United Nations
Department of Economic and Social Affairs

Population Division

Technical Paper
No. 2018/1

Historical Development of Civil Registration Systems: A European Perspective

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Etienne van de Walle

United Nations • New York, 2018

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This publication has been issued without formal editing

PREFACE

Civil registration is a continuous, permanent, compulsory, universal and confidential administrative system recording the occurrence of vital events (births, deaths, fetal deaths, marriages and divorces). The production and analysis of real-time statistics assist countries in their planning and delivery of development programs. Detailed and disaggregated information by sex, age and other relevant characteristics is critical to meet the needs of the most vulnerable populations, as well as to follow and monitor progress toward development challenges and goals.

Over the past decade, despite improvement in some civil registration and vital statistics systems (CRVS) and several initiatives launched to accelerate progress in this area, important gaps remain in the registration of vital events around the world. Only 68 per cent of the countries or areas of the world register at least 90 per cent of births occurred and only 55 per cent of the countries or areas register at least 90 per cent of deaths. Clearly, sustained efforts and further investments are required if legal identity, and therefore the registration of all births, is to be provided to all as part of the promotion of peaceful and inclusive societies as formulated in the Sustainable Development Goals (Goal 16).

This paper focuses on the historical development of civil registration in Europe. The history of the development of modern civil registration systems across Europe is reviewed from early initiatives at the parish level in 14th century France and Italy to the more recent development of national population register in Scandinavia. The various contributions of complete and comprehensive civil registration data are then presented through the discussion of various contemporary examples. The paper stresses the importance of long-term commitments from governments to the development of well-functioning civil registration systems.

The paper was written by Etienne van de Walle (University of Pennsylvania) shortly before his untimely death in 2006. The contents of this paper remain of importance today as the lessons that can be drawn from the European experiences of developing civil registration systems can still benefit the initiatives taken by today's developing countries in this area.

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HISTORICAL DEVELOPMENT OF CIVIL REGISTRATION SYSTEMS: A EUROPEAN PERSPECTIVE

Etienne van de Walle[1]

1. SOME DEFINITIONS

The United Nations (2001:3), defined a vital statistics system as:

> The total process of (a) collecting information by civil registration or enumeration on the frequency of occurrence of specified and defined vital events, as well as relevant characteristics of the events themselves and of the person or persons concerned; and (b) compiling, processing, analyzing, evaluating, presenting and disseminating these data in statistical form. The vital events of interest are: live births, adoptions, legitimations, recognitions; deaths and fetal deaths; and marriages, divorces, separations and annulments of marriage.

According to the same source:

> Civil registration is the continuous, permanent, compulsory and universal recording of the occurrence and characteristics of events, including vital events… in accordance with the legal requirements of a country.

Vital events are described by the *Multilingual Demographic Dictionary* (IUSSP, 1982) as "all the events which have to do with an individual's entrance into or departure from life together with changes in civil status".

Modern usage thus distinguishes between a civil registration system and a vital registration system. The first term is the more general one. One of the purposes of civil registration is to compile and analyse vital events in order to produce vital statistics. Vital statistics, however, can also be obtained by other means, for examples, by sample surveys. However, the terms "vital registration" and "civil registration" are largely synonymous in practice and historically they reflect the two main traditions that presided over the registration of births, deaths and marriages in the past: an English tradition that highlighted the medical use of information on *vital* events; and a French tradition that privileged the use of registered information for the attribution of *civil* status and the settlement of legal issues.

The contracting and dissolution of marriages are included among so-called vital events through a stretch of the conventional meaning of "vital." Their role in determining civil status (for example, the legitimacy of children) and legal rights undoubtedly qualifies them as parts of civil registration. However, if the genuine vital events, births and deaths, have relatively unambiguous definitions, this is not the case with marriage, divorce, separation or annulment. Their definitions change according to national traditions and systems of laws, and their legal consequences may be modified over time. This is particularly relevant in today's world, where new forms of unions are becoming increasingly common. In the context of sub-Saharan African countries, where there are multiple forms and stages of unions, and where neither onset nor dissolution may be solemnized by a ceremony or a legal document, the registration of marriage is usually not a condition of their legal existence. Demographic and Health Surveys (DHSs) in sub-Saharan Africa routinely distinguish

[1] Posthumously published, original manuscript finalized by the author in 2006.

between “married” women and women “living with a man” and treat these two types of unions together in the analyses. The terminology is also changing in western countries, as so-called cohabitations are increasingly recognized as unions with legal standing. In this paper, the demography of nuptiality will be discussed peripherally only.

2. The early history of civil registration systems

In view of the lack of development of civil registration in sub-Saharan Africa, it is interesting to ask why European countries had effective systems at a stage when their economic and technological development were less advanced than that reached on the African continent today.

The Greco-Roman tradition already considered ages (which were routinely collected in census operations and often inscribed on tombstones) and dates of birth and death as important characteristics of individuals. There may have been attempts at registration of births and deaths in Antiquity, but these have left no traces in the statistical record. The Western tradition of registration (in the literal meaning of sequential inscription in bounded volumes or registers) of vital events goes back to the documents of the Christian churches and probably originates in the individual practices of members of the clergy who found it necessary, for accounting purposes, to keep track of the ceremonies of baptisms and burials that they performed. One of the earliest registers in existence, for a parish in Burgundy, France, goes back to 1334 (Hollingsworth, 1969). Continuous records subsist for the Italian city of Sienna from 1381 to 1817 (id., p. 177). Yet, the registers appear rare before the sixteenth century, except in France and Italy. They are mostly the product of local practices, although some bishops imposed the keeping of registers early on in all parishes of their diocese, as did the Archbishop of Nantes in France from 1406 (Garenne, 2001). From the sixteenth century, however, the frequency of parish registration increased in most countries of Europe. With the growth of Protestantism, the registers were useful to keep track of affiliation to particular denominations. In the meantime, church documents were increasingly resorted to in legal disputes as proof of legal status. This situation was sanctioned by various royal ordinances, the most important being Thomas Cromwell’s ordinance in 1538 for the United Kingdom of Great Britain and Northern Ireland, and the edict of Villers-Cotterêts of 1539 for France. The importance of these state documents was that they imposed the keeping of registers covering the entire population of the land by the church, and that they required a copy to be deposited in a courthouse for legal use. For the entire Catholic world, the Council of Trent in 1563 imposed the registration of marriages and births and new formalities for marriage, including the celebration by a member of the clergy in the presence of witnesses. The example was followed by various Protestant Churches.

The success of civil registration in Europe, thus, was the outcome of a long history of recording events in parish registers. Completeness in turn depended on several factors: the sanction of the state, the existence of a network of parish priests who registered events as parts of sacramental rites, the commitments of the population because these rites (baptism, burial, marriage) coincided with crucial stages in the life of individuals and involved the salvation of their immortal souls, and the integration of parish documents in a legal system that controlled the patrimonial rights of individual and the settlements of judicial conflicts. Because they were legal documents that could be invoked over a very long time (for example certificates of baptism might be resorted to until the death of the concerned individual and even beyond in matters of inheritance), their conservation and public access was a primary concern.

Early on, there was no separation of church and state, and church ministers acted as agents of the civil administration. In Scandinavia, the situation continued until 1930. In France, it ceased at

the Revolution, when civil registration took over in 1792. The French parish registers are especially complete and reliable sources for scientific enquiry from the latter third of the seventeenth century. In the United Kingdom of Great Britain and Northern Ireland, however, parish registers were most reliable in the seventeenth century. Dissenters were not reliably included. Non-conformity is only one reason for the deterioration; anti-clericalism and slackness on the part of the clergy also contributed (Hollingsworth, 1969). Religious homogeneity was a great advantage with regard to completeness. The multiplicity of religious denominations in the United States of America prevented the constitution of a country-wide system of civil registration until the early twentieth century.

If parish registration systems are the direct predecessors of civil registration (which in French is called "*État Civil,*" i.e. civil status) the tradition of "vital registration" goes back to another type of document. The periodic visitations of the bubonic plague in Europe from 1347 on led municipalities to keep "bills of mortality," that is, weekly lists of deaths with indication of their cause. These bills go back in some cities of Italy to the early fifteenth century and the practice spread progressively to other parts of Europe. The bills for London were initiated in 1592 and the series for 1604 to 1660, were analyzed by John Graunt in 1662, for what is generally considered the founding document of the discipline of demography, his *Natural and Political Observations Made upon the Bills of Mortality* (Graunt, 1975).

This is how Graunt described the main reason why these documents were kept by the municipality of a large city such as London:

> …to look how the *Burial*s increased, or decreased…; and withal, in the *Plague-time*, how the *Sickness* increased, or decreased, that so the *Rich* might judge of the necessity of their removal, and *Trades-men* might conjecture what doings they were like to have in their respective dealings. (Graunt, 1975).

"Removal" of the rich represented their main methods for avoiding the deadly consequences of the plague. When a suspicious increase in the recorded number of deaths signalled a periodic return of the epidemic, they would embark their family and retreat to some safe country residence. The process is described in De Foe's 1732 *Journal of the Plague Year,* a fascinating example of early epidemiological analysis destined for the education of laymen. It consisted in an attempt to forewarn the British public of the advent of a new plague epidemic which had decimated Provence in southern France. In the event, however, the disease did not reach British shores. In his narration, the author described a "plague year" that occurred many years before and uses bills of mortality to reconstruct the course of the epidemic.

There are two lessons to be drawn from this episode, which have some relevance for Africa. First, it shows that vital registration was considered from the start as a practical instrument of policy and of the management of public health. As the plague failed to return, the bills of mortality were neglected. A new threat appeared with cholera in 1832. The need of information to combat the epidemic led to the creation of the Registrar-General's Office in the United Kingdom of Great Britain and Northern Ireland in 1838, and of the appointment of William Farr as Compiler of Abstracts, a position he retained until 1879. Farr has been called the greatest statistical epidemiologist who ever lived. He used registration of deaths to identify the spatial distribution of the disease and by linking fatalities and systems of water distribution, was eventually able to demonstrate the diffusion of cholera by drinking water, a finding which led to great progress in sanitation and public health as it demonstrated the need for filtration.

The second lesson is that the collection of data through registration led to essential progress in statistical analysis. Graunt was able to extract an extraordinary amount of new knowledge out of the rather primitive bills of mortality for London (which incidentally, also recorded some information on births and marriages). Another signpost in the history of demography was the use of the bills of mortality of the city of Breslau in Germany (which recorded the age of the deceased, in contrast with those of London) by the astronomer Edmund Halley to compute the first life table in 1693.

In view of the relatively modest role played by civil registration in Africa today, it is interesting to note that it constituted the mainstay of demographic analysis before 1800, at a time when there were no regular censuses of the population (and of course no demographic surveys). In addition to the computation of life tables from distributions of deaths (using the Halley method which assumes a stationary population), there were attempts to estimate the size of provincial or national populations by multiplying the number of births or baptisms by a standard multiplier. This required the centralization of data from various parishes, a task attempted for France by the Abbé d'Expilly in 1764, and in the United Kingdom of Great Britain and Northern Ireland by Rickman, the organizer of the first five censuses of Great Britain from 1801 to 1841. Rickman instructed the parish clergy to tabulate baptism data from their registers going all the way back to 1700, and derived a population series by multiplying their total number by a ratio based on the 1801 experience (Hollingsworth, 1969). These early efforts, however doubtful their result, were symptomatic of the confidence placed by early demographers in the analytical potential of civil registration data. Malthus believed in parish registers as an important source of information and used a ratio of births to marriages as an index of fertility.

Present-day historical demography has progressed well beyond the methods of early analysts. Parish records have proven to be invaluable source materials to explore the past history of Europe, and by the same token, the demographic characteristics of human populations under conditions of high fertility and mortality as still prevail in many parts of the world. Painfully extracted from dusty registers, the data have been used in demographic analysis both at the aggregate level and for nominal linkage. The study of mortality crises (epidemics and famines) can rely on distributions of deaths over time, even when the sources are incomplete. Social phenomena such as illegitimacy, seasonality or even literacy (from the presence of signatures on marriage certificates) can be investigated. More comprehensively, the demographic history of the United Kingdom of Great Britain and Northern Ireland and Wales has been reconstructed and population trends have been linked with socioeconomic movements in a long-term perspective (Wrigley and Schofield, 1981). By linking data for the same families over time, at a time when birth control was not widely practiced, it was possible to investigate the physiology of reproduction. Large national studies in France (for a review, see Seguy, 2001), Canada (Charbonneau, Boleda and Bates, 1993) and Germany (Knodel, 1988) have used parish registration for the reconstitution of long national series. It has been argued that historical demography played a decisive role in the shaping of public opinion and the activities of international organizations (Rosental, 2003). The French demographer Louis Henry, inventor of the technique of family reconstitution that relied on eighteenth-century parish data, maintained an active correspondence with statistical offices in the developing world, admonishing them that their estimates for various demographic measures were out of line with expectations based on the historical experience. Historical data served as a standard and a benchmark for the study of demographic phenomenon in the world and influenced the thinking of technical demographers (for example, in the study of the proximate determinants and the modelling of fertility), but also for policymakers (measurement of natural fertility and of the impact of fertility control).

3. DEVELOPMENT OF NATIONAL CIVIL REGISTRATION SYSTEMS

In Europe, the development of Political Arithmetic and Statistics (etymologically the use of quantitative information to inform and further the objectives of the state) in the eighteenth century led to new demand for quantitative information, which culminated in the practice of taking periodic censuses and of making the collection and processing of vital statistics a function and prerogative of civil bureaucracies. The measurement of demographic phenomena became imperative as an instrument of good administration. It was eventually recognized that the Halley method for computing life tables on the basis of a distribution of deaths, without concern for the age distribution of the population, was leading to strong biases. Per Wargentin in Sweden was the first to combine lists of events with lists of people to compute life tables.

By the middle of the nineteenth century, the main demographic measures became the various rates obtained by combining aggregate data from civil registration with population numbers obtained from the census. A demographic rate is expressed as the number of events during a period per thousand (or another multiple of 10) person-years lived during the period. As a shortcut, the population at the middle of the period, multiplied by the number of years of its duration, is used as the denominator. Today, countries in the industrialized world publish detailed yearly estimates of the national population at mid-year, extrapolated from the last census and these estimates are used for the computation of annual rates.

Early writers, such as T.R. Malthus, used the reciprocal of the rate as a measure (for example, the number of people per birth), but William Farr generalized the use of the rate as it is known, and used it in the computation of crude birth and death rates, but also of more sophisticated measures such as occupational mortality or mortality by cause of death. This led to the creation of standard classifications of occupations (so that the categories in the numerator and the denominator would be comparable) and of causes of deaths. In turn, death certificates had to be standardized and had to include carefully stated additional questions, for example, so as to distinguish the underlining from the immediate cause of death. Since the days of Farr, there have been multiple revisions of the causes of death classification. Questions to include in the birth certificate initially were limited to the identity of the parents and the legitimacy status of the child. A significant step was accomplished at the time of the reform of the Scottish vital registration system in 1855, when the age of the mother was included on the form and the data were used to compute the first age-specific fertility rates (Lewis and Lewis, 1906).

Today, birth, death and marriage certificates contain a great deal of additional information. Birth certificates may include information on place of birth (name of hospital or clinic), birth weight and on the characteristics of both mother and father (such as education), number of previous deliveries, details on prenatal care and even use of tobacco and alcohol during the pregnancy. Deaths certificates usually include information that will make it possible to link the record with other information and other documents on the same person, for example, in the social security system, the national population register, or the census (in countries where personal identification codes are included). The classifications (of causes of deaths or occupations) follow international standards, codified by international organizations (such as the World Health Organization or the International Labour Organization), to facilitate international comparisons. European statistical systems usually tabulate the information according to what has been termed the double classification, i.e. by age and by year of birth. This is necessary for cohort studies, as a person born in a particular year may belong to two different birth cohorts.

Access by computer has enormously increased the variety of studies that can be performed on the basis of certificates of vital events and they are increasingly becoming available to researchers.

Two features that present distinct advantages over surveys are (a) the possibilities of linkages; (b) the size of the databases. Whereas a large survey might involve 5,000 respondents, a study of vital statistics even in a moderate-size country like Denmark or in a state of the United States of America, will cover many times that number of individuals.

4. POPULATION REGISTERS

In addition to the civil registration systems responsible for the continuous registration of vital events and the independent system of enumerations that provide population numbers to serve as denominators for the computation of rates, some countries have developed population registers. The term should not be confused with the conventional registration of vital events, although the latter is used to update the population listed in the register.

Starting in 1750, Sweden had organized, on a national basis, a system of population registers that consisted of a population list updated by adding intervening vital events. The Swedish clergy acted as agent for the state in this. This obviated the need to take regular censuses (the first conventional national census for Sweden was only taken in 1930). The population registers also provided a permanent longitudinal record of the population that could be used for administrative and sacerdotal needs. The registers included, for example, mentions of vaccination and religious confirmation. These were the data that Wargentin compiled and used for the computation of life tables.

There were other population register systems in Europe (for example, in Norway and Finland, under Swedish influence, and in Belgium and the Netherlands from the middle of the nineteenth century). They were local population lists used for administrative purposes and the data they produced before the era of computers, were hand-tabulated on a yearly basis, centralized and published. Their longitudinal design was not exploited at the time. They have been a boon to historians, though, because of the analytical possibilities that they offer for longitudinal studies (Bengtsson and others, 2004).

In general, population registers were introduced in areas where a system of parish or civil registration existed already. For example, the history of civil registration in Denmark is reported in Jeune and Skytthe (2001). A royal decree of 1645 required the clergy to transcribe births, baptisms, marriages and burials that occurred in their parish. Starting in 1735, the parishes were required to report the numbers of births and deaths to the central administration. Only in 1812 was it required to create two copies and keep them in different places. Since 1943, all deaths occurring in Denmark were transcribed in a national register of causes of deaths maintained by the Danish Institute of public health. In 1968, a population register was established and every inhabitant was attributed an identification number. Thus, national population registers are not necessarily an extension of local population registers. In Belgium, for example, the population registers were initiated in 1846, but the computerized national register only in 1985.

The national identification number permits the linking of large number of databases. The population registers resulting from this system of linkage are used for multiple administrative purposes (for example, identification of people for taxation, voting, military service, entitlement to social insurance and benefits, and pension systems). Such national population registers have been increasingly popular in Europe. There are different possible administrative arrangements used to combine civil registration, periodic censuses and population registers. In some countries such as Norway, the national population register has completely replaced the census; in others, the periodic censuses are used to check on the quality of the register and to purge it from inevitable confusions,

losses, or double counts. In some countries, the civil registration system has remained independent, and provides one of the databases that are linked to the register. In other countries, the agency responsible for maintaining the population register also produces vital statistics. Medical records on births and deaths are produced by the health system and their timely linkage is essential to its success.

The pooling of information from connected databases opens up many statistical applications for scientific purposes. For example, the Swedish population register includes data on the taxation of individuals, thus providing a proxy for income, a variable which is notoriously difficult to collect in scientific studies. These systems include safeguards to protect confidentiality and individual civil rights. Typically, any linkage using the national identification must be performed by a specialized agency of government that provides specific tabulations to the researcher.

Population registers have met a great deal of resistance in the United States of America, on confidentiality grounds or because of a suspicion they might be used by totalitarian governments. Seltzer (1998) provides historical examples of their use for purposes of genocide. In the hands of a police state, they would provide a powerful instrument of control. The American public shows an instinctive suspicion towards identity documents and sees nothing peculiar in the widespread use of a driver's license for purposes of identification. Even so, linkage of information for administrative or statistical purposes has become a fact of life, even in the United States of America. The social security number, as a unique identification tool, has played a role similar to the national identification number in European countries. Historical genealogies of the population of the state of Utah have been extended to the present through links with contemporary sources including birth and death certificates and medical records, and used for epidemiological studies (Skolnick, 1980). The researchers produce retrospective "pedigrees" over several generations that allow them to track rare genetic diseases.

5. COMPARATIVE ADVANTAGES

In the more developed nations that have benefited for a long time from the existence of complete and comprehensive civil registration systems, there are also well-established traditions of census taking and a regular use of surveys (either periodic or occasional) for the collection of specific demographic information. These various systems of data collection are complementary. Surveys are not a substitute for the collection of vital statistics, in contrast with the role they have assumed in many developing countries.

Accurate information on future civil registration documents and in censuses or surveys, depends on the accuracy of previous records. For example, to analyse the mortality of the oldest old, one needs reliable information on their age, which hinges on the existence of a birth certificate a century ago or more. With the extension of human life, there is increased interest in mortality above the ages at which conventional life tables are terminated. Some studies look at mortality above age 85 or even 100. This presupposes that age data on the death certificates of the oldest old are reliable, that is, that their life started when birth registration was complete. In populations where this condition is not fulfilled, people are naturally over-reporting their ages. One implication is that the full benefit of a civil registration system is only achieved after a long time. An accurate and complete civil registration system also improves the results of censuses or surveys. The accuracy of reporting in surveys depends on the knowledge of ages and of the dating of events in written documents such as civil registration records. Civil registration is a long-term project, dependent on stable institutions. Although there have been experiences of sample vital registration, they do not generate durable results at a national level.

One important comparative quality advantage of civil registration is that it does not depend on the recollection of events long after they occurred, but in most cases, records them with the authority of a legally valid document, certified by competent administrative or medical authorities. This is particularly important for the reporting of causes of death, an integral part of civil registration statistics, which derives its authority from the expertise of reporting physicians near the time of death.

The combination of census and civil registration results makes it possible to obtain demographic information covering the entire country and to explore differentials at a level of aggregation (at a geographical level and along various social and cultural dimensions) that is much smaller than any survey can achieve. On the other hand, specific surveys can study a problem in depth. They can concentrate on a particular part of the population (for example, women in the childbearing ages), investigate one particular phenomenon in great detail (for example, contraceptive prevalence), explore attitudes and motivations (for example, desired family size), or concentrate on variables that are left out of civil registration (for example, religion). Some surveys are periodic, so that they can follow the evolution of a phenomenon over time and yield up-to-date information that can be used by policy makers (for example, the Current Population Survey in the United States of America, the German micro-census or the Eurobarometer surveys). Some surveys can follow a panel over time and adopt a life history perspective.

6. STUDIES USING CIVIL REGISTRATION

Published aggregate civil registration data are a mainstay of demographic studies in the more developed countries. The routine publication of monthly statistics for the entire country involves the main fertility, mortality and nuptiality rates, either crude (that is, for all ages together) or age-specific. Abridged life tables and cause-specific death rates are published with a lower frequency, typically annually. The publication of more detailed statistics at the regional level is less systematic, and is often the subject of special publications. Researchers are typically able to obtain more detailed tabulations of the data from the statistical services of the country. The computation of rates requires the availability of an estimate of the size of the base population, which may sometimes be based on a relatively distant census and has to be revised when a more recent census takes place.

The evolution of causes of death over time is a favourite topic of epidemiologists and demographers. Because of a long history of past efforts at standardizing the lists of causes of death, it is possible to constitute long series and compare them over time for different countries. Even when the expectation of life at birth is very similar in two neighbouring countries, the detailed examination of cause-specific mortality suggests differences that are due to subtle differences in culture, diet or public policy and suggest means of improving the situation in particular areas. The comparison of main causes of death in France and Germany over the period 1950-95 shows, for example, that France has a clear and growing advantage with respect to cardiovascular diseases, and a clear disadvantage with respect to infectious diseases and violent deaths (Haudidier, 2005). Similarly, demographers and epidemiologists have devoted much attention to the different evolution of causes of death in Western and Eastern Europe.

There has been a great deal of interest in the study of longevity and the life span, a topic which requires accurate dates of birth for people who were born a very long time ago. Typically, life table end with an age category such as 85 years and over, an age towards which the expectation of life (that is the average duration of life for the entire population) of industrialized countries is converging and which is already exceeded by women in several countries. There is a growing

literature on the mortality of centenarians, a group that requires the preparation of special data banks with carefully checked dates of birth (see, for example, Robine and Caselli, 2005, in a special issue of the journal *Genus,* devoted to the issue. For the problem of identifying supercentenarians—that is, persons ages 110 years and over—in the United States of America where reliable civil registration did not exist in the nineteenth century, see Rosenwaike and Stone, 2003). Most life tables at advanced ages are not based on unreliable reporting in the censuses, but use a technique of reconstruction of the denominator by reverse accumulation of the deaths, the so-called "extinct generation" technique (Meslé and Vallin, 2002).

7. LINKING DATABASES

In this section, particular interested will be paid to the joint use of civil registration and other databases. The linking takes several forms. A first one is the use of civil registration for evaluating the quality of reporting in another medium, or conversely the use of another data source to check the quality of civil registration. A second use of the registration of birth is as a sample base, to constitute a cohort of individuals that will be followed over time. Another use is to combine information derived from several data based that are linked. This linkage may be facilitated by the use of unique national identification numbers, or by the merging of databases in a population register. Because of the confidential nature of the information, tabulation and analysis of the material must be done by, or in close collaboration with, the national statistics office.

a) *Checking the quality of reporting*. One application is the matching of census data on age with birth or death registration, a technique that is frequently resorted to in assessing the quality of age at death reporting, or the validity of older age reporting in the census. For example, Meslé and Vallin (2002), have computed life table for the oldest old (based on deaths above age 100) on the basis of census data where the French National Institute of Statistics and Economic Studies (INSEE) verified the accuracy of the date of birth, and of a special INSEE file of deaths of persons aged over 90 years (the data are confidential and were communicated to the researchers after nominal information had been deleted).
Another illustration is provided by a classical study by Kitagawa and Hauser (1963), where occupation and marital status recorded on a sample of death certificates were compared with the corresponding information in a recent census, in a matched file of 340,000 cases. The idea behind the comparison is that the information at the time of death may not reflect the status of the dead person when he was alive and healthy.

b) *Use of birth registration as a sampling frame.* A classic American fertility study, the Family Growth in Metropolitan America series of surveys used a longitudinal design to investigate family formation. A first volume (Westoff and others, 1961) reported on the interview of a random sample of 1,165 mothers, living in metropolitan areas with at least two million inhabitants, who had a second birth in September of 1957. The panel was re-interviewed in 1960, to investigate the couples' decision process in having a third child (Westoff and others, 1963), and once again at the end of their reproductive life between 1963 and 1967 (Bumpass and Westoff, 1970).
The British National Child Development study used a somewhat related methodology of sampling on dates of birth, but this time to constitute a sample of births rather than one of mothers. Information on members of the sample

was collected from parents, teachers, health services and so on. All those born in a single week of 1958 were re-interviewed (if they could be contacted) on six occasions, the last time being when they were 42 years old in 2000. This large study has been used for many analyses (for example, Steele and others, 2005).

c) *Combining information from civil registration and other databases.* This is increasingly possible with the computerization of databases and the constitution of national population registers. One of the advantages of this approach is the size of the databases that allows comparisons and studies of differentials that are greatly in excess of what might be obtained in a survey. There are no refusals to participate, no recall errors or deliberate misrepresentations on the part of the respondent. Since an entire population is covered, there is no error resulting from random selection of cases—the time horizon that can be covered by such studies depends on the temporal depth of the databases. Some population registers that started in the nineteenth century (for example, the Dutch one) have been computerized for earlier periods and allow longitudinal studies far back in time (for example, Engelen and Kok, 2003).

8. EXEMPLARS OF STUDIES COMBINING SEVERAL DATABASES

This section lists a number of studies that have been featured in recent demographic publications and that use either linkages within the civil registration system, civil registration in combination with census data, or the national population register and national identity number.

A. Studies using linkages within the civil registration system

The main application here is the linkage of birth registration and death registration during the first year of life of the infant, to investigate the correlates of infant mortality. Frisbie and others, (2004, pp. 779-780) summarize the advantages of the civil registration system for such a study:

> A data set with a large number of cases is required for the construction of multivariate models from which reasonably stable estimates of the effects of risk factors on infant mortality risk and on specific causes of death can be derived. This essentially means that vital statistics must be available. In the United States of America, the National Center for Health Statistics (NCHS) linked birth and infant death cohort files for the years 1989-1990 and 1995-1998 were used, which contained all infants born alive nationwide during those years. The data set contains millions of cases each year and the match rate is exceptional—as early as 1989, more than 97 per cent of the records were successfully linked.

B. Studies using registration in combination with census data

Most of the studies consider the impact of a particular variable on mortality. For example, Doblhammer (2000), compared databases in Austria, the United Kingdom of Great Britain and Northern Ireland and Wales to look at the relation between the parity of women and their subsequent mortality. The Austrian cross-sectional data-set linked death and census records. The deaths of 35,234 women who died within one year after the census of 1981 were linked to the census records and compared to a corresponding enumerated population of 1,254,153 ever-married women between age 50 and 94 years. The English data came from the longitudinal study of the

Office for National Statistics, based on a 1 percent sample of the population of the United Kingdom of Great Britain and Northern Ireland and Wales. It included linked census and vital events data on 56,164 ever-married women enumerated in the 1971 census and followed until the end of 1996. By the end of the observation period, 16,941 women had died. The study concluded that both childless and high-parity women had higher mortality in both data sets.

Martikainen and others (2005) looked at the evolution of differential mortality by marital status in Finland. The study linked 1975 and 1995 Finnish census and population records of men and women over 30 years of age with the records of all deaths during the periods 1976-1980 and 1996-2000, respectively. Linkage was carried out by Statistics Finland using personal identification codes. The authors were able to show that relative mortality differences have grown over time.

In another study of the impact of marital status on mortality, Lusyne, Page and Lievens (2001), looked at the effect of the death of a spouse on the survival of the widowed individual. The data resulted from a linkage of the Belgian 1991 census with the death records for the five-year period following the census. The final dataset consisted of 49,849 widowers and 126,746 widows. One interesting finding was that the education of the widowed person increased the risk of his or her subsequent death.

It is often possible to link death statistics to other databases than the census, particularly when the latter does not include unique identifiers such as a national identity number. Rogers and others (2005), linked a nationally representative health survey in the United States of America, which included information on the individuals' history of smoking, with multiple causes of death files based on death certificates. The record linkage was based on nominal data, dates of birth and residence, but also on the Social Security number and resulted in a file of 36,600 deaths above age 20 years between 1990 and 1997. The results show survival curves that are clearly spaced according to the intensity of smoking, from non-smokers at the lowest levels to heavy smokers at the highest.

The next study (Kalmijn and others, 2005) involves marriage and divorce statistics rather than mortality. It used information provided by municipalities of the Netherlands about all marriages and divorces registered and centralized in the national bureau of statistics. The study considered all marriages formed between 1974 and 1984, and traced divorces during the period 1974-1994 back to them. Linkages were made on the basis of municipality of the marriage, exact date of marriage, and years of birth of both spouses. There were 931,000 marriages linked, a large file that made it possible to distinguish between homogamous and heterogamous marriages in term of religious denomination and national origin.[2]

C. Studies using population registers

Such studies combine demographic events (including marriages and divorces) and make use of the longitudinal nature of the data and of the large size of the databases. Scandinavian countries that have a long tradition with population registers, are conducting a number of innovative studies on demographic problems that would be difficult to investigate in another way. Typical of mortality studies is an article on social differentials in cancer survival by Kravdal (2000), using the Norway register. The analysis is based on individual socio-demographic histories for all men and women with a Norwegian personal identification number, that is, all those who have lived in Norway for some time after 1960. These life histories have been extracted from the Norwegian population register and the population censuses of 1960, 1970 and 1980 and include information on date of

[2] Homogamous refers to marriages occurring in a common social group of the spouses and heterogamous refers to mixed marriages.

death, changes of residence, marital status, income and occupation at the time of the censuses. The biographies have been linked with data from the Cancer Registry of Norway, which from 1953 has received information on all cancer cases in the population.

Rindfuss and others (2006) are involved in another study of the Norwegian population register over time, where they link births by parity with the availability of child care in the district of the mother's residence. The issue is whether the fertility of countries where female education and labour force participation is on par with those of men, can be sustained above the level of reproduction if society provides subsidized care for young children, a topic that have policy implications at a time when the fertility of many countries is declining.

Population registers were used by Murphy and Knudsen (2002) for an intergenerational comparison of fertility in Denmark. The individuals can be identified by a unique Person Number given to each individual with a residential permit in Denmark since 1968, and that may be used to link information from different registers. All linkage and analysis is done by Statistics Denmark. This study is based on a national Fertility Database available to researchers.

Finally, let us look at a study of marriages and divorces in Finland (Jalovaara, 2001). The data consisted of records from the 1990 census, which were linked with divorce records for 1991-1993 and enriched by records from various annual registers for this period. The records of husbands were linked with those of their wives. The linking of registers was carried out by Statistics Finland. The data was restricted to formal marriages in a country where unmarried cohabitation has become common, but is not recorded in official documents.

10. CONCLUSION

In addition to their indispensable role in the administration of bureaucratized modern societies, their contribution to the legal and civil rights of individuals in developed nations, and their uses in public health applications, civil registration systems are increasingly used for complex demographic studies. The routine computation and publication of aggregate numbers and rates, which provided raw materials for many studies at the level of countries or sizable administrative units, have recently been complemented by the analysis of large databases at the individual level. This is one of the many achievements of the age of the computer.

Surveys have grown in a parallel fashion and are prized for their ability to focus on specific issues, and to verify hypotheses or answer questions quickly on the basis of small samples. Studies based on civil registration have distinct advantages when large numbers of cases are needed, when the retrospective assessment of facts through the direct interview of individual may be subject to recall biases, or when the problem at hand requires the comparison of several cohorts. Surveys and civil registration should be treated as complementary parts of a vital statistics system. Surveys alone, however, cannot satisfy the statistical and demographic need for information.

In countries with a long history of civil registration, the temporal depth of the information makes it possible to look at the evolution of particular variables over very long periods. It may be a drawback that these databases are controlled by the national statistical services and that the researcher depends on their good will and time availability. This is unavoidable in order to protect the privacy of individuals and the confidentiality of the information. It has become one of the functions of modern governments to provide access to highly confidential information on individuals while protecting their identity. Some databases linking information have been prepared by the statistical services and are made widely available. Others have to be prepared for particular

projects, a process that is greatly facilitated when population registers already exist in the country, as they do in Scandinavian countries.

A functional vital statistics system is the product of efforts over several generations. The process cannot be short-circuited. Conversely, the progressive improvement of civil registration systems should produce growing benefits with time and it is never too early to start the process.

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