effectiveness. With respect to health services, the study concluded that improving the provision of surgical facilities at district hospitals would have an important effect on health, pain management, and cancer outcomes in developing countries.

Mr. Jha stressed that the continued diffusion of new knowledge and technologies would be the drivers of future progress to address current global health challenges, such as noncommunicable diseases, HIV/AIDS, potential pandemics and neglected populations. Indeed, there was strong evidence that the diffusion of new knowledge and products (e.g., oral rehydration therapy (ORT), immunizations, and low-cost treatments), as opposed to increases in income and education alone, underpinned the enormous improvements in health observed over the 20th century.

Future work for the DCPNetwork was to address the insufficient attention as yet paid to the instruments of policy that aimed to improve health, including tax and other fiscal instruments, information and education campaigns, regulation and legislation, direct finance, and research and development. The DCPNetwork was also to focus on the platforms that carried interventions such as primary care facilities, hospitals, public health and inter-sectoral platforms Additional work was to examine support systems such as disease and risk factor surveillance, education and training of health professionals, and monitoring and evaluation of interventions, expenditures and the consequences of ill-health. In addition, Mr. Jha said that the DCPNetwork recognized a need to address country applications. Two country applications were already underway, in South Africa and India, and additional country applications were to follow.

Mr. Jha informed participants that the results of the first wave of DCPP were particularly influential in India, yielding US$1 billion in lending from the World Bank to India for various health projects. He and Mr. Ramanan Laxminarayan were engaged in the DCPNetwork country project in India, entitled *Choosing health: an entitlement of all Indians,* which aimed to create a blueprint for better health in India. It considered disease burden, cost-effectiveness and feasibility to produce recommendations for an entitlement package to ensure universal access to cost-effective interventions for all Indians. At a cost of US$10 per person, the package—which included incentives for safe birth attendance, expansion of the number and types of vaccines provided to children, expansion of low-cost combination therapy for malaria, tobacco taxation and enforcement, low-cost treatments for those with heart disease, and interventions for epilepsy—could avert 80 million premature deaths over the next decade if implemented.

Mr. Jha concluded with a description of a study designed to investigate how to influence health

Concern was expressed about a perceived disconnect between the priorities identified by the global health community and the priorities of health care users. This phenomenon could be seen in the increasing funding for HIV/AIDS initiatives in Africa, without comparable resources being directed toward maternal health. Mr. Jha responded that in India, a portion of the package had been allocated for discretionary use according to local priorities. In addition, when priority setting was based upon disease burden, the DCPP provided good, practicable, cost-effective solutions.

Participants also asked what the India study had revealed about community-based interventions for maternal mortality, which had received less attention in the global health literature relative to more distal determinants of maternal mortality, such as gender and poverty. Mr. Jha described the Janani Suraksha Yojana (JSY) programme in India, which was established in 2004 and provided women with 2,000 rupees to deliver their babies in institutions. The programme had resulted in more women attending health centres, but because the money was paid for only delivery and not for remaining in hospital for observation, many women were discharged 24 hours after delivery, which was likely too soon to prevent certain causes of morbidity and mortality, such as sepsis. Thus it was not yet known what impact the programme had on maternal mortality.

C. HEALTH SYSTEMS AND FINANCING OF GLOBAL HEALTH

Mr. Piva described four sets of primary healthcare reforms that were proposed in response to persistent health inequities. First, universal coverage reforms were needed to ensure sufficient supply of

cost-effective. Some countries needed more regulation of private providers while others needed better governance in state-provided services. He stressed that markets and regulation were not incompatible. Health markets were imperfect and deserved accurate regulation. Lastly, health promotion and prevention were essential public goods that required fundamental commitment from Governments.

Participants asked how health priorities should be set when resources for health were not sufficient to address the full spectrum of disease burden in a given country. Mr. Medici underscored that addressing human resources in the health sector needed a priority. He identified economic incentives or mandatory civil service for graduating doctors as good strategies to retain health workers in rural and poor areas.

Participants were concerned about how to reform

E. INFECTIOUS AND PARASITIC DISEASES

Communicable diseases continued to inflict a large burden of disease, particularly among poorer populations. This session of the meeting was dedicated to understanding the burden of infectious and parasitic diseases and priorities for prevention and treatment.

Mr. Ramanan Laxminarayan, Director of the Center for Disease Dynamics, Princeton University, presented an overview of the burden of infectious and parasitic diseases and proven interventions. Estimates from the GBD study corresponding to the year 2001 showed that sub-Saharan Africa experienced nearly 6 million deaths and nearly 1 billion DALYs from infectious and parasitic diseases in that year. The region with the second highest burden of mortality and morbidity from these causes was South Asia, with 3 million deaths and nearly 90 million DALYs attributed to infectious and parasitic diseases in 2001.

Mr. Laxminarayan identified immunizations as a critical component of infectious disease prevention programmes that required sustained support. While some Indian states, such as Bihar, Rajasthan and Uttar Pradesh had seen immunization rates increase between 1998-1999 and 2005-2006, some wealthier states had seen declines in immunization rates, producing a flat trend in deaths from vaccine-preventable diseases on the country level. It was not yet clear why rates of immunization were declining in India's wealthier states.

Mr. Laxminarayan explained that treatment for infectious and parasitic diseases produced benefits both to the individual receiving treatment and to the broader population by preventing transmission to others and avoiding the emergence of drug resistance. For example, there were significant benefits to treating multi-drug resistant tuberculosis in that treatment prevented transmission of the disease to others.

Mr. Laxminarayan presented the results of analysis undertaken to assess whether the economic benefits of increased treatment and other control measures for tuberculosis (TB) exceeded the costs associated with such an increase. The model estimated the economic burden of TB deaths and benefit-cost ratios for TB control for countries with high burden of TB. Three TB control scenarios were assessed in the analysis: 1) no Directly Observed Treatment Shortcourse (DOTS), meaning that treatment would continue as it existed before DOTS programmes were developed, characterized by variable rates of case detection and lower cure rates; 2) sustained DOTS, in which DOTS implementation was held constant at 2005 levels through 2015; and 3) the full implementation of the Global Plan to Stop TB 2006-2015, which included the expansion of DOTS coverage, programmes to address TB/HIV co-infection and multi-drug resistant tuberculosis, new TB diagnostics and drugs and vaccines, and expanded efforts in advocacy, communications and social mobilization.

The analysis revealed significant benefits of sustained DOTS and the Global Plan relative to a baseline of no DOTS, but relatively modest benefits from moving from sustained DOTS to the Global Plan. For countries of sub-Saharan Africa, the study concluded that the benefits of implementing the Global Plan exceeded the costs by a wide margin. Notably, despite having the greatest number of TB deaths, the benefit-cost ratios of implementing the Global Plan in Africa were lower than in Asia. This result arose from the moderate income growth projections for Africa as well as high prevalence of HIV co-infection.

Mr. Laxminarayan then turned to discuss some of the findings on cost-effectiveness of other infectious and parasitic disease interventions studied in the second wave of DCPP. Recalling the discussion that had taken place on the first day of the meeting, Mr. Laxminarayan noted that water and

sanitation systems were quite expensive, and thus very not cost-effective for dealing with diarrhoeal diseases. ORT was often mentioned as a more cost-effective intervention (US$1,062 per DALY averted), although purchased commercial packages were less cost-effective than solutions prepared in the home. Particularly given that most children had multiple diarrhoeal events between the ages of 0 and 4 years, commercial ORT could quickly become a very costly intervention. More cost-effective interventions included the promotion of breastfeeding (US$980 per DALY averted), hand pumps, stand posts and house water connections (US$159 per DALY averted) and construction and promotion of basic sanitation (US$141 per DALY averted). Water sector regulation was identified as the most cost-effective intervention to address diarrhoeal diseases (US$47 per DALY averted).

Both clinical treatments for individuals and public health interventions on the population level were considered in the second wave of DCPP cost-effectiveness analyses. Results revealed no systematic pattern of cost-effectiveness across these two categories. Case management of acute lower respiratory infection, at a cost of US$398 per DALY averted, was not cost-effective. Interventions to improve

burden of malaria. He referred participants to his 2005 article in the journal *Health Affairs* for an analysis of how the subsidy would work relative to the current system. The Global Fund Board was to host the subsidy mechanism and had recently approved US$230 million for a pilot programme in nine countries, which suffered 60 per cent of the global burden of malaria. If the programme worked, it was to be scaled up to all malaria-affected countries.

Continuing the discussion of infectious and parasitic diseases, Mr. Peter J. Hotez, Chairman of the Department of Microbiology, Immunology and Tropical Medicine, The George Washington University and of the Sabin Vaccine Institute, delivered a presentation entitled *The development impact of the neglected tropical diseases*. He noted that MDG 6 identified HIV/AIDS, malaria and "other diseases" as priorities on the global development agenda, but while great strides had been made to address HIV/AIDS, malaria, and TB, the "other diseases" had been largely forgotten.

Approximately 1.4 billion people worldwide were infected with NTDs, and the most common type of infection were those caused by worms,

There was strong evidence that the number of worms a child was infected with was inversely associated with the intelligence quotient of the child. A University of Chicago economist, Mr. Hoyt Bleakley, had estimated that hookworm infection in childhood led to a 40 per cent reduction in future earnings. Hookworm was also a significant problem among pregnant women, causing blood loss, increasing maternal mortality and enhancing susceptibility to malaria. In addition, hookworm infection during pregnancy was associated with low birthweight and increased perinatal mortality. Mr. Hotez said that an estimated one third of pregnant women in sub-Saharan Africa were affected by hookworm. There was a huge social stigma associated with the NTDs, especially for women, as in many populations NTD infection was grounds for marital abandonment or removal of children from a mother's care.

Mr. Hotez posited that the reason the NTDs did not

USAID, through the President's Global Health Initiative, was considering whether to commit US$180 million over the next three years for NTD control.

Mr. Hotez posited that there was an important human rights dimension to the NTDs. Schistosomiasis, particularly in the Americas, was a legacy of the slave trade. Schistosomiasis could be eradicated in Haiti with treatment over five years at a cost of US$20 million over that period. The cost seemed especially manageable when one considered that 20 million tourists visited the Caribbean region each year.

Mr. Hotez closed by noting that NTDs were not just a problem in developing countries. The United States had also neglected the infections of poverty. In the United States, these were not just diseases of immigrants. There was endemic transmission of parasitic diseases occurring in the country, particularly in regions south of the "Continental Poverty Divide", including Appalachia, the Cotton Belt, the Bootheel area of Missouri, the Mississippi Delta, the southern border regions of Texas and New Mexico, and the tribal lands of New Mexico and Arizona.

Discussion centred on the presenters' decisions to focus on disease-specific global health initiatives, rather than to emphasize the need to strengthen countries' health systems. There was concern that costing exercises failed to assess the efficiencies of interventions delivered through an existing health

F. CHRONIC AND DEGENERATIVE DISEASES

The final substantive session of Part I of the Expert Group Meeting addressed the burden of noncommunicable diseases and priorities for intervention.

Mr. Prakash Shetty, Professor of Public Health Nutrition, Institute of Human Nutrition, University of Southampton, discussed the relationship between nutrition, lifestyles, obesity and chronic diseases. Overweight and obesity had become a global epidemic. They were prevalent in industrial, developing and transition economies around the world. Obesity increased the risk of co-morbidities including type II diabetes, gall bladder disease, insulin resistance, coronary heart disease, hypertension, and osteoarthritis, among others.

The determinants of the obesity and noncommunicable disease epidemics in developing societies were tied to the developmental transition. This transition encompassed the demographic transition from high to low fertility and mortality; the epidemiological transition from high infectious disease prevalence to predominance of chronic diseases; and a nutrition transition from a high level of undernutrition to a situation in which diet-related noncommunicable diseases predominated. These transitions occurred together with the phenomena of urbanization, migration and globalization.

The drivers of the obesity epidemic operated at both the macro level and the micro level. At the macro level, average caloric availability was increasing globally along with a drastic decline in real prices for food and agriculture. As national incomes rose, the composition of diets changed, with increases in consumption of fats, sugars and animal products and decreases in consumption of carbohydrates. In Asia, for example, increased vegetable oil consumption was a key component of the nutrition transition. Poor countries had access to higher fat diets at lower levels of gross domestic product than was the case for countries developing further in the past. Urbanization also drove changes in diet and levels of physical activity. As societies became more urban, occupational activity decreased and the amount of time spent in sedentary activities increased. There were few data, however, on levels of physical activity in developing countries.

The level of overweight and obesity among school-aged children was also a concern. Worldwide, around 10 per cent of children aged 5-17 years were overweight or obese, and the percentages were much higher in the Americas, Europe and the Near/Middle East. In the United States, changes had occurred in the patterns of transportation to school such that trips by vehicle had increased, while trips by walking decreased. Also, there was a positive relationship between the duration of television viewing and body mass index in children.

The determinants of energy balance and weight gain were extremely complex, as mapped in a recent Foresight Report on obesity in the United Kingdom. It was quite difficult to untangle the causes in order to identify where policy interventions might have an impact.

Mr. Shetty also discussed the relationship between social inequalities and risk of noncommunicable disease. In the Whitehall study of the British Civil Service, persons in lower-grade occupations had a higher risk of disease that was independent of biological and behavioural markers such as cholesterol, smoking, or blood pressure. Social support was another important protective factor.

Mr. Shetty went on to note that nutritional deprivation experienced by children early in life could have repercussions in terms of greater risk of chronic disease later in life. A link had been established between low birth weight and adult-onset cardiovascular disease. Also, undernourished children had an increased risk of obesity in adulthood. It was important to track the progress of low birth-weight and

undernourished children through adulthood to understand the implications. For example, low birth-weight infants in India showed elevated blood glucose by ages 7-11 years.

In conclusion, Mr. Shetty stressed that the epidemic of obesity and its co-morbid noncommunicable diseases was not confined to the industrialized world. Determinants of the emerging global epidemic were complex and included both macro-level and micro-level drivers. Hence, intervention strategies would need to address a complex range of individual and environmental determinants.

Participants were interested in other public health interventions to influence food intake were considered viable strategies to combat obesity and chronic disease. Mr. Shetty noted that such efforts were underway, such as the United Kingdom's Food Standards Agency initiative to reduce average salt consumption to below 6g per day. In addition, Poland had seen declines in cardiovascular disease following the abolition of government subsidies for margarine. For additional information on what some developing countries were doing to combat chronic disease, Mr. Shetty directed participants to the Centers of Excellence programme, funded by the United States National Heart, Lung and Blood Institute and UnitedHealth.

Mr. Thomas Gaziano, Assistant Professor in the Department of Health Policy and Management, Harvard School of Public Health, then made a presentation entitled *The global burden of chronic diseases*. At the outset, he wished to dispel three myths. The first was the myth that chronic diseases were a problem only of affluent countries. Already by 2001, cardiovascular disease had become the leading cause of death in the developing world. About 28 per cent of deaths in low- and middle-income countries were the result of cardiovascular disease. Other causes of death such as injuries, respiratory infections, nutritional deficiency, and HIV/AIDS collectively still played a predominant role in certain regions, but it was clear now that even in these areas cardiovascular disease was a significant cause of mortality. The burden of cardiovascular disease was projected to grow between 1990 and 2020, ischemic heart disease alone was anticipated to increase by 120 per cent among women and 137 per cent among men in developing countries, compared to age-related increases of between 30 per cent and 60 per cent in developed countries.

Mr. Gaziano called attention to the younger age profile of deaths from cardiovascular disease in developing countries as compared to developed countries. For example, 40 per cent of cardiovascular deaths in South Africa took place between the ages of 35 and 64 years, as opposed to just 10 per cent in the United States. This would have profound economic effects over the next 25 years as workers in their prime would fall to cardiovascular disease.

Next, Mr. Gaziano emphasized the importance of prevention from a cost perspective. Taking the example of blood pressure, he said that blood pressure accounted for 10 per cent of worldwide health care expenditure but that the costs of blood pressure drugs just were the tip of the iceberg. In the United States the treatment and management of high blood pressure accounted for only 21 per cent of total health care costs related to blood pressure. The remaining costs were all due to treating the sequelae of high blood pressure including myocardial infarction and stroke. In developing countries, the fraction of costs related to management of high blood pressure would likely be lower because of lower drug costs.

There were several prevention opportunities to reduce the risk of morbidity and death from chronic diseases. Primordial prevention meant preventing risk factors from developing. Primary prevention referred to preventing risk factors from progressing into symptomatic disease. Secondary prevention consisted of treating symptomatic disease to prevent chronic suffering and death. Interventions could be applied at the individual level or the population level. Both treatments and population interventions (such as reductions in smoking) had contributed to lowering cardiovascular disease mortality in developed countries.

In evaluating the cost-effectiveness of prevention, it was crucial to take into account the level of risk as well as a range of expected outcomes. In an example of population-level intervention, the cost-effectiveness of salt reduction strategies ranged from cost-saving to US$250 per DALY saved, depending

used RHIME forms (enhanced verbal autopsy) to record all deaths in those households. The study was to capture one million deaths between 1997 and 2014. To study tobacco-related mortality thus far, two physicians had classified 74,000 adult deaths over the period 2001-2003 according to the underlying fatal disease. A smoking history of the deceased was collected from living household members and those histories were then compared to the smoking histories of 78,000 living adults.

Analysis revealed that among women aged 30-69 years, the risk of tuberculosis death for smokers was three times that of non-smokers. A similarly high relative risk was found for deaths from respiratory diseases. For all causes of death combined, the risk of death for female smokers was double that of non-smokers. Among males, the relative risk associated with smoking tended to be slightly smaller than those estimated among females. Among males aged 30-69 years, the study measured about a six year loss of life associated with smoking. Risks of death were indiscernibly different for smokers compared to non-smokers even by age 50. Both bidis and cigarettes were harmful, with eight or more cigarettes per day associated with the greatest risk of death.

In addition to India, increasing tobacco-related morbidity and mortality in China was a matter of great concern. Despite a plateau in smoking uptake in the 1990s, cigarette production in China had increased since 2000. An estimated 300 million male smokers were currently alive in China and 100 million of them were likely to be killed by smoking.

Mr. Jha then turned to discuss the results of the Million Women Study, a longitudinal study of health and mortality in the United Kingdom, which had recorded 45,000 deaths through seven years of follow-up thus far. Smokers in the study tended to start early, by age 19 years. They smoked an average of 15 cigarettes per day. Results demonstrated that any amount of smoking was harmful, even as little as five cigarettes per day and even with low tar cigarettes. The Million Women Study was the first large prospective study to show the full effects of prolonged smoking in women.

Mr. Jha explained that smoking was an important source of social inequalities in mortality. It was estimated that if smoking were eliminated as a cause of death, mortality differentials by level of educational attainment in the United States and Poland would be more than halved.

Research showed that by quitting smoking, smokers could realize substantial health benefits. The probability of death from lung cancer was significantly smaller if smoking ceased by age 50 years. If cessation occurred by age 30 years, the risk of lung cancer death for former smokers was similar to that of persons who had never smoked. Mr. Jha concluded his presentation by inviting participants to view additional information on tobacco-related morbidity and mortality on his institution's website (www.cghr.org/tobacco).

Participants inquired about the roles of second hand smoke and solid fuel smoke exposure in contributing to smoking-related morbidity and mortality in India. Mr. Jha replied that while it had not been studied in India, evidence from other portions suggest2(TD .0003 Tducatiof 15 cs45 0 TD .0013

G. SUMMARY AND CONCLUDING REMARKS

Mr. Philip Guest, Assistant Director of the Population Division, thanked participants for their presentations and discussion. He noted that a key objective of the meeting was to gather substantive

PART 2: ADULT MORTALITY

H. OVERVIEW

Mr. François Pelletier, Chief of the Mortality Section of the Population Division, opened the second part of the meeting with a brief overview of the collaboration between United Nations agencies that had occurred over the last few years. Within the United Nations system, both the Population Division (UNPD) and the WHO were responsible for producing life tables and corresponding mortality estimates for all countries of the world. Mr. Pelletier noted that

Completeness of VR was assessed using demographic techniques such as Growth Balance Equation, Bennett-Horiuchi and Variable-r. After adjusting for completeness, AIDS-free estimates of child mortality or adult mortality were used as inputs into the modified logit model utilised by WHO to generate life tables. IGME estimates were used for child mortality, while a projection of mortality was used as an input for adult mortality. This projection procedure entailed taking the trend of $_{60}$l

WHO's assessment. In the future, the WHO aspired to conduct a more systematic review of its estimates,

154,000 simulated population environments were created

The database or life tables for MORTMatch included a total of 8,134 country-years. Of these, 632 life tables were from Africa or low-income and middle-income countries of Asia. The majority of the empirical life tables (5,362 country years) came fro

To address these sources of bias, Ms. Rajaratnam and colleagues had developed the corrected sibling survival method (CSS). This method made use of the observed, generally consistent age patterns of mortality across contexts. Namely, patterns in the shape of log death rates between the ages of 15 and 60 were consistent regardless of the level of mortality. The CSS method used logistic regression to estimate the probability of dying for a given country, sex, age group and time period. The regression model was applied to multiple surveys pooled together. It could be applied to a single population with multiple surveys over time, or to any grouping of populations where at least some of the populations had multiple surveys over time. In the model, the probability of dying was regressed on dummy indicators for age group, dummy indicators for country-time periods, and on a continuous variable expressing time prior to the survey (TiPS).

Ms. Rajaratnam said that it was possible to make the model more flexible to account for different age patterns of mortality. Additional sets of dummy variables could be included for contexts where the age pattern would be expected to be different. HIV/AIDS was a major reason to do this, but other reasons such as conflict/war or high injury rates could also result in different age patterns of mortality.

The TiPS variable was intended to account for recall bias and took advantage of overlapping recall periods from successive surveys. It captured the difference between deaths reported in the more

Participants requested clarification on the methodologies employed by IHME. On measuring adult mortality using sibling survival, participants were curious about whether the World Health Surveys had been assessed, the potential impact of recall bias, the assumption of a linear TiPS factor over time, the choice of the age range for mortality estimates, and opportunities to validate the estimates. Ms. Rajaratnam responded that the World Health Surveys had failed to produce plausible estimates, likely because sample sizes were small and the questionnaire limited responses to eight siblings, which was insufficient for some countries. To address recall bias, 15 years of data used were split into three five-year time periods. Ms. Rajaratnam planned to examine further the potential for recall bias in reporting of deaths close to the time of the survey. She was, however, comfortable with the assumption of a linear TiPS factor over time. Ms. Rajaratnam clarified that $_{45}q_{15}$ estimates were calculated directly from the empirical data, using inputs above age 60, that they were not derived from the $_{60}q_{15}$ estimates. Lastly, she explained that there were not yet good data sources against which to validate mortality estimates obtained from sibling histories.

With regard to IHME's model life table system, participants inquired about the methods used to estimate mortality at older ages. Mr. Wang explained that for countries for which death distribution methods were used, old-age mortality was estimated using the Gompertz curve. He planned to use the Kannisto-Thatcher method to predict mortality at old ages.

Ms. Rajaratnam informed participants that once the results were published, the software developed to derive the mortality estimates would be made publicly available.

Mr. Pelletier then provided a brief explanation of the methods UNPD used to estimate adult mortality for WPP. For some countries, estimates of $_5q_0$ were used to select a model life table. For other countries, empirical age-specific mortality rates were used to calculate adult mortality directly for one or more periods. For this second group of countries, to complete the population projection the "modified method" was used which entailed selecting a model life table and projecting into the future such that the age-pattern of mortality converged toward that model.

In addition to the adult mortality estimates produced by WHO and UNPD, the discussion would consider empirical estimates of $_{35}q_{15}$ and $_{45}q_{15}$ obtained from various sources. Mr. Pelletier noted that empirical data on adult mortality were not as abundant and readily available as data for the estimation of child mortality. The UNPD was continuing to gather empirical information on adult mortality for all countries. As such, the data presented were not to be considered comprehensive in scope. It had been hoped that IHME estimates of adult mortality could have been included in the discussion, but those estimates were unfortunately not yet ready to be shared. Mr. Pelletier looked forward to seeing those estimates at a later date.

Where possible, estimates of $_{35}q_{15}$ had been calculated from sibling survival recorded in the DHS. The recommendation from DHS had been to estimate $_{35}q_{15}$ rather than $_{45}q_{15}$, from sibling survival data. Mr. Pelletier acknowledged that this recommendation was contentious. From each DHS with sibling histories, two estimates of $_{35}q_{15}$ were calculated for each sex. The first estimate referred to the period zero to six years prior to the survey and the second referred to the period seven to 13 years prior to the survey. For comparison with the WHO and WPP estimates, these were plotted at the middle of the period.

Mr. Pelletier explained that countries identified for discussion had been categorized according to the method WHO had used in estimating adult mortality levels. The discussion would begin with those countries for which the child mortality estimate, $_5q_0$, was the only input. Starting with the input, WHO then used the modified logit procedure to derive adult mortality levels, while UNPD usually employed Coale-Demeny or United Nations model life tables. Both agencies used their procedures to estimate non-AIDS adult mortality and then later added AIDS deaths for those countries highly affected by the HIV/AIDS epidemic. Mr. Pelletier noted that the greatest difference between mortality estimates between the WHO and UNPD for countries in this category occurred when UNPD was using the Coale-Demeny South model life table (which had the lowest level of adult mortality for a given $_5q_0$) and the UN Far Eastern model life table (which had the highest adult mortality for a given $_5q_0$). Estimates from the two agencies tended to be in agreement when the Coale-Demeny North and West model life tables were used.

The fourth and final category of countries identified for discussion included those that had experienced a mortality crisis between 1980 and the present due to war, civil strife, collapse of the health system or other crisis situation. This last cate

UN/POP/MORT-CM/2009/INF.1
10-12 November 2009
English only

UNITED NATIONS EXPERT GROUP MEETING ON HEALTH, MORTALITY AND DEVELOPMENT
United Nations Secretariat
Department of Economic and Social Affairs
Population Division
New York, 10-12 November 2009

Venue: One Dag Hammarskjöld Plaza
2nd Avenue
48th Street, 37th Floor (Conference Room 1DHP-3833)
New York, NY 10017

ORGANIZATION OF WORK

Tuesday, 10 November 2009

Morning session: *9:00-13:00 (continued)*

6. CHRONIC AND DEGENERATIVE DISEASES

   (a) *Nutrition, lifestyles, obesity and chronic diseases*

   Prakash Shetty, University of Southampton

   (b) *The global burden of chronic diseases*

   Thomas A. Gaziano, Harvard Medical School

   (c) *Global mortality from tobacco*

   Prabhat Jha, University of Toronto

   Discussion and questions

7. SUMMARY AND CONCLUDING REMARKS : Philip Guest, Assistant Director, Population Division

Lunch break: *13:00-14:30*

PART 2: ADULT MORTALITY
Chair: François Pelletier

Afternoon session: *14:30-17:30*

8. OVERVIEW : Francois Pelletier, Chief, Mortality Section, Population Division

9. METHODOLOGICAL ASPECTS TO THE ESTIMATION OF ADULT MORTALITY

   (a) *Overview of procedures used by WHO to generate life tables at the country level*

   Mie Inoue, World Health Organization

Afternoon session: *14:30-17:30 (continued)*

(b) *Evaluating methods to estimate the completeness of death registration*

Julie Knoll Rajaratnam, IHME, University of Washington

Coffee break

(c) *An Improved Model Life Table System: Semi-parametric Method*

Haidong Wang, IHME, University of Washington

(d) *Measuring adult mortality using sibling survival: a new analytical method and new results for 44 countries, 1974-2006*

Julie Knoll Rajaratnam, IHME, University of Washington

Discussion and questions

Thursday, 12 November 2009

Morning session: *9:30-12:30*

10. A REVIEW OF ADULT MORTALITY ESTIMATES AT THE COUNTRY LEVEL (ALL DAY)

Discussion will focus on adult mortality estimates by sex for selected countries.

Representatives of WHO, IHME, the Population Division and others

Lunch break: *12:30-14:00*

Afternoon session: *14:00-17:00*

11. NEXT STEPS AND CONCLUDING REMARKS : François Pelletier, Chief, Mortality Section, Population Division.

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