INTRODUCTION

Traditionally, only the underlying cause of death is considered in mortality analysis. But since death is due to a complex process, especially at advanced ages, analysis based solely on this concept has its limitations and some causes are more likely to be identified as the underlying cause than others. Selecting only one cause per death may influence the relative importance of the various causes of death. Multiple causes of death statistics has the particularity of using every cause cited on the death certificate. This type of analysis would be particularly indicated to better explain mortality when death is due to a concurrent morbid process, which is often the case at advanced ages. But very few mortality analyses use this methodology mostly because of the data inaccessibility.

Therefore, the aims of this paper are to better understand as well as identifying diseases and conditions which contribute to the mortality process, but that are rarely identified as the underlying cause of death. We will also demonstrate that taking into account the multiple causes of death will allow increasing our knowledge of Quebec health situation. Since this study will be the first one published on the subject, it will most likely become a reference and consequently, multiple causes of death could systematically be considered in future mortality analyses.

DATA

In this paper, we will focus on mortality data for six years, thus between 2000 and 2005. For these years, a total of 329 594 deaths have been observed in the province of Quebec. Death certificate data for each individual death were obtained and various variables (sex, age (last birthday), underlying cause of death and multiple causes of death) were made available through the *Institut national de santé publique du Québec (INSPQ)*. Since the analyses reported in this study will entirely focus on elderly deceased, only the results for age 65+ will be extracted.

Up until recently, only the underlying cause of death was registered in a machine readable format. But since 2000, Quebec used a coding system allowing up to ten

different causes to be compiled from the death certificates. These causes are codified with the International Classification of Diseases (10th revision) produced by the World Health Organisation (WHO). Therefore, the entirety of the causes of death written on the death certificate will be available for analysis for the present paper.

The underlying cause of death can be defined as the following: a) the disease or injury which initiated the train of events leading to the death or b) the circumstances of the accident or violence which produce the fatal injury (WHO, 1993). Thus, the multiple causes of death comprise the entire set of diseases, injuries or complications listed on the death certificate. The associated causes of death comprise all listed multiple causes of death except the underlying cause.

The age- and sex-specific population data are the population estimates released by Statistics Canada for the years 2000 to 2005.

METHODS

First, basic descriptive statistics, such as the average number of causes per registered death, will give an overview of the data and their quality. Mortality rates will also be calculated and tabulated for the underlying cause as well as for the associated causes. Therefore, a comparison between the two types of rates will be possible. Age-standardization of marginal counts and rates will be use to control for population age differences.

Ratios of multiple to underlying cause counts will be use to establish which causes are more frequently identified as underlying or as multiple causes of death.

Association of causes will be presented for the two leading causes of death in Québec which are tumours and diseases of heart. This will enable us to point out which other diseases are more frequently associated with the underlying cause. This analysis will also be done with diabetes, a chronic disease with high prevalence in the elderly population.

In addition, an in depth analysis of the data quality will also be undertaken since it is often cited as one limitation of multiple causes of death analysis.

EXPECTED FINDINGS

The expected findings of this article are that the most frequent causes of death, which are tumours and cardiovascular diseases, will remain unchanged. Nevertheless, the method will show the importance of causes such as Alzheimer, diabetes and hypertension, causes which frequently appear as a contributing cause of death rather than as an underlying cause.

REFERENCES

Australian Bureau of Statistics. 2003. « Multiple causes of death analysis, 1997-2001 ». Site consulté le 15 juin 2006. www.abs.gov.au/Ausstats/abs@.nsf/

Désesquelles, Aline and France Meslé. 2004. « Intérêt de l'analyse des causes multiples dans l'étude de la mortalité aux grands âges : l'exemple français ». *Cahiers québécois de démographie,* 22 (1) : 83-116.

Eberstein, Isaac W., Charles B. Nam and Kathleen M. Heyman. 2005. « Comparing underlying and multiple causes of death in analyzing mortality among the elderly: United States, 1986-1997 ». *Présentation dans le cadre de la Conférence internationale sur la Population,* Tours, 18-23 juillet 2005.

Paquette, L., C. Alix and R. Choinière. 2006. « Proposition pour l'analyse des séries temporelles des données de mortalité selon la cause au Québec suite à l'adoption de la CIM-10 », Montréal, *Institut national de santé publique du Québec*. 35 p.

Stallard, Eric. 2002. « Underlying and multiple cause mortality at advance ages: United States 1980-1998 ». *North American Actuarial Journal*, 6 (3) : 64-87.

Wilkins, Kathryn, Marek Wysocki, Carole Morin and Patricia Wood. 1997. « Causes multiples de décès ». *Rapports sur la santé*, Statistique Canada, 9 (2) : 21-32.

WOLRD HEALTH ORGANIZATION (WHO). 1994. « Classification statistique internationale des maladies et des problèmes de santé connexes », Dixième révision, 1993, 1 : Table analytique. Genève : 1336 p.

WOLRD HEALTH ORGANIZATION (WHO). 1995. « Classification statistique internationale des maladies et des problèmes de santé connexes », Dixième révision, 1993, 2 : Mode d'utilisation. Genève : 426 p.

WOLRD HEALTH ORGANIZATION (WHO). 1996. « Classification statistique internationale des maladies et des problèmes de santé connexes », Dixième révision, 1993, 2 : Index alphabétique. Genève : 761 p.