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LEVELS OF ORPHANHOOD AND MEASUREMENT OF ADULT MORTALITY IN POPULATIONS OF THE PAST: THE CASE OF THE NETHERLANDS (THE HAGUE, 1850-1880)

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1. INTRODUCTION

A proper historical study of the breakup of vertical family links has, as yet, not been carried out, Laslett wrote in 1974 1_/. His words still apply now, a decade later. The meager research carried out into the phenomenon of orphanhood cannot be attributed to its marginal character. Namely, in the demographic situation of the pre-industrial and early industrial era a high proportion of children had lost one of their parents by the time they ceased to be children: according to the traditional social order at the moment they got married . The death of one, or both parents had important demographic, social and economic consequences for many individuals, as well as for society. However, this substantive significance is not the only reason why data on the magnitude of the occurrence of orphanhood in different periods are so important. It is also highly significant that during the past two decades - in particular since 1973 -methods have been developed for estimating the death rate of the population to which orphans belong, based on information about the number of orphans, classified by age 2_/. These estimation techniques allow one to determine the

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1_/ P. Laslett, "Parental deprivation in the past. A note on orphans and step-parenthood in English history", Local Population Studies, 13, Autumn 1974, p. 11-18. Extended version published in: P. Laslett. Family life and illicit love in earlier generations, Cambridge University Press, Cambridge 1977.

2_/ L. Henry, "Mesure indirecte de la mortalité des adultes". Population, 15e Anneé, No. 3, 1960, pp. 457-466.
W. Brass and K.H. Hill, "Estimating adult mortality from orphanhood". Proceedings of the International Population Conference, Liège, 1973 (Liège, International Union for the Scientific Study of Population, 1973), vol. 3, pp. 111-123.
K. Hill and J. Trussell, "Further developments in indirect mortality estimation". Population Studies, vol. XXXI, no. 2 (July, 1977), pp. 313-333.
A. Palloni, M. Massagli and J. Marcotte, "Estimating Adult Mortality with Maternal Orphanhood Data: Analysis of Sensitivity of the Techniques". Population Studies, vol. XXXVIII, no. 2 (July, 1984), pp. 255-279.

mortality of the higher age groups in countries and during periods for which data about the numbers of deceased are inadequate or even non-existent. These indirect methods can also be very usefully applied to historical populations for which very little is, as yet, known about adult mortality.

However, the fact that these indirect estimation techniques are based on particular assumptions regarding fertility and mortality is a great disadvantage. Up till now the question whether these techniques yield plausible estimates of adult mortality has only been approached by looking at their internal consistency, by sex and age, of the adult death rates and of their relationship to childhood mortality. But an empirical evaluation of the technique is needed, based on a comparison of the results of the estimation with those of precise direct estimates of adult mortality. Local historical data could do the job.

This paper will attempt to:

1. give an estimate of the levels of orphanhood in a 19th century local population;
2. compare the different techniques for estimating adult mortality with the death rates of this population derived from direct observations;
3. indicate factors which are responsible for the deviations between indirect and direct estimates.

First, a general picture is given of the statistical material on orphans which has been published in the Netherlands up to the present moment. Next, an introduction to the selected municipality is presented, and the data used are discussed in detail. Finally, the results are evaluated and the reasons for the deviations are given.

2. HISTORICAL STATISTICAL DATA ABOUT ORPHANS

It is very difficult to acquire statistics about orphans from the customary demographic sources, for pre-industrial and early industrial populations. This also holds true in the Netherlands. The usual sources for demographic analysis - general and local population censuses, reports of the number of hearths, homes or families, poll-tax registers and the like - are very rarely detailed enough for the researcher who wishes to obtain reliable information on the numbers of orphans.
Useful information for analysis has until now usually related more to the situation of (heads of) households (e.g. the number of widows with children under 16 years present) than to the situation of the children (the number of children under 16 years who have lost their father) 3_/. Nor does the work of famous 17th and 18th century Dutch empiricists, such as Kerseboom, Huygens and Hudde, who all tried to find laws governing mortality, give us a deeper understanding of the pattern of orphanhood. Nicolaas Struyck (1687-1769), a mathematician and astronomer from the city of Amsterdam, was the only one to publish data on the orphans of Amsterdam for the years 1740 and 1741 in his "Onderzoek over den Staat van 't Menselijk Geslagt te Amsteldam" 4_/.

However, as was the case in later publications, Struyck's research was limited to a particular group of orphans, namely those who were taken care of by the church and the state, that is to say, those orphans who lived in an orphanage.

> Until the 13th century, the church alone looked after orphans and the poor. But since then, church assistance has been rivalled by various secular institutions which started to take over part of the monasterial work. Yet the driving force behind these initiatives was still the desire to do pious deeds. Combating beggary became a societal problem in the 15th century, when poverty took on alarming dimensions as a result of economic disasters and continuous warfare. The founding of orphanages fit in with the government policy of reducing beggary to a minimum. And it met the prevalent anxiety regarding the neglect and exploitation of those orphans who were boarded out yearly to the cheapest tender. Thus, in the sixteenth and early seventeenth century, almost every Dutch town

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3_/ E.g. this statement applies to an analysis carried out by Klep of the tax records of 1775 for the western part of the province of Noord-Brabant (P. Klep, "Het huishouden in westelijk Noord-Brabant: structuur en ontwikkeling, 1750-1849". A.A.G. Bijdragen, 18, pp. 23-94, 1973), but it undoubtedly also applies to other analyses of 17th and 18th century censuses.

4_/ Vervolg van de Beschrijving der Staartsterren, en nader ontdekkingen omtrent den staat van 't menschelyk geslagt, beneevens eenige sterrekundige, aardrijkskundige en andere aanmerkingen, te Amsterdam, by Isaak Tirion, 1753. p. 132-136.
See also "Les oeuvres de Nicolas Struyck" (1687-1769) qui se rapportent au calcul des chances, à la statistique générale, à la statistique des décès et aux rentes viagères, tirées des oeuvres complètes et traduites du Hollandais par J.A. Vollgraff. Amsterdam 1912. p. 324-329.

had an orphanage, intended specifically for burgher children 5_/.
Then, in the 17th century, orphanages were founded for orphans of parents without civil rights, followed by orphanages designed specifically for children whose parents were not members of the state church (the Gereformeerde kerk - Dutch Calvinist Protestants - later called the Hervormde kerk - Dutch Reformed Protestants -): Lutherans, Baptists and after 1750, Roman Catholics 6_/. The orphanages were primarily designed for children who had lost both their mother and their father, and who were no older than 18 to 21-years-old. Full orphans were also, of course, lodged by their relatives, some continued to live with their older brothers or sisters, whereas others were boarded out, payed or unpayed, to strangers. Half orphans generally stayed with their mother or father.

When, in the 19th century, statistical information started to become available, data on orphans were limited to those housed in orphanages. This was the case, for example, in 1811, when by order of the French government, data were collected about the numbers of male and female orphans, classified by age and type of orphanage in which they lived. The territory to which these statistics apply was not identical to the present Dutch territory 7_/.
The 1859 census was the first to include information about orphans at a national level, yet once again, only about orphans from orphanages. In 1859, on a total population of 1,629,035 males and 1,680,093 females, there were 5257 male, and 4962 female orphans living in orphanages and other institutions. In 1869 there were far fewer orphans: 4,713 and 4,643, respectively, on a higher total population of 1,764,118 males and 1,815,411 females 8_/.

A great number of orphans counted in 1859 and 1869 formed part of a study set up in 1863-1867 by a governmental committee charged with an investigation into the

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5_/ See J.L. van der Gouw, "Burgerweeshuizen". Historiunculae, Jrg. 10, Mrt. 1965, p. 56-78, and H. Hardenberg, Het Burgerweeshuis voor Nederlands Hervormden te 's-Gravenhage 1564-1964, 's-Gravenhage 1964, N.V. De Zuid-Hollandsche Boek en Handelsdrukkerij.

6_/ Dozens of books have been written to commemorate the fact that these Dutch orphanages existed 400, 300 or 200 years. Here, we only refer to:
J.M. Fuchs, Opvangen en opvoeden. Lutherse wezenzorg in Amsterdam, 1678-1978, Amsterdam 1978.
O. Moorman van Kappen, Tot behoef der arme wesen. Hoofdstukken uit de geschiedenis van het burgerweeshuis te Harderwijk. De Walburg Pers, Zutphen, 1981.
Of a more general character are the following articles:
M.J. Mees, "Iets over weezenverpleging", Vragen des Tijds, 1877, p. 196-221 and M.W. Scheltema, Weesverzorging in vroegere en in onze dagen, Leiden, A.W. Sijthoff, 1871.

7_/ M. D'Alphonse, Enige hoofdstukken uit het "Aperçu sur la Hollande". Bijdragen tot de Statistiek van Nederland. Uitgegeven door het CBS. Nieuwe Volgreeks no. 1, 's-Gravenhage 1900 (Original 1813).

8_/ Uitkomsten der vierde tienjarige volkstelling in het Koningrijk der Nederlanden op den een en dertigsten december 1859. Derde deel, 's-Gravenhage 1864. Uitkomsten der vijfde tienjarige volkstelling in het Koningrijk der Nederlanden op den eersten december 1869. Derde deel. 's-Gravenhage 1873.

investigation into the condition of child labourers in factories 9_/.
In order to be able to compare the health situation of child factory workers, 1396 male, and 1276 female orphans of various ages (constituting about 35% of all orphans living in orphanages) also had to have their length, weight, muscular strength and lung capacity measured. This yielded valuable information on the state of their health.

It is clear that, on the basis of the above-mentioned published statistics, we cannot possibly present a complete picture of the proportions orphaned at different ages and for given periods of time. However, in a publication of 1960, Henry pointed to the possibilities of another source of information; in a large number of countries marriage certificates have, since quite some time, included information on whether the father and/or mother of the bride and groom were still alive 10_/.
In the Netherlands, Diederiks has, as yet, been the only one to make use of this type of information recorded on marriage certificates. But his research only dealt with a limited number of cases 11_/.
It therefore seems worthwhile to make more thorough use of this source of information.
It speaks for itself that an analysis of the data included on the marriage certificates is not feasible at the national level. We therefore decided to restrict our study to one municipality, namely The Hague, and to a particular period of time: 1860-1880.
Important factors which influenced this choice were geographical proximity, the availability of information, and population size.
In the 19th century The Hague was the third-largest city of the Netherlands, after Amsterdam and Rotterdam. It was one of the four cities for which detailed demographic statistics (number of deaths classified by various characteristics, age structure etc.) had already been collected and published, starting from as early as 1840. Its large population (more than 50000 from 1830) gave us the opportunity to make sufficient observations for all kinds of demographic phenomena.
We also chose the particular period for practical reasons. In The Hague, the marriage certificates we needed for the analysis were only directly accessible up to the year 1882. Moreover, the pattern of mortality and fertility in The Hague changed to such an extent after 1880 - due to a sharp decline in mortality and in marital fertility - that an entirely different demographic situation resulted. Both considerations were reason enough to restrict our study to the years preceding 1880. The start of the period to be studied was determined by, on the one hand, the limited amount of time we had at our disposal and on the other hand by the fact that material with which one could independently check the mortality rates derived from an indirect estimation was not available until after 1840. The amount of detail of this material, i.e. the recording of the marital status on the death certificate, increased after 1850, resulting in an even

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9_/ Rapport der Commissie belast met het onderzoek naar den toestand der kinderen in fabrieken arbeidende. Uitgegeven op last van den minister van binnenlandsche zaken. Eerste aflevering. Eindverslag Leiden 1867.
Tweede aflevering. Resultaten van het vergelijkende onderzoek van lengte, gewigt, vitale capaciteit en spierkracht. Leiden 1867.

10_/ See L. Henry cited in footnote 2 and Y. Blayo et L. Henry. "Données démographiques sur la Bretagne et l'Anjou de 1740 à 1829", Annales de Démographie Historique 1967, p. 91-172.

11_/ Diederiks analysed 300 ondertrouwakten (a certificate giving notice of intended marriage) for Amsterdam from the period 1801-1806. See H. Diederiks, Een stad in verval. Amsterdam omstreeks 1800. Demografisch, economisch, ruimtelijk. Amsterdamse Historische Reeks 1. Amsterdam 1982.

further restriction of the period under investigation. Finally, the fact that the census definition of the population remained unaltered after 1860 is reason enough to select the period 1860-1880. As far as the analysis of marriage certificates goes, the above means that they relate to the 1870s and 1880s.

3. THE HISTORY OF THE HAGUE

3.1. Introduction

The Dutch city of 's-Gravenhage or Den Haag (The Hague in English; La Haye in French; La Haya in Spanish) is the seat of the government of the Netherlands and the capital of the province of South Holland. The Hague is situated on a sandy plain that runs along the shore of the North Sea, protected from the sea by a wide row of dunes. It lies at about 50 km from Amsterdam, and approximately 20 km from Rotterdam. Within the city boundaries, on the North Sea coast in the northwestern part of The Hague, lies the fishing village of Scheveningen. Although this village was not administratively independent from The Hague, its relation to The Hague was not that of an ordinary town quarter 12_/: due to the distance from The Hague, due to its principle means of existence (fishing industry) and due to its function as a seaside resort (since 1818). Nevertheless, we shall treat The Hague and Scheveningen as entity, which it has in fact always been from a statistical and administrative point of view.

The name 's-Gravenhage "recalls the hunting lodge and principal residency of the counts of Holland, located in a woodland area called Haghe, or "hedge" (whence 's-Gravenhage, "the counts' private dominion" 13_/..Count William II built a castle there in 1248, around which several buildings - including the famous Knight's Hall (1280) 14_/- came to be clustered. Together they form the Binnenhof ("inner courtyard") in the very heart of the city..This inner courtyard together with the outer courtyard and the areas north and east of it, formed a complex under the Count's immediate rule and jurisdiction. He rented part of the ground to the nobles who formed his council and to high court dignitaries, who built their mansions there, giving rise to a spacious and well-laid-out distinctive district..West of the court area, a small settlement of farmers and craftsmen grew up to service the court, gradually forming a village, the boundaries of which were officially determined in 1370. A flourishing wool industry grew up within the village. The village became the centre of a larger rural district known as the Haagambacht..Until 1795 the court area and the village comprised two separate sections, each with its separate administration and jurisdiction. Because of its open location, the borough suffered much in the beginning of the Dutch war of liberation from Spain (1568-1648). But in 1585, when much of the danger had passed, the States-General, the governing body of the seven United Provinces of the Netherlands, along with other bodies of the central government, established themselves in the Binnenhof. The government of the province of Holland also returned, and stadhouder Prince Maurice of Orange took up residence here.
In the 17th century, when the Dutch Republic played a leading role in Europe, The Hague became an international city, a centre of diplomacy, and a refuge for

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12_/ One could possibly infer that Scheveningen was independent, from the fact that on the marriage and birth certificates of the time, Scheveningen, instead of The Hague, had often been entered as the place of birth and/or residence.

13_/ These, and the following quotations about the history of The Hague are from: The New Encyclopedia Britannica in 30 Volumes Macropaedia Vol. 8 Encyclopaedia Britannica, Inc. Chicago etc. 1979, p. 543-545.
The history of Scheveningen has been traced by J.C. Vermaas, Geschiedenis van Scheveningen, Vol. I and II, Mouton, 's-Gravenhage 1926.

14_/ The first mention of Scheveningen dates back to these years (FvP/JB).

persecuted minorities such as the French Protestants and the Portuguese Jews. A mixture of nationalities lived within the city, and all of them helped to fashion its social and cultural life". In 1622 the city had 17430 inhabitants. After 1630 there was an important expansion, both in the court area and in the newly constructed Prinsengracht region in the village. Canals and small harbours were constructed around the Spui, the canal that connected the Binnenhof with the Dutch waterways, encouraging the development of small trades and industries. Building continued in the 18th century. Around 1755 the city already numbered 41500 inhabitants. "During French rule (1795-1813), The Hague declined into a poor provincial town, but with liberation from the French it once again became the residence of the monarch and the administrative centre, now of the kingdom of The Netherlands. Immediate revival, however, was impeded by a lack of money and the narrow-mindedness of the city magistrates. It was not until after 1850, when the revenues from the Dutch East Indies started to pour in, that any real signs of improvement were seen. Cheap housing was constructed for a rapidly growing middle class. Netherlanders repatriating from the Dutch East Indies showed preference for living in The Hague, thus giving the population a markedly "Indonesian" aspect still found today. After 1870, prosperity increased, and a more progressive city administration provided modern public facilities. Many new shops were built in addition to better housing areas".

Employment statistics show that during the 19th century - at least until 1880 - The Hague was predominantly an industrial and a service centre, not a trade and transport centre, as were Amsterdam and Rotterdam.
As the seat of the national government and as the provincial capital, The Hague's civil service was relatively large (approximately 11.2% of the labour force in 1849), yet, in the period considered here, of declining importance. About 1850, 3.7% of the total labour force was employed in the fishing industry; 40 years later this percentage amounted to 4.4%. In 1849, 34.1% of the labour force was employed in industry, compared with 38.8% in 1889: the building trade accounted for the greater part of this increase. The trade sector (almost 10% of the labour force in 1849) became increasingly important as well. In 1849, 21.8% of the labour force was employed in household services, which is barely lower than the percentage for 1889.

Judging from the classification of heads of families by their taxation bracket, The Hague was, in the mid-19th century, a city of a multitude of rich on the one hand and of an even greater number of poor on the other hand. In Scheveningen, prosperity and inequality were far less pronounced. The working classes predominated in both The Hague and Scheveningen.

The religious conviction of 19th century The Hague was predominantly Nederlands Hervormd (Dutch Reformed Protestants). Including the Waals Hervormden (Walloonian Reformed Protestants) and Presbytarians, about 60% of the population belonged to the Reformed Church. Approximately 30% of the population was Roman Catholic; 4% of the inhabitants of The Hague were Israelites and another 4% were Lutherans.

3.2. Some aspects of the demographic situation of 19th century The Hague

In March 1811 The Hague numbered 42350 inhabitants; almost 70 years later, the period dealt with in this study, there were almost 70000 more. Table 1 shows the population trends of the time.

TABLE 1. NUMBER OF INHABITANTS OF THE HAGUE AND SCHEVENINGEN, 1830-1879

Date	The Hague	of which Scheveningen had:
1- 1-1830	56105	4501
1- 1-1840	63556	5035
1- 1-1850	69707	5700
31-12-1859	78378	7436
1-12-1869	90201	7919
31-12-1879	113430	12139

Source: Documentatie Bevolkingsstatistiek

The average annual growth rate per period fluctuated strongly. It amounted to 1.49% at the beginning of the 19th century, dropped to a level of 1.25% in the years 1830-40, and as low as 0.93% between 1840 and 1850, after which it started to rise again, to 1.18%, 1.41% and 2.32% (1870-1879). Information on the demographic factors that were responsible for this growth are available from 1840 onwards, and in more detail for the years after 1850.

Table 2 gives the population growth, in five-year periods, which was brought about by migration and by natural increase. Note, however, that the registration of migration in particular, was not complete.

TABLE 2. POPULATION GROWTH DUE TO NATURAL INCREASE AND MIGRATION

Period	Total population growth	By natural increase		By migration	
		Absolute	%	Absolute	%
	(1)	(2)	(2):(1)	(3)	(3):(1)
1840-45	3737	3066	82,0	671	18,0
1845-49	2645	2142	81,0	503	19,0
1850-54	4796	3686	76,9	1110	23,1
1855-59	5074	2917	57,5	2157	42,5
1860-64	7371	4145	56,2	3226	43,8
1865-69	6332	4100	64,8	2232	35,2
1870-74	7068	3709	52,5	3359	47,5
1875-79	17371	7282	41,9	10089	58,1

Source: Documentatie bevolkingsstatistiek

Bearing in mind that, as a rule, fewer people were present during the censuses 15_/ than one would expect from the registration of births, deaths and migrants in the intervening periods, it seems likely that the number of emigrants in particular have been underestimated. Apart from this, natural increase appears to have been the reason for the population growth in The Hague until the mid 1850's. In the years to

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15_/ In 1849 this shortage (compared with the expectations over 1840-49) was 231, in 1859 it was 2376, in 1869 1524 and in 1879 1476.

follow, migration became extremely inportant; after the mid 1870's, it even became the dominant factor underlying population growth.

The net gain by migration, which displayed neither a preponderance of women nor of men over the years 1850-54, was very clearly sex-selective after 1855: women accounted for about 60% of the net gain by migration. Consequently, The Hague had a surplus of women: for the period 1840-1880, there were only 827-848 men per 1000 women. The number of unmarried women in particular, was much higher than the number of unmarried men 16_/. If we assume that the data for the years 1877-79 are representative for the entire period 1850-79 then we can say that about 40% of the persons who settled in The Hague (a slightly higher percentage for women) came from a municipality in the province of South Holland itself, and about 50% from another Dutch province. Approximately 10% of those who settled in The Hague came from the colonies or from abroad.
The growing importance of migration was reflected in the origin (by place of birth) of the population of The Hague at the time of the censuses. In 1879, 65.6% of the population was born in The Hague, compared with 68-70% at the time of the 1849, 1859 and 1869 censuses. About 14% was born in a municipality in the province of South Holland, but outside of The Hague (slightly more than in the years before 1879).

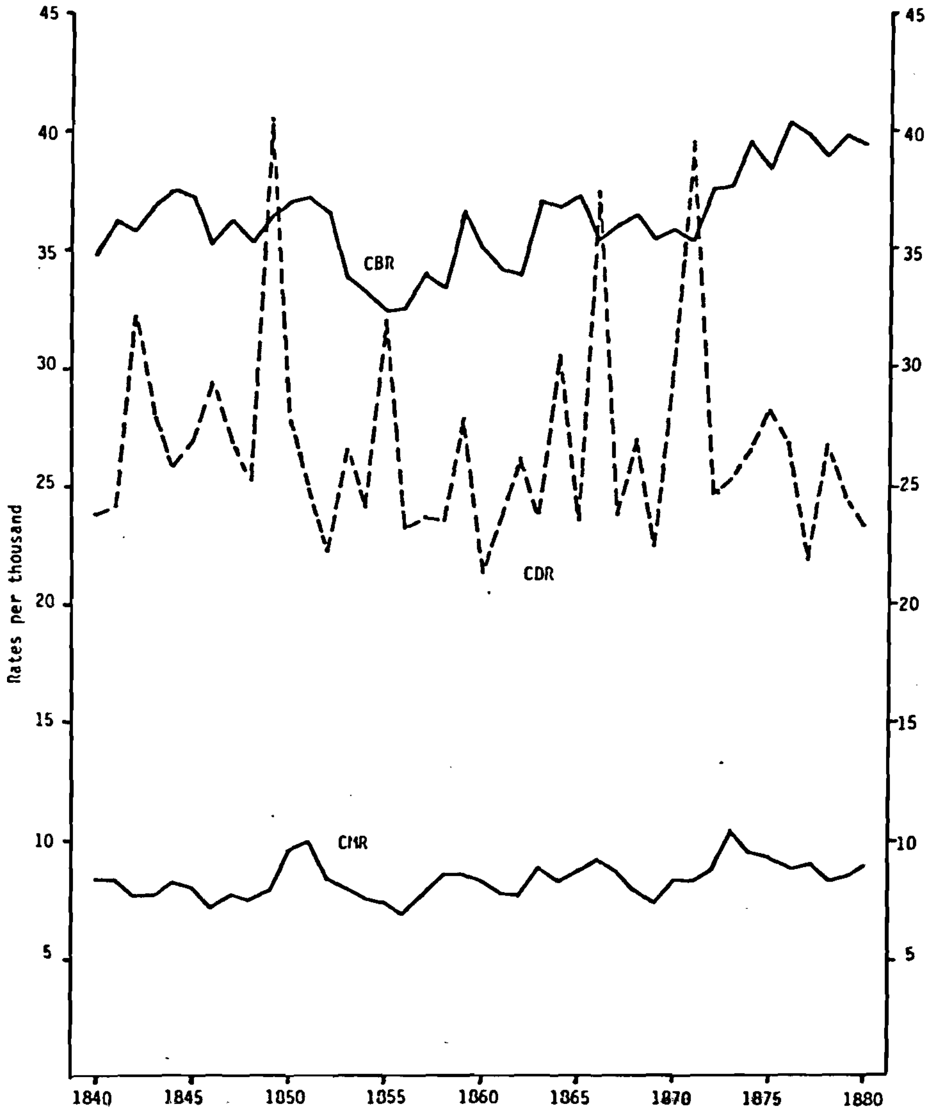
Figure 1 gives a detailed picture of the crude birth rate (CBR), crude death rate (CDR) and crude marriage rate (CMR) for the years 1840-1880.

The crude birth rate was fairly stable in the years 1840-1852; it dropped to a lower level in the mid 1850s, after which it fluctuated around 35-36^{o}/oo. By the late 1870s, however, the CBR increased by 3-4^{o}/oo.
On the whole, the birth rate was quite stable, the two extreme values being 40.3^{o}/oo and 32.4^{o}/oo.

The crude death rate (CDR) on the other hand, behaved in a totally different manner; besides lows at 21.4^{o}/oo, peak years in which the death rate was almost twice as high were also found (1849: 40.5^{o}/oo; 1871: 39.5^{o}/oo), caused by cholera and a smallpox epidemic, respectively. However, in "normal times" the death rate in The Hague was 23 to 27^{o}/oo.
Figure 1 shows that, for the period 1840-1880, there was neither a decline in the death rate nor a decline in the birth rate.
The crude marriage rate fluctuated considerably, but in the 1870s a slightly higher level was reached than in the previous 3 decades.

16_/ This is comparable with the situation in present-day Latin America. Here, rural/urban migrants constitute a similar category, both in terms of age and of sex: young adults, notably women (mostly unmarried) migrate most frequently. See: Ramiro Cardona G. "New insights into the economic and social consequences of rural/urban migration" pp. 323-338. In: I.U.S.S.P., Economic and Demographic Change: Issues for the 1980's. Proceedings of the Conference Vol. II, Helsinki 1978. A. Simmons, Diaz-Briquets and Laguian (Social Change and Internal Migration: A Review of Research Findings from Asia, Africa and Latin America, International Development Research Center, Ottawa 1977) have even called the situation in which migrant flows to the city are predominantly composed of women: "the Latin American pattern".

FIGURE 1. CRUDE BIRTH RATE (CBR), CRUDE DEATH RATE (CDR) AND CRUDE MARRIAGE RATE (CMR), THE HAGUE, PERIOD 1840-1880.



Source: Documentatie bevolkingsstatistiek

Table 3 gives more detailed information on patterns of marriage and family formation, gathered for the years preceding and following the censuses.
Data on mortality are missing. These will be dealt with in section 4.

TABLE 3. SOME DEMOGRAPHIC INDICATORS FOR THE HAGUE, PERIOD 1839-1881

	1839-40	1848-50	1859-61	1868-70	1879-81
Ever-married males per 100 males aged 25-29 a_/	48.0	40.8	40.8	43.9	56.7
Ever-married females per 100 females aged 25-29 a_/	42.9	37.5	38.8	42.2	51.5
Marriages per 1000 unmarried males aged 15 and over b_/	56.5	54.3	58.6	57.4	71.9
Divorces per 10000 married males		3.4	4.4	5.7	9.0
Marital fertility rate per 1000 unmarried women aged 15-49	274.2	278.9	284.3	278.2	315.6
Non-marital fertility rate per 1000 unmarried women aged 15-49	198.9	224.6	210.4	172.6	133.0
Extra-marital live births per 100 live births (Illegitimacy ratio)	9.1	11.2	10.1	8.2	4.9

a_/ On the census dates themselves
b_/ Period 1840-41

Source: F.W.A. van Poppel. Stad en platteland in demografisch perspectief: de Nederlandse situatie in de periode 1850-1960. NIDI Intern Rapport no. 29. Voorburg 1984

The detailed statistics given in Table 3 confirm the trends described earlier. Around 1880, marriages were contracted much more frequently than in the foregoing period, and also - judging by the percentage of ever-married 25 to 29-year-olds at the time of the respective censuses - at a younger age than in the foregoing period, possibly as a result of growing employment opportunities in industry. During these years, divorce started to gain ground as a cause of marriage dissolution, yet the position of marriage as the institute for procreation was strengthened, as indicated by the strong decline in non-marital fertility (the illegitimacy ratio was halved). The marital fertility rate, which was constant in the period 1840-1870, increased significantly around 1880: a similar trend was found for Ig, the standard marital fertility rate (values for the periods 1839-40, 1848-50, 1859-61, 1868-70 and 1879-81, were, respectively, 0.772, 0.816, 0.822, 0.817 and 0.877) which implies that the declining age at marriage was not the determining factor behind the increase in marital fertility.

4. DATA: SOURCES AND RELIABILITY

4.1. Introduction

The different methods which have been designed for the estimation of adult mortality, based on information concerning the proportions orphaned, all make use of the same data: the number of respondents with a mother (or father) alive (or dead), classified by age, and the number of births occurring in a given year classified by age of mother or father.
These data were extracted from various sources: on the one hand we used the separate sections of the vital registration system (the birth register, the marriage register and the death register), on the other hand we consulted the so-called bevolkingsregister (population register). In order to compare our estimates of the death rate with independently constructed mortality tables, we had to use aggregated statistical data, notably the number of deaths classified by age, sex and marital status, and the age structure by sex and marital status. These data were extracted from the published vital statistics and from various censuses, respectively.
Since 1812, registers of births, marriages and deaths were kept in all Dutch municipalities, following the instructions set down in the French Code Civil; this code of law, which was introduced when the Netherlands was annexed by France (1810-1813), was not replaced until 1838-25 years after the Netherlands became independent - by the Burgerlijk Wetboek (Civil Code). However, the legal regulations regarding the system of vital registration did not change significantly.
Next to, but not independently of, the vital registration system, all Dutch municipalities have, since 1850, had a second source of demographic data at their disposal: the population register. Population registers are a cross between a vital registration system and a census. They are composed of an inventory of the inhabitants of a municipality which is continuously updated by current information on events such as births, deaths, marriages, divorces and changes of residence. The Dutch system of continuous population accounting is based on regulations set down in a Royal Decree of 1849. The first register was based on the census held in November 1849 17_/.
A more detailed account of the different sources - of their assets and shortcomings - will be given later, when discussing the variables which play a role in the estimation of mortality.

4.2. Estimation of the proportions orphaned

The sources of information on the numbers of people whose father and/or mother is /are still living, were the marriage certificates incorporated in the marriage registers.

Data incorporated in these marriage certificates included: the christian names, surname, age, place of birth, occupation and municipality of residence of the spouses, and, if they had been married before, the christian names and surnames of their former spouses. The parents' christian names, surnames and place of residence were also recorded. The quality of the data incorporated in these marriage certificates -and

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17_/ This is based on: J.C. van den Brekel The Population Register: The Example of the Netherlands System. Laboratories for Population Statistics. Scientific Report Series no. 31, August 1977. The University of North Carolina at Chapel Hill. Chapel Hill USA.

of other information which will be mentioned later - was more or less ensured by the by the rules set down in the civil code (BW) regarding marriage requirements and the registration of marriages. Marriages had to be contracted in the municipality of residence of one of the two parties, and could only be entered upon - unless the king had given dispensation - by young men who had reached the age of 18 years, and by young girls who had reached the age of 16. "Minors", i.e., persons under 23 years old, were not authorized to enter upon a marriage without parental permission, that is to say, the father's permission. In cases where both the father and the mother of the bride or groom had died, the grandfather on the father's side had to grant his permission. Adult children under 30 years old, also needed their parents' permission to marry, but they could take the case to court if this permission was not granted. In the marriage certificates, special mention was made of the permission granted by parents, grandparents or guardians or, where required, of the permission to marry granted by the court. The reliability of these data was guaranteed by the fact that the registrar had to be in possession of copies of the birth certificates of both the bride- and groom-to-be, before he could pronounce the marriage 18_/.
The parent's permission to marry could be granted at the very moment the marriage was pronounced, or else the father, mother, grandfather or grandmother had to submit an authentic certificate acknowledging their permission. In case of death, the death certificates of those relatives who, by law, had to give their permission for the marriage had to be presented to the civil servant 19_/.
At the end of each year all the proxies, birth and death certificates which had been demanded by the registrar were brought to the district courts. In The Hague, these marriage documents are kept in the municipal archives.

As mentioned in the introduction, the period 1860-1880 was, for various reasons, the most suitable period to study.

Considering the fact that the estimates of adult mortality, derived from information on orphanhood, generally refer to a period of 10 to 20 years preceding the moment the proportions orphaned are measured, it seemed most meaningful to calculate the orphanhood proportions for the years around 1880. In addition, a hypothetical intersurvey cohort could be constructed, derived from estimates referring to the period 1870-1880, by estimating these proportions for the year 1870.
In view of the relatively small number of marriage certificates for 1870 and 1880, it seemed desirable to supplement them with records for the years 1869 and 1871, and 1879, respectively.

In 1869, a total of 676 certificates were recorded in the marriage register; in 1870 a total of 764, in 1871 766, in 1879 963 and in 1880 1061. It goes without saying that certificates regarding divorce (62) or the legalisation of a pre-marital birth (10) have not been taken into account in our study. This also applies to those citizens of The Hague who married outside of the Netherlands - a total of 22 marriages. Marriages that were contracted by proxy have been included here. We consequently

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18_/ Bearing in mind that the system of vital registration was introduced in 1811, and that we studied the period after 1869, it follows that, at least for persons aged 57 years or younger, the age of the bride and groom could be determined unequivocally.

19_/ This implies that for persons aged 30 years and over it was not necessary to produce a copy of the parents' death certificates.

had a total of 4136 marriage certificates at our disposal. It was thus possible to determine whether the father and/or the mother of 8272 brides and grooms were still alive at the time of marriage. In 8 cases this question could not be answered for the mother because she was stated as being "absent". There was greater uncertainty about the fathers' existence. 18 fathers were recorded as being absent.

In 248 cases of natural children the child's orphanhood status could not be fully determined. These marriages constitute 3% of the total, a perfectly plausible proportion, in view of the percentage of registered illegitimate births in The Hague, the recognition of these births at a later date and the higher death rate amongst illegitimate children.

4.3. Mean age of mothers (fathers) at the birth of their children

The mothers' (fathers') mean age at the birth of their children, denoted by M, has been estimated using data over 1880.

As shown in Table 3, marital fertility in The Hague increased considerably between 1870 and 1880, partly due to the fact that people married at an earlier age than in the years before 1880. It is therefore plausible that the value of M for 1880 is slightly different from (probably lower than) the value for the period 1840-1870. However, we chose to estimate M on the basis of data over 1880, by reason of efficiency and accuracy; this flows from the fact that the population register used for the estimation of M has a truly alphabetical index of the names of the inhabitants only in the year the register was introduced.

The number of births in 1880, classified by mother's (father's) age, was primarily derived from the birth register and the population register. In addition, information was derived from the marriage and death registers. The birth certificates incorporated in the birth register were taken as a starting point. These certificates refer to live-born (and -registered) children 20_/; data included are the year and date of birth, the sex and christian names of the child, the christian names, surnames and place of residence of the parents, and the age of the person who notified the registrar. If the father was the one who gave notice of the birth, his age was known. The age of the child's mother - as well as that of the father -could be determined from the data incorporated in the population register, by referring to the name of the father and/or mother. Namely, for all persons whose actual residence was The Hague, the population register contained information on the date and year in which they were entered in the register, their surname and christian names, date of birth, sex, marital status, their relation to the head of the family and place of residence 21_/.

The dates of birth of the parents of children born in 1880 were taken from the register covering the period 1880-1895. If it was not possible to locate certain persons in this register, or if there was uncertainty about an individual's particulars, we used the population registers for the years 1861-1879 and 1895-1913. In concept, these

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20_/ Infants born alive but dying prior to the registration of the birth (which may take as long as 3 days) have therefore occasionally been registered as still-born children.

21_/ Changes in the particulars of an individual (birth, death, migration, change in marital status) have been incorporated for the period covered in the register, including the date of the change and, in case of migration, the place of new residence and of departure.

registers were identical. Any further uncertainties about the parents' age could be done away with by consulting the alphabetical index of the marriage certificates in order to find out whether the couple in question married in The Hague; if this was indeed the case, the exact dates of birth could be derived from the copies of their birth certificates, which were attached to their marriage certificate. If it was certain (from the population register) that the parents had been born in The Hague, we were able to refer directly to their birth certificates.
A 20% sample was taken from the birth certificates which had been entered in the birth register in 1880. Taking a random certificate number below six, every fifth certificate was selected; similarly, for the certificates entered in 1881, those certificates were selected which belonged to children born in 1880. A total of 922 certificates were examined: 905 of them referred to children born out of parents living in The Hague.

In 513 cases the father gave notice of the birth of his child; his age was therefore entered on the child's birth certificate. In 396 cases (77.2%) the husband's age at last birthday, derived from the dates of birth recorded in the population register, coincided with the age given on the birth certificates. In 83 cases (16.2%) the age given by the husband upon registration of his child was overstated by one year and in 20 cases (3.9%) the age given was understated by one year as compared with that recorded in the population registers. In the 14 cases in which the ages given by the father differed from the age at last birthday by more than a year, the exact date of birth was determined by referring to the marriage documents. In view of the fact that the above-mentioned 83 cases, in which the age was overstated by a year, almost all concerned men whose birth-days were not far off, one may assume that the ages derived from the population register are sufficiently reliable. Double-checking the date of birth of the parents randomly via the parents' birth certificates, the age at marriage as indicated on the marriage certificate, and the date of birth recorded in the population registers for the years 1860-79 and 1895-1913 strengthened our impression that the above method of determining the father's and mother's age at the birth of their child was reliable.

The age at the birth of their child could be determined for a total of 903 women and 861 men: constituting 19.9 and 19.0% of all births in 1880 (4533), respectively. If we assume that, on average, six months elapse between the last birthday and the date of birth of the child, the mean age of mothers at the birth of their child stands at 31.18 years, and the mean age of the father at 33.59 years 22_/.
For females, the median age at maternity (paternity), which is sometimes used to reduce the influence of older and, for the purpose at hand, largely irrelevant couples, is almost the same (30.99 versus 31.18). For males, however, the median is 1.19 years lower (32.4 years). The consequences of this difference for the conversion of proportions orphaned into survivorship probabilities will be dealt with later.

22_/ An estimation by Festy puts the mean age at childbearing, m(i.e., the mean age of the age-specific fertility schedule), for generations born in the years 1851-1860, 1856-1865 and 1861-1870 at 32.7, 32.2 and 32.0 years, which is slightly higher than our estimate. Considering the younger age-structure, compared with m, on which M is based, and in view of the lower fertility found in cities, such a difference is most definitely acceptable. See Festy, P. La fécondité des pays occidentaux de 1870 à 1970. INED. Travaux et documents. Cahier no. 85. Presses Universitaires de Frances, Paris 1979, p. 272.

4.4. Life tables based on data from the vital registration system

The Hague has a long tradition in death statistics. Since 1755, publications have appeared annually, giving information on the number of deaths classified by the person's age and the cause of death based on the notification of the municipal registrar 23_/. As from 1811, together with the introduction of the Code Civil, The Hague wrote out a death certificate for each death case in accordance with the national regulations. These certificates included the christian names, surname, age, profession and place of residence of the deceased.
Due to the fact that, when (formerly) married persons died, their (ex)-spouse's name also had to be entered, the marital status of the deceased was also known. In the municipality of The Hague, statistics of the deceased, classified by age, sex and marital status, based on these certificates were published from the period 1840-1851 onwards, in various forms and in varying degrees of detail 24_/.

Whatever kind of death rate one wishes to calculate, one must have access to information on the average population exposed to the risk of death. The necessary data could be derived from the decennial censuses. Namely, for 1 January 1840, November 19th 1849, December 31st 1859, December 1st 1869 and December 31st 1879, the composition of The Hague's population, by age, sex and marital status, was known. It has been assumed that the average of the population numbers at the beginning, and at the end of the ten-year period represents the average population exposed to risk of death or the average annual number of "person-years of life" lived during that period 25_/.
Table 4 shows both the number of deaths for several important age groups and the size of the midperiod population.
Death rates, classified by sex and age group, have been calculated for both the total population and for the ever-married (married, widowed and divorced), by dividing the average number of deaths in a given category for every ten-year period by the mid-period population of that category.
Rates were computed per 5-year age group, but separate rates were computed for the age group under 1, and the 1 to 4-year-old age group. The mortality rate for the first

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23_/ Nierop, L. van. "De aanvang der Nederlandsche demographie". Econo-misch-Historisch Jaarboek Deel V. 1919, p. 192-208.

24_/ For the years 1840-49 only the numbers of deaths by age and sex were known; for the following years the marital status of the deceased was given in addition to age and sex.

25_/ The censuses did not all use the same definition of the total population.
In 1840 the population actually resident in the municipality was counted. In 1849 the published population structure, by age, sex and marital status, was that of the de facto population, i.e., any person present in the municipality at the time of the census, even if their presence was purely coincidental. As a result, 2656 more persons were registered than found when using the definition of the de jure population (1602 men and 1054 women).
However, for the total population size, data on the de jure population were also published; these figures have been used to calculate the CBR, CDR and CMR mentioned earlier. In 1859 and 1869, both the de facto and the de jure population were counted and the census results were published according to both definitions. In 1879 only data on the de jure population were published. For consistency's sake, the calculation of the midperiod population for the years 1850-1859 was

age group is defined as the number of infant deaths per period per 10,000 live births during the same period.
Abridged life tables have been constructed on the basis of the age-specific mortality rates, per five-year age group, except for ages under 5 years.

The probabilities of dying, ${}_nq_x$, are computed as:

$$ {}_nq_x = \frac{n.{}_nM_x}{1+(n-k)\,.\,{}_nM_x} $$

where:

${}_nq_x$ is the probability of dying between the exact age x and the exact age x+n
${}_nM_x$ is the age-specific death rate for age group x to x+n
n is the age group interval (4 years for the second age group and 5 years for the remaining age groups), and
k is the death separation factor for each age group (Coale-Demeny death separation factors are used for age group 1-4, whereas the separation factor for all higher age groups is taken as 2.5) 26_/.

Figure 2 presents the resulting values of ${}_nq_x$ for those ages that are most relevant for the evaluation of the indirect estimation technique. It appears that, apart from the period 1840-49, ${}_nq_x$ values for x = 40, 45 etc. are fairly stable, especially for females. For men, ${}_nq_x$ values fluctuate more frequently but these fluctuations are strong only at very high ages (x=70 or over).
As could be expected from figure 2, the expectation of life at birth in the period 1850-1879, did not change much: for males it rose from an initial 33.21 in the period 1840-49 to 35.25 in the years 1850-59 and 34.42 and 34.90 years in the following decades. The expectation of life at age 20 increased among males from 35.95 to 39.29 in the period 1850-59: it stayed at that level in the following decades (39.25 and 39.46). For women, nearly the same development took place; the expectation of life at birth increased after 1840-49 (from 38.56 to 39.67) and did not change afterwards (39.42 and 39.65). The expectation of life at age 20 increased from 42.15 via 42.61 and 43.08 to 43.61 years.

Before discussing the results of the indirect estimation of adult mortality and comparing them with the directly calculated values, a few remarks have to be made concerning the quality of the empirical life tables.
In order to obtain an independent measure of the internal consistency of the data concerning the number of deaths and those concerning the po-pulation at risk two exercises were done: the Brass's Distribution of deaths method was applied and an intercensal evaluation was carried out. In both instances the tests were limited to data for the period 1850-1879 because of the fact that the mortality pattern in these 3 decades was nearly the same and differed rather strongly from that of the years 1840-49.

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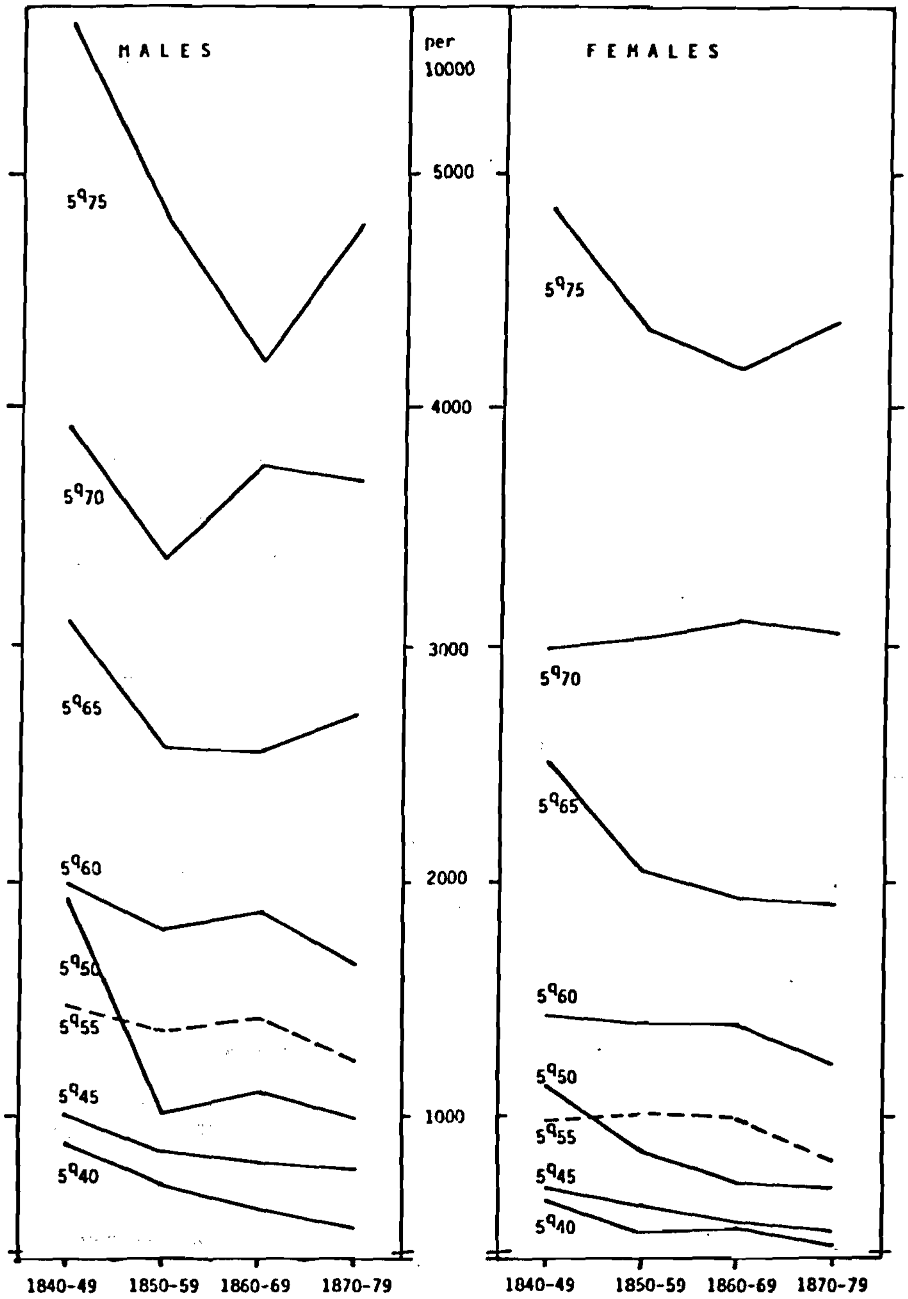
based on the (de facto) population which was present at the time of the 1849 and 1859 censuses. In all other cases the de jure population was used as far as possible. As far as tangible results are concerned, however, the two definitions hardly differ.

26_/ U.S. Bureau of the Census, Computer Programs for Demographic Analysis by E. Arriaga, P. Anderson, L. Heligman, Washington 1976.

TABLE 4. AVERAGE POPULATION BY AGE, SEX AND MARITAL STATUS, NUMBER OF LIVE-BORN CHILDREN AND NUMBER OF DEATHS BY AGE, SEX AND MARITAL STATUS. THE HAGUE, PERIODS 1840-49, 1850-59, 1860-69 AND 1870-79.

Average population by age group	Males							Females						
	Total population				Ever-married			Total population				Ever-married		
	1840-49	1850-59	1860-69	1870-79	1850-59	1860-69	1870-79	1840-49	1850-59	1860-69	1870-79	1850-59	1860-69	1870-79
20-24	3087	3156	3319	3778	278	312	506	3414	3728	4171	4940	522	620	885
25-29	2654	2854	3043	3680	1168	1293	1868	3218	3454	3709	4637	1319	1510	2198
30-34	2282	2580	2876	3297	1741	1998	2463	2865	3208	3573	4177	1860	2149	2676
35-39	2016	2327	2504	2881	1865	2023	2397	2487	2882	3125	3597	1997	2164	2548
40-44	1765	1988	2265	2719	1704	1959	2410	2296	2547	2890	3440	1892	2139	2597
45-49	1438	1659	2017	2361	1466	1812	2127	2042	2250	2539	2948	1733	1992	2284
All ages	31015	34178	38181	46346	12603	14661	18392	36861	41109	46062	55470	15348	17482	21727
Number of live-born children	12404	12964	15534	19420	-	-	-	11842	12679	14597	18456	-	-	-
Number of deaths by age group														
20-24	148	276	310	432	17	22	33	127	210	236	325	48	43	69
25-29	355	225	262	341	74	93	138	198	246	279	346	122	156	186
30-34	330	260	260	296	160	163	175	223	302	290	347	186	207	240
35-39	300	294	307	315	229	234	219	262	291	327	366	213	253	269
40-44	327	293	287	298	242	238	246	305	268	318	321	210	255	230
45-49	306	292	337	383	247	293	322	295	291	291	306	214	225	231
All ages	9565	9168	10902	13480	3005	3516	4209	9474	9638	10931	13361	3599	4013	4575

FIGURE 2. VALUES OF $_5q_x$ FOR THE TOTAL MALE AND FEMALE POPULATION, THE HAGUE, PERIODS 1840-49, 1850-59, 1860-69 AND 1870-79



Brass 27_/ has demonstrated that the growth balance equation, formulated in terms of the crude growth rates, death rates and birth rates of a population over the

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27_/ W. Brass, Methods for Estimating Fertility and Mortality from Limited and Defective Data, Chapel Hill, North Carolina, Carolina Population Center, Laboratories for Population Studies, 1975.

entire age range also applies in stable populations to the population above any given age, so that the entries into that population segment divided by the population in question minus the exits divided by the same denominator equals the growth rate of the population of that age range. In a stable population this growth rate, of course, equals the growth rate of the whole population. Deviations from the growth balance equation indicate whether there are inconsistencies in the data, referring to the population and deaths at age x and over. For our purpose it will suffice to know that the intercept alpha in the following table should be equal to the growth rate rho and the slope beta should be unity, if the assumption of stability applies and there are no irregularities in the data.

In the Brass technique the adjustment factors are within 3% except for the decade 1860-1869, where there is an indication of underregistration of deaths or overregistration of persons, particularly for the male sex. The growth rates implied are close to those calculated in the stable female population with the observed life tables for the periods in consideration combined with the fertility schedule 28_/. Table 5 bears witness to these statements.

TABLE 5. SLOPE (BETA) AND INTERCEPT (ALPHA) IN THE CLASSICAL BRASS GROWTH BALANCE EQUATION, AND INTRINSIC GROWTH RATES (RHO) CALCULATED WITH FEMALE LIFE TABLES FOR THE DECADES INVOLVED IN COMBINATION WITH THE ESTIMATED FERTILITY SCHEDULE (CONSTANT)

	Period					
	1850-1859		1860-1869		1870-1879	
	Males	Females	Males	Females	Males	Females
Beta	1.02	.99	1.14	1.03	1.05	1.02
Alpha	.014	.010	.009	.010	.010	.010
Rho		.009		.009		.009

The intercensal evaluation consisted in projecting the observed population forward with the empirical life tables and comparing the results with the census population at the end of the decade. For the 1850-59 period, the saldo was less than 1000 persons of ages over 10 which is consistent with the conclusions one would have drawn from an examination of the material considered thus far: reliable mortality estimates and moderate net migration. For the next decade there is a surplus of about a 1000 for males and 2500 for females. The surpluses increase for the last decade, 1870-1879, to respectively three and six thousand persons. These data confirm the direct evidence of

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28_/ The age-specific fertility rates for the years 1879-80 are based on the sample data concerning the relative distribution of live births by age of the mother, on the average number of live births in 1879-1880 and on the number of women per age group on December 31st, 1879. The resulting total fertility rate is 4.85.

non-negligible net immigration, accumulating towards the end of the study period and concentrated in the female sex.

In order to obtain an idea about the degree in which the mortality of The Hague is 'exceptional' an attempt was made to fit the Brass relational logit system to the observed tables and goodness of fit indicators were calculated 29_/. The underlying assumption is that the Brass general standard is indeed what it proposes to be, a model which replicates average western mortality rather well. The results are presented in Table 6.

In order to obtain a visual impression of the degree in which the deviations are systematic, a series of graphs is presented with the residuals of the fitted versus the observed l(x) and q(x) values. (Figure 3)

The best fits are reached in the period 1850-59. As time progresses, attempts to replicate the recorded mortality patterns are slightly less successful. Fits for the female population are less faithful than those for males. On the whole we may conclude that the fit for l(x) is rather good; that for q(x) is poor. Furthermore, systematic deviations appear. As might have been anticipated, the residuals are largest at the tails of the distribution. The q(x) values are typically lower at infancy, higher in the 1 to 15 age groups and higher after the age of 70, when comparing observed with estimated values. We may conclude that our empirical tables are not replicated as well with the instrument applied than might have been expected. The pattern diverges systematically from the fit obtained with the procedure. It remains to be seen whether the indirect mortality estimating procedure under consideration is robust to this deviant pattern of mortality.

29_/ The goodness-of-fit indicators for l(x) are defined as follows:

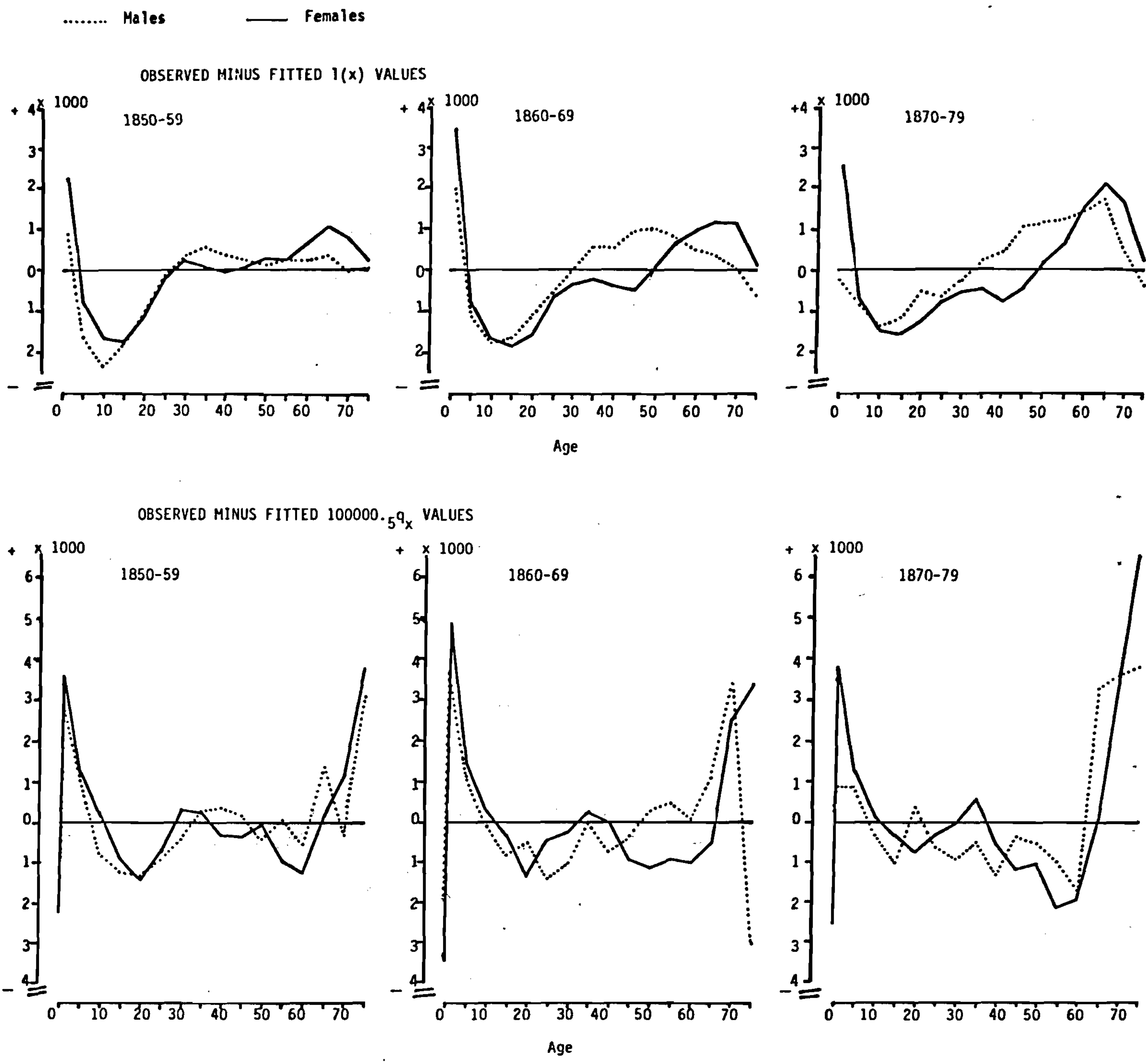
- chi square $= \sum_{n} (l'(x) - l(x))^2 / l'(x)$
- mean absolute deviation $= \frac{1}{n} \sum_{n} \left| l'(x) - l(x) \right|$
- mean absolute percentage deviation $= \frac{1}{n} \left(\left| l'(x) - l(x) \right| / l(x) \right)$

In these formulas, l(x) denotes observed and l'(x) fitted values.
Common to all these indicators is that a value of zero points to a complete fit: the maximum values of these indicators may vary however.

TABLE 6. PARAMETERS AND GOODNESS-OF-FIT INDICATORS OF EMPIRICAL LIFE TABLES AGAINST LEAST SQUARES FIT IN THE BRASS RELATIONAL LOGIT SYSTEM, THE HAGUE, PERIODS 1850-59, 1860-69, 1870-79

	Period					
	1850-1859		1860-1869		1870-1879	
			FEMALES			
Function	l(x)	q(x)	l(x)	q(x)	l(x)	q(x)
Alpha	.08655		.09013		.08315	
Beta	.77227		.75448		.72315	
R square	.99760		.99406		.99365	
Chi square	.00287	.03555	.00464	.04986	.00636	.05218
MAD	.00707	.01113	.00940	.01343	.01053	.01557
MAPD	.01643	.14392	.02013	.14815	.02675	.14548
			MALES			
Alpha	.21524		.24365		.23177	
Beta	.86397		.86044		.84366	
R square	.99494		.99768		.99707	
Chi square	.00251	.02781	.00318	.03031	.00473	.02625
MAD	.00633	.00973	.00808	.01186	.00826	.01258
MAPD	.14183	.01479	.11785	.01865	.12616	.02705

FIGURE 3. RESIDUALS OF OBSERVED VALUES OF l(x) AND $_5q_x$ VERSUS VALUES FITTED WITH THE LOGIT SYSTEM USING THE BRASS GENERAL STANDAR
THE HAGUE, PERIODS 1850-59, 1860-69 AND 1870-79. TOTAL POPULATION.



5. RESULTS

5.1. Levels of maternal and paternal orphanhood

Table 7 shows both the raw data collected in The Hague for the periods 1869-71 and 1879-80 and the proportions of respondents whose mother or father was alive at the time of marriage. The data only refer to age-groups with 20 or more respondents. In table 7, and in the following tables, the data showing whether or not the bride's parents were dead, and the same data for the bridegroom, have been taken together. In Figure 4, these figures are given as the proportions of respondents whose mother or father is no longer alive.

FIGURE 4. PERCENTAGES OF BRIDES AND GROOMS WITH MOTHER RESPECTIVELY FATHER DEAD BY FIVE-YEAR AGE GROUP. THE HAGUE, PERIODS 1869-71 AND 1879-80.

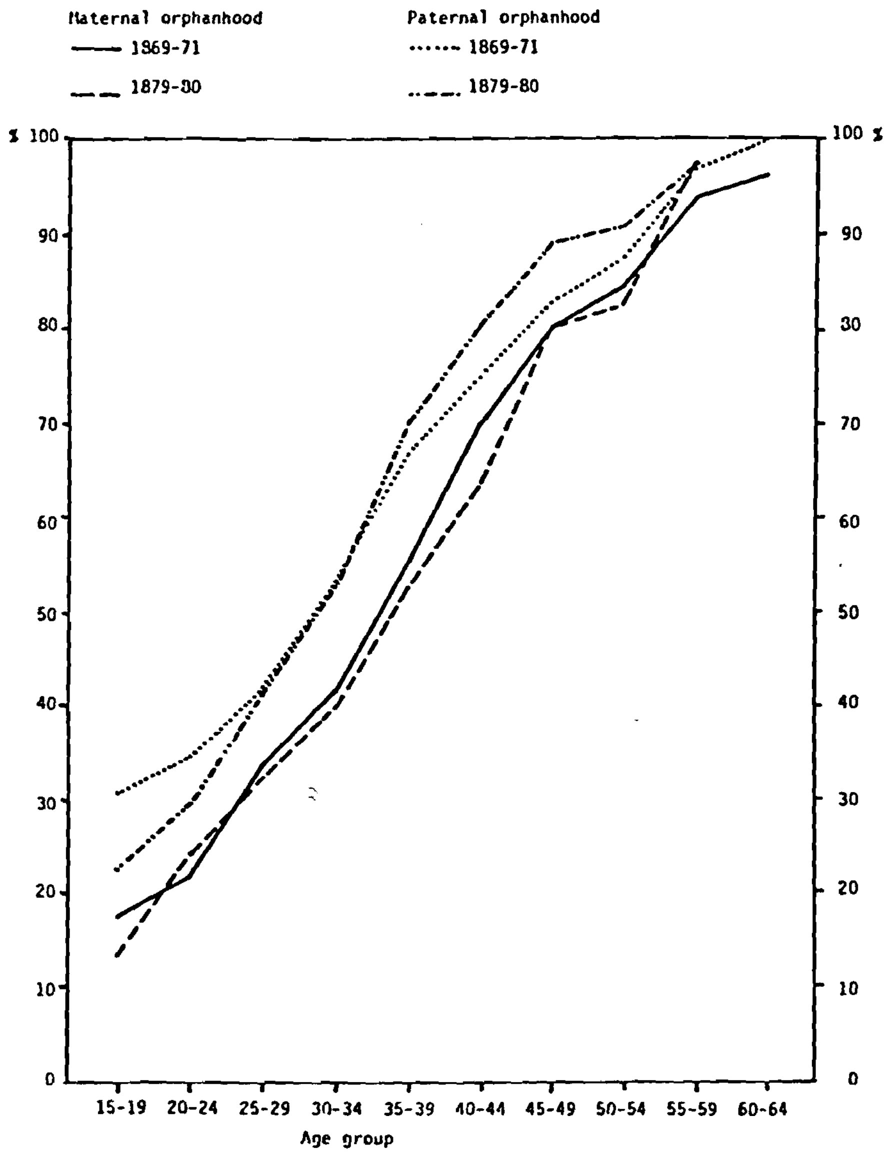


TABLE 7. DATA ON ORPHANHOOD STATUS AND PROPORTIONS OF RESPONDENTS WITH MOTHER RESPECTIVELY FATHER ALIVE. THE HAGUE, PERIODS 1869-71 AND 1879-80.

Maternal orphanhood

Age group of respondents	Total number of respondents	Number of respondents with mother alive	mother dead	unknown maternal orphanhood status	Proportions with mother alive
Period 1869-71					
15-19	120	99	21	0	.8250
20-24	1348	1054	292	2	.7831
25-29	1368	908	460	0	.6637
30-34	676	393	281	2	.5831
35-39	319	142	177	0	.4451
40-44	210	63	146	1	.3014
45-49	126	25	101	0	.1984
50-54	84	13	71	0	.1548
55-59	32	2	30	0	.0625
60-64	27	1	26	0	.0370
Total	4310	2700	1605	5	
Period 1879-80					
15-19	163	141	22	0	.8650
20-24	1445	1098	347	0	.7599
25-29	1171	790	378	3	.6764
30-34	492	296	196	0	.6016
35-39	272	129	143	0	.4743
40-44	171	62	109	0	.3626
45-49	85	17	68	0	.2000
50-54	69	12	57	0	.1739
55-59	41	1	40	0	.0244
Total	3909	2546	1360	3	

Paternal orphanhood

Age group of respondents	Total number of respondents	Number of respondents with father alive	father dead	unknown paternal orphanhood status	Proportion with father alive
Period 1869-71					
15-19	120	79	35	6	.6930
20-24	1348	855	451	42	.6547
25-29	1368	771	558	39	.5801
30-34	676	302	344	30	.4675
35-39	319	102	205	12	.3322
40-44	210	50	149	11	.2513
45-49	126	21	102	3	.1707
50-54	84	10	70	4	.1250
55-59	32	1	30	1	.0323
60-64	27	0	27	0	.0000
Total	4310	2191	1971	148	
Period 1879-80					
15-19	163	121	35	7	.7756
20-24	1445	1001	418	26	.7054
25-29	1171	663	466	42	.5872
30-34	492	226	250	16	.4748
35-39	272	79	185	8	.2992
40-44	171	32	131	8	.1963
45-49	85	9	73	3	.1098
50-54	69	6	60	3	.0909
55-59	41	1	37	3	.0263
Total	3909	2138	1655	116	

At all ages, fatherless children appear to be more common than motherless children, in particular among 30 to 45-year-olds. It is remarkable that, from the age of 30 onwards, the proportion of fatherless people was much larger among brides and grooms who married in 1879-80 than among those who married in 1869-71. This was not the case for female orphanhood. We will not go into the causes of this phenomenon here.

Our primary concern is to estimate the mortality level with the given data. For this, we will firstly use the method designed by Henry, after which we will deal with the methods of Brass and Hill and of Hill and Trussell. Thereby, we will present mortality estimates derived from the proportions not-orphaned in the periods 1869-71 an 1879-80. Next, the estimated probabilities of survival will be compared with the values of the probabilities of survival which have been deduced from the empirical life tables.

In doing so, the problem arises that the estimated probabilities do not refer to specific time periods: they represent averages of the mortality experienced over the period during which the parents of the orphans were exposed to the risk of dying. In cases where mortality has remained essentially constant, problems in the interpretation of the estimates obtained do not arise, since they should all imply the same unchanging mortality level. In section 4, we showed that this situation existed in The Hague from 1850 to 1880.

Neither do problems of localisation in time arise when estimates are deduced from proportions orphaned for the period between 1869-71 and 1879-80: in this case the experience of a hypothetical intersurvey cohort can be reconstructed, and the survivorship probabilities which are estimated on the basis of the data for this "cohort" refer directly to the life table for this period 30_/. However, even in those cases where mortality is not constant, and where no estimates are made for a hypothetical intersurvey cohort, the estimated survivorship probabilities can be related to specific time periods.

If one assumes that mortality has been changing regularly and that the adult mortality pattern of the target population is similar to that represented by the general standard proposed by Brass, a point in time prior to the survey can be found with a period life table that has a survivorship probability equal to the one that has been estimated.

The number of years, t, preceding the survey that define the period to which this life tables refers, depend mainly upon the average exposure to risk of the parents and upon the average age range of their exposure.

The method described here was proposed by Brass and Bamgboye 31_/; it will be used when we compare and interpret the Brass-Hill and Hill-Trussell estimates with the empirical life tables. In both these last cases we will also compare the estimated

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30_/ The proportions not-orphaned in age group n to n+4 in this hypothetical cohort (designated as S(n,s)) are taken from the observations over 1879-80 for the first two age-groups; for the following age-groups they are calculated by the formula:
$S(n,s) = S(n-10,s)S(n,1879\text{-}80)/S(n-10,1869\text{-}71)$
See: United Nations, Manual X, Indirect techniques for demographic estimation. Population Studies, No. 81, New York 1983.

31_/ W. Brass and E.A. Bamgboye, "The time location of reports of survivorship: estimates for maternal and paternal orphanhood and the ever-widowed. Working Paper No. 81-1, London School of Hygiene and Tropical Medicine, Centre for Population Studies, 1981.

survivorship ratios with the mortality levels in the Coale-Demeny West family of model life tables. These levels provide a useful index for examining the consistency of the survivorship ratios themselves.
The degree of agreement between the estimated and the empirical survivorship ratios has, in all cases, been calculated by the chi square, the mean absolute deviation (MAD) and the mean absolute percentage deviation (MAPD).

5.2. Henry's method

Henry was the first person to develop a method for estimating adult mortality from the proportion of orphans in a particular age-group.
If S(n) is the proportion of persons aged n, whose mother is still living, and M is the mean age of mothers at the birth of their children, the probability of survival between ages M and M+n (l_{M+n} / l_M) is calculated by

$$l_{M+n} / l_M = \frac{S(n)}{.99} + b\,\sigma^2$$

In this formula, σ^2 is the variance of the age distribution of mothers at the birth of their children and b is a constant dependent on M, n, and the mortality level. An analogous relationship can be used for paternal orphanhood and male mortality.
Several authors have pointed out that Henry's method is not very useful. "First, an estimate of b must be selected from among Henry's standard values, but b depends itself on the (unknown) level of mortality. Thus, a series of approximations is required. Secondly, the survival probabilities yielded by the method usually refer to very awkward ages, for M and M+n rarely fall on the neat multiples of five that are the conventional ages for mortality analysis" 32_/.
However, this does not mean that Henry's method is totally useless, especially not for males. Table 8 gives, for both females and males, the different stages in the calculation of the level of mortality, departing from the proportions not-orphaned at age 20 and at age 25 33_/. In this table, the levels of mortality refer to the mortality pattern characterised by the value of the expectation of life at age 0 in the UN Model life tables of 1955 34_/.

Usually, the proportions not-orphaned at exact ages 20 and 25 are calculated as the average of the proportions not-orphaned in the two contiguous 5-year age groups (15-19 and 20-24, and 20-24 and 25-29 respectively). The resulting proportions can deviate considerably from the results of a more precise calculation, departing from individual ages 19 and 20, and 24 and 25, respectively. The same holds true, of course,

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32_/ H.J. Page and G. Wunsch, "Parental Survival Data: Some Results of the Application of Ledermann's Model Life Tables", Population Studies, Vol. 30, No. 1, March 1976, p. 59-76, p. 59.

33_/ Variances were, respectively, 42.4830 for women and 193.9971 for men.

34_/ United Nations. Age and sex patterns of mortality. Model life-tables for under-developed countries. Population Studies, No. 22, New York 1955. Values of l(M+n)/l(M) falling outside the range given by Henry were computed with the l_x values published in the United Nations, Manual III. Methods for Population Projections by Sex and Age, Population Studies, No. 25, New York 1956.

TABLE 8. STEPS IN THE CALCULATION OF MORTALITY LEVELS FOR HENRY'S METHOD

	Maternal orphanhood				Paternal orphanhood			
	Exact age n							
	n=20		n=25		n=20		n=25	
	Average of age groups							
	15-19/ 20-24	19/20	20-24/ 25-29	24/25	15-19/ 20-24	19/20	20-24/ 25-29	24/25
	Period 1869-71							
Proportion not-orphaned	.8041	.8288	.7234	.7170	.6739	.6952	.6174	.5898
First approximation of l(M+n)/l(M)	.812	.837	.731	.724	.681	.702	.624	.596
Corresponding level of mortality	45.51	48.72	44.05	43.45	37.24	39.05	41.02	38.81
Corresponding value of b	.229	.226	.358	.357	.320	.340	.406	.372
New value of l(M+n)/l(M)	.822	.847	.746	.739	.743	.768	.703	.668
Corresponding level of mortality	46.79	50.00	45.41	44.74	43.06	45.73	48.20	44.75
	Period 1879-80							
Proportion not-orphaned	.8125	.8463	.7182	.7048	.7405	.7564	.6463	.5994
First approximation of l(M+n)/l(M)	.821	.855	.725	.712	.748	.764	.718	.606
Corresponding level of mortality	46.67	51.29	43.53	42.41	43.57	45.24	49.70	39.55
Corresponding value of b	.228	.224	.357	.355	.368	.375	.483	.386
New value of l(M+n)/l(M)	.831	.865	.740	.727	.819	.837	.812	.681
Corresponding level of mortality	47.95	52.90	44.83	43.71	52.05	54.36	61.05	46.00
	Intersurvey cohort							
Proportion not-orphaned	-	-	.7346	-	-	-	.6813	-
First approximation of l(M+n)/l(M)	-	-	.742	-	-	-	.688	-
Corresponding level of mortality	-	-	45.00	-	-	-	46.70	-
Corresponding value of b	-	-	.360	-	-	-	.462	-
New value of l(M+n)/l(M)	-	-	.757	-	-	-	.778	-
Corresponding level of mortality	-	-	46.53	-	-	-	56.14	-

for the corresponding mortality levels, as is especially clear in the period 1879-80. The use of a proportion not-orphaned, derived from the average of 2 five-year age groups, here results in an underestimation of the death rate of the population in question, particularly in cases of paternal orphanhood.
Probabilities of survival, corresponding to those which can be deduced from Brass-Hill and Hill-Trussell, were calculated for the average levels of mortality only (46.74 and 47.35 for females and 45.44 and 53.37 for males, respectively) (Table 9).

Table 10 gives the goodness-of-fit of the estimates derived by the method of Henry and empirical life tables. This goodness-of-fit is determined both with respect to the life table which describes the mortality situation in the decade directly preceding the time for which the proportions not-orphaned are known, and with respect to the life table of the period preceding the time for which the proportions not-orphaned are known by more than 10 years.
The estimated values for females appear to coincide very well with the empirical life table values. The mean absolute percentage deviation lies below 3.5%. On average, the method of Henry underestimates the mortality level (partly as a result of the afore-mentioned fact that the average of the 5-year age groups overestimates the values of the porportions not-orphaned). Note that, for Henry's method, both the absolute and the relative deviations are almost independent of age: even for values of l(n+40)/l(25) or more, the relative differences do not excede 6%: The most recent mortality table appears to coincide best with the estimated l(25+n)/l(25) values.
The estimates for males deviate very strongly from the empirical life table values, in particular where the figures for 1879-80 constitute the point of departure 35_/.

5.3. Brass and Hill

The method of estimation proposed by Brass and Hill is based on an equation relating the female probability of surviving from age 25 to age 25+n to the proportions of men and women in two contiguous five-year age-groups whose mother was still alive at the time of marriage. This equation has the form: $l(25+n)/l(25) = W(n)\,S(n-5) + (1.0-W(n))\,S(n)$ where S(n) is the proportion of men and women aged n to n+4 with a mother alive, and W(n) is the weighting factor employed to make allowance for typical age patterns of fertility and mortality. The weights, W(n), depend both upon n, the central point of the age-groups being considered, and upon M, the mean age at maternity.

The probabilities of male survival, starting in this case from age 32.5, can be calculated in exactly the same way, from the mean age at paternity and the proportions with a father alive.

A problem arises when applying Brass and Hill's method to females. Brass and Hill only give values to the weighting factors, W(n), for the mean ages of mothers at maternity between 22 and 30 years old. Our value of M (31.18) lies outside of this range. Values of W(n) for n-values of 20 to 60 have been estimated for M=31 and M=32 by linear extrapolation of the W(n) values for the given ages. Next, W(n) was estimated for M=31.18 by linear interpolation between M=31.0 and M=32.0.

35_/ If one takes the proportions not-orphaned for the individual ages as the point of departure, the estimate improves considerably: with respect to the life table for 1860-69, the chi square falls to 0.07280, the MAD to 0.08559 and the MAPD to 20.93%.

TABLE 9. FEMALE SURVIVORSHIP PROBABILITIES FROM AGE 25 AND MALE SURVIVORSHIP PROBABILITIES FROM AGE 32.5 USING HENRY'S METHOD. THE HAGUE, PERIODS 1869-71 AND 1879-80 AND INTERSURVEY COHORT

Central age n	Female survivorship probability l(25+n)/l(25)	Male survivorship probability l(35+n)/l(32.5)
	Period 1869-71	
20	.8432	.7382
25	.7953	.6439
30	.7372	.5317
35	.6658	.4024
40	.5731	.2646
45	.4569	.1411
50	.3197	.0531
55	.1826	
60	.0766	
	Period 1879-80	
20	.8477	.8059
25	.8008	.7254
30	.7437	.6215
35	.6731	.4934
40	.5812	.3459
45	.4651	.2010
50	.3270	.0858
55	.1881	
	Intersurvey cohort	
20	.8416	.8260
25	.7933	.7498
30	.7349	.6495
35	.6632	.5227
40	.5703	.3733
45	.4541	.2222
50	.3172	.0984
55	.1807	

Tables 11 and 12 give the estimates of female and male mortality, respectively, resulting from the Brass-Hill method. The internal consistency of the estimates is small, judging from the variation in the levels of the West family of model life tables. For females, the most coherent estimate refers to the period 1869-71, judging from the variance of the levels (σ^2=2.7193 versus 3.8842 and 3.9816). This is also the case for males, but here the differences are more extreme (σ^2=0.9518 versus 3.6832 and 5.4388).

We are primarily interested in the external consistency, however. Judging from the t-values (ranging from 9.57 to 15.97 for males and from 7.88 to 16.45 for females), the

TABLE 10. GOODNESS-OF-FIT INDICATORS OF ESTIMATED VALUES OF l(25+n)/l(25) (FEMALES) AND l(35+n)/l(32.5) (MALES) USING HENRY'S METHOD AND EMPIRICAL VALUES FOR THE TOTAL POPULATION

	Females		Males	
	Estimates for 1869-71 in comparison with life table for total female population		total male population	
	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69
Chi square	.00489	.00088	.01105	.01432
MAD	.01975	.00858	.03333	.03593
MAPD	3.56	1.38	7.26	8.75
	Estimates for 1879-80 in comparison with life table for total female population		total male population	
	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79
Chi square	.00274	.00157	.13041	.08246
MAD	.01535	.00954	.11819	.09194
MAPD	2.64	1.73	29.06	21.85
	Estimates for intersurvey cohort in comparison with life table for total female population 1870-79		total male population 1870-79	
Chi square	.00464		.12782	
MAD	.01456		.11778	
MAPD	2.83		27.96	

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estimates for 1869-71 partly refer to the period 1860-69, but mainly to the mortality levels of the 1850-59 decade. Similarly, the 1879-80 estimates mainly refer to a period preceding the time of observation by more than 10 years (for males, t has values ranging from 9.29 to 16.95, for females, from 7.75 to 15.14). However, in both cases we carried out the comparisons between the estimates and the empirical life tables for both decennial life tables. Table 13 summarizes the above.

On the whole, the relative deviations are very small up until a value of l(25+40)/l(25): with the exception of two values, the deviations remain below 6% for females. Differences of more than 10% only appear in the oldest age groups. For males, the relative deviations are, on average, slightly lower, but this is caused by the fact that in the oldest age groups less extreme deviations have been observed. The estimates for males often yield an overestimation of the l(35+n)/(32.5) values with respect to the empirical life table values (i.e. an underestimation of the mortality rate): such a trend is not apparent for females. As could be expected from the t-values, comparison of the estimate with the life table generally yields smaller deviations with respect to the periods preceding the time of observation by more than 10 years. The intersurvey

TABLE 11. FEMALE SURVIVORSHIP PROBABILITIES FROM AGE 25 USING PROPORTIONS WITH SURVIVING MOTHERS AND THE BRASS METHOD. THE HAGUE, PERIODS 1869-71 AND 1879-80 AND INTERSURVEY COHORT

Period 1869-71

Respondent's age group	Proportion not-orphaned	Central age n	W(n)	l(25+n)/(25)	West mortality level
15-19	.8250	20	1.18930	.83293	11.80
20-24	.7831	25	1.35108	.82502	14.21
25-29	.6637	30	1.48186	.70254	10.96
30-34	.5831	35	1.59028	.66456	12.51
35-39	.4451	40	1.63352	.53614	11.34
40-44	.3014	45	1.64004	.36732	9.48
45-49	.1984	50	1.50048	.22022	8.57
50-54	.1548	55	1.23940	.17690	12.16
55-59	.0625	60	0.90808	.14868	N.A.

Period 1879-80

Respondent's age group	Proportion not-orphaned	Central age n	W(n)	l(25+n)/l(25)	West mortality level
15-19	.8650	20	1.18930	.88490	15.42
20-24	.7599	25	1.35108	.78922	12.11
25-29	.6764	30	1.48186	.71244	11.39
30-34	.6016	35	1.59028	.67674	13.01
35-39	.4743	40	1.63352	.54506	11.66
40-44	.3626	45	1.64004	.46667	13.00
45-49	.2000	50	1.50048	.21306	8.27
50-54	.1739	55	1.23940	.20969	13.99

Intersurvey cohort

Respondent's age group	Proportion not-orphaned	Central age n	W(n)	l(25+n)/l(25)	West mortality level
15-19	.8650	20	1.18930	.88490	15.42
20-24	.7599	25	1.35108	.77770	11.51
25-29	.7092	30	1.48186	.76963	14.15
30-34	.5838	35	1.59028	.62925	11.11
35-39	.5068	40	1.63352	.59790	13.67
40-44	.3630	45	1.64004	.44960	12.39
45-49	.2277	50	1.50048	.23686	10.26
50-54	.2094	55	1.23940	.25283	16.26

TABLE 12. MALE SURVIVORSHIP PROBABILITIES FROM AGE 32.5 USING PROPORTIONS WITH SURVIVING FATHERS AND THE BRASS METHOD. THE HAGUE, PERIODS 1869-71 AND 1879-80 AND INTERSURVEY COHORT

Period 1869-71

Respondent's age group	Proportion not-orphaned	Central age n	W(n)	l(35+n)/l(32.5)	West mortality level
15-19	.6930	20	.70408	.68167	10.34
20-24	.6547	25	.68947	.63153	12.34
25-29	.5801	30	.56468	.53108	12.91
30-34	.4675	35	.36871	.38209	12.08
35-39	.3322	40	.06453	.25652	12.42
40-44	.2513	45	-.24737	.15076	13.50
45-49	.1707	50	-.44848	.10450	N.A.
50-54	.1250	55	-.52290	-.01617	N.A.

Period 1879-80

Respondent's age group	Proportion not-orphaned	Central age n	W(n)	l(35+n)/l(32.5)	West mortality level
15-19	.7756	20	.70408	.75483	13.73
20-24	.7054	25	.68947	.66870	13.92
25-29	.5872	30	.56468	.53827	13.19
30-34	.4748	35	.36871	.36394	11.37
35-39	.2992	40	.06453	.20294	9.86
40-44	.1963	45	-.24737	.08840	8.97
45-49	.1098	50	-.44848	.08242	N.A.
50-54	.0909	55	-.52290	-.00748	N.A.

Intersurvey cohort

Respondent's age group	Proportion not-orphaned	Central age n	W(n)	l(35+n)/l(32.5)	West mortality level
15-19	.7756	20	.70408	.75483	13.73
20-24	.7054	25	.68947	.69043	14.94
25-29	.6572	30	.56468	.59382	15.53
30-34	.5116	35	.36871	.40264	12.92
35-39	.3390	40	.06453	.22281	10.81
40-44	.2148	45	-.24737	.08657	8.83
45-49	.1120	50	-.44848	.06232	N.A.
50-54	.0777	55	-.52290	-.01428	N.A.

TABLE 13. GOODNESS-OF-FIT INDICATORS OF ESTIMATED VALUES OF l(25+n)/l(25) (FEMALES) AND l(35+n)/l(32.5) (MALES) USING THE BRASS METHOD AND EMPIRICAL VALUES FOR THE TOTAL POPULATION

	Females		Males	
	Estimates for 1869-71 in comparison with life table for total female population		total male population	
	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69
Chi square	.04961	.06509	.00494	.00820
MAD	.03599	.04093	.02100	.02620
MAPD	8.25	9.19	4.49	6.30
	Estimates for 1879-80 in comparison with life table for total female population		total male population	
	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79
Chi square	.05283	.07948	.01631	.01275
MAD	.03246	.03929	.03723	.02582
MAPD	7.22	8.46	7.76	6.58
	Estimates for intersurvey cohort in comparison with life table for total female population 1870-79		total male population 1870-79	
Chi square	.05167		.01386	
MAD	.03973		.03529	
MAPD	7.97		7.21	

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cohort for females coincides very well with the life table for the years 1870-79 (MAPD=4.40%), with the exception of the highest value of l(25+n)/l(25).

5.4. Hill and Trussell

The estimation procedure proposed by Hill and Trussell is based on the following equation:

$$l(25+n)/l(25) = a(n)+b(n)M+c(n)S(n-5)$$

where a(n), b(n) and c(n) are given coefficients.
Table 14 shows the results of the application of this techique to data for The Hague. Compared with the Brass method, the levels of the West family of model life tables coincide with each other more strongly by the regression method. The variance is significantly lower (1.2145, 1.6497 and 1.2419 as opposed to 2.7193, 3.8842 and 3.9816, respectively). As shown in Table 15, the external validation also gives better results:

TABLE 14. FEMALE SURVIVORSHIP PROBABILITIES FROM AGE 25 USING PROPORTIONS WITH SURVIVING MOTHERS AND THE REGRESSION METHOD. THE HAGUE, PERIODS 1869-71 AND 1879-80 AND INTERSURVEY COHORT

Period 1869-71

Respondent's age group	Proportion not-orphaned	Central age n	l(25+n)/l(25)	West mortality level
15-19	.8250	20	.83528	11.95
20-24	.7831	25	.80898	13.27
25-29	.6637	30	.70620	11.13
30-34	.5831	35	.64406	11.69
35-39	.4451	40	.51826	10.72
40-44	.3014	45	.37423	9.72
45-49	.1984	50	.26001	10.20

Period 1879-80

Respondent's age group	Proportion not-orphaned	Central age n	l(25+n)/l(25)	West mortality level
15-19	.8650	20	.87730	14.90
20-24	.7599	25	.78511	11.89
25-29	.6764	30	.71926	11.70
30-34	.6016	35	.66344	12.50
35-39	.4743	40	.54985	11.83
40-44	.3626	45	.44295	12.16
45-49	.2000	50	.26184	10.28

Intersurvey cohort

Respondent's age group	Proportion not-orphaned	Central age n	l(25+n)/l(25)	West mortality level
15-19	.8650	20	.87730	14.90
20-24	.7599	25	.78511	11.89
25-29	.7092	30	.75300	13.32
30-34	.5838	35	.64480	11.72
35-39	.5068	40	.58501	13.19
40-44	.3630	45	.44340	12.18
45-49	.2277	50	.29357	11.54

all goodness-of-fit indicators used produce much lower values than those produced by the Brass method 36_/. Here, the level of these indicators is also primarily driven up

36_/ The t-values once again refer primarily to the older life tables: t varies from 8.88 to 15.16 in 1869-71 and from 8.95 to 14.46 in 1879-80.

by the deviations of l(25+45)/l(25): prior to this age, a strong coincidence between the estimate and the observation is usually apparent. The l(n+25)/l(25) values for n is 45 or less differ from the observed values by more than 6% in two cases only. On the whole, the indirect estimation yields an overestimation of the death risk. Once again, the deviation between the estimations and reality is smallest in those life tables which refer to the period preceding the time of the survey by more than 10 years: again, the t-values give a more accurate localisation of the estimates. If, in the intersurvey cohort, one disregards the highest age group, the average deviation amounts to a more 3.85%.

Comparison of tables 10, 13 and 15 shows that for females, the method of Henry yields the best estimates. For males, the Brass method is superior; the results of Henry's method can, however, be improved by calculating the proportions not-orphaned more precisely.
Figures 5 to 10 summarize these results. Once more, it is evident that satisfactory results can be obtained by the indirect estimation technique -with the exception of Henry's method for men - in particular when restricting the estimates of l(n+25)/l(25) and l(35+n)/l(32.5) to values for n less than 45.

Although the different estimation techniques generally produce satisfactory or even good results, it nevertheless remains important to trace the causes of the deviations observed. It then becomes possible to consider whether certain adjustments of the estimates might yield better results.

TABLE 15. GOODNESS-OF-FIT INDICATORS OF ESTIMATED VALUES OF l(25+n)/l(25) (FEMALES) USING THE REGRESSION METHOD AND EMPIRICAL VALUES FOR THE TOTAL POPULATION

	Estimates for 1869-71 in comparison with life table for total female population	
	Period 1850-59	Period 1860-69
Chi square	.02148	.03424
MAD	.02646	.03469
MAPD	5.84	7.35
	Estimates for 1879-80 in comparison with life table for total female population	
	Period 1860-69	Period 1870-79
Chi square	.01366	.03131
MAD	.02031	.03545
MAPD	4.26	7.06
	Estimates for intersurvey cohort in comparison with life table for total female population 1870-79	
Chi square	.01381	
MAD	.02730	
MAPD	5.09	

FIGURE 5. OBSERVED AND ESTIMATED FEMALE SURVIVORSHIP VALUES l(25+n)/l(25), THE HAGUE, PERIOD 1869-71

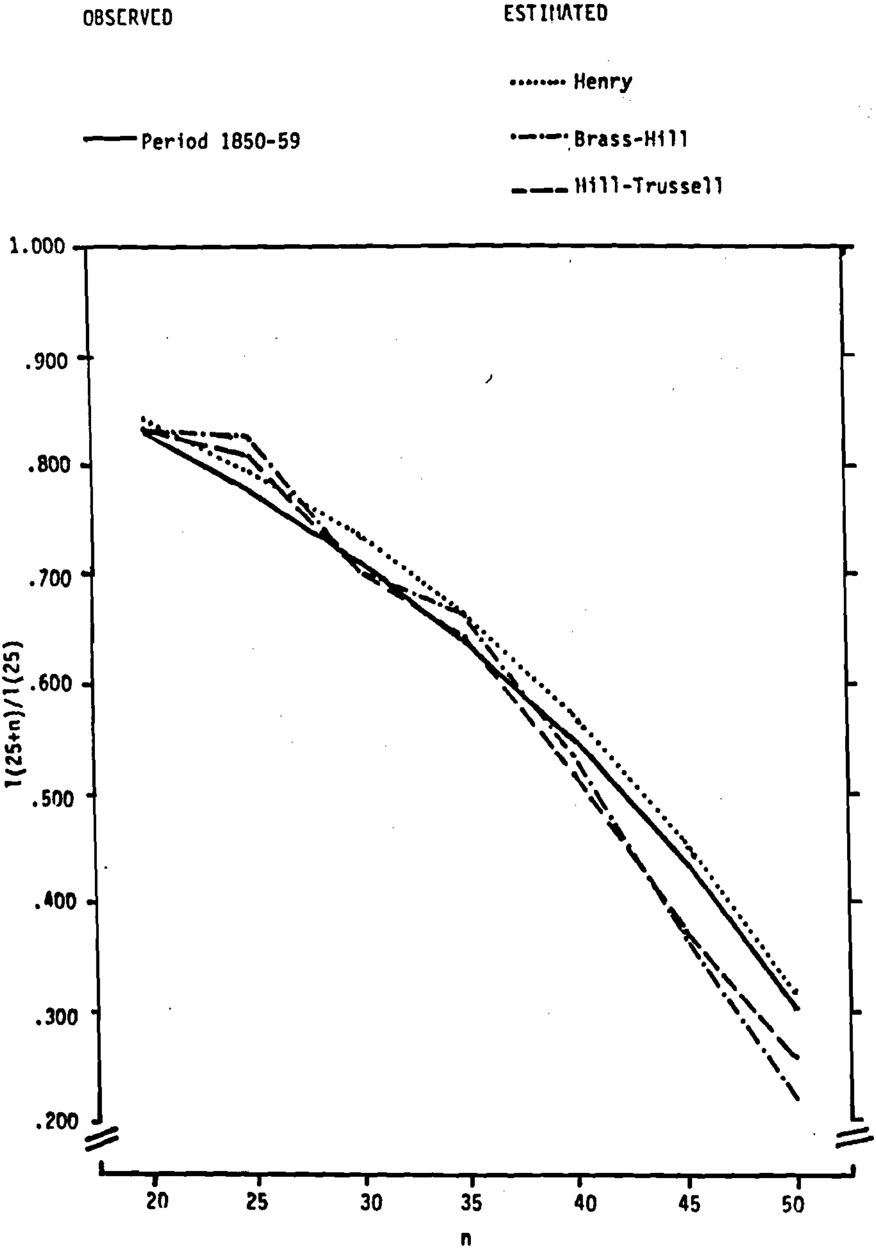


FIGURE 6. OBSERVED AND ESTIMATED FEMALE SURVIVORSHIP VALUES 1(25+n)/1(25
THE HAGUE, PERIOD 1879-80.

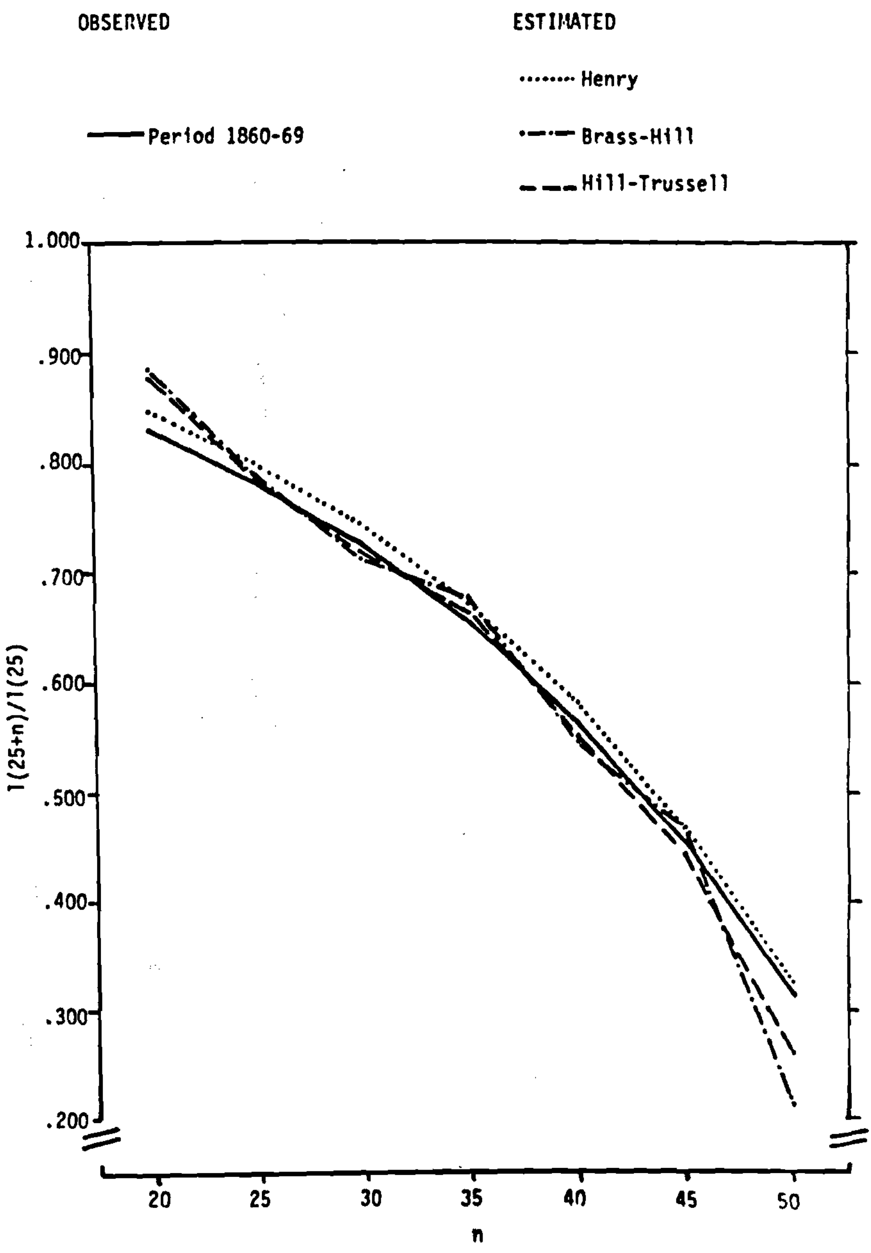


FIGURE 7.OBSERVED AND ESTIMATED MALE SURVIVORSHIP VALUES l(35+n)/l(32.5), THE HAGUE,PERIOD 1869-71

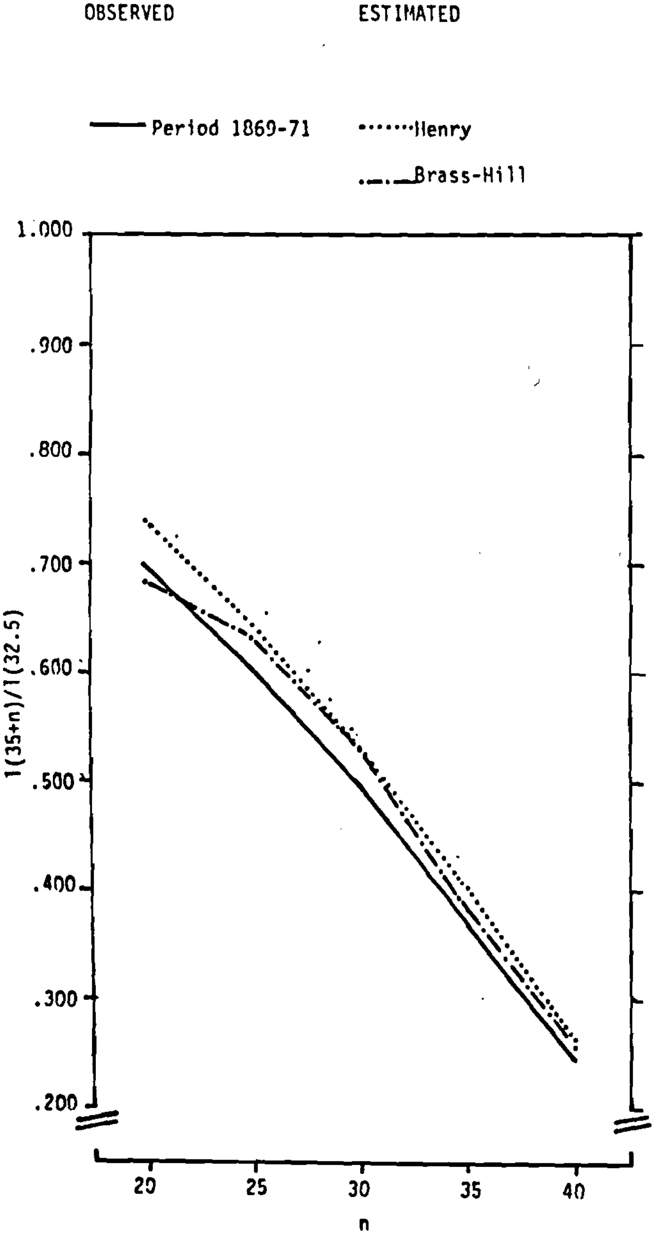


FIGURE 8. OBSERVED AND ESTIMATED MALE SURVIVORSHIP VALUES l(35+n)/l(32.5), THE HAGUE, PERIOD 1879-80.

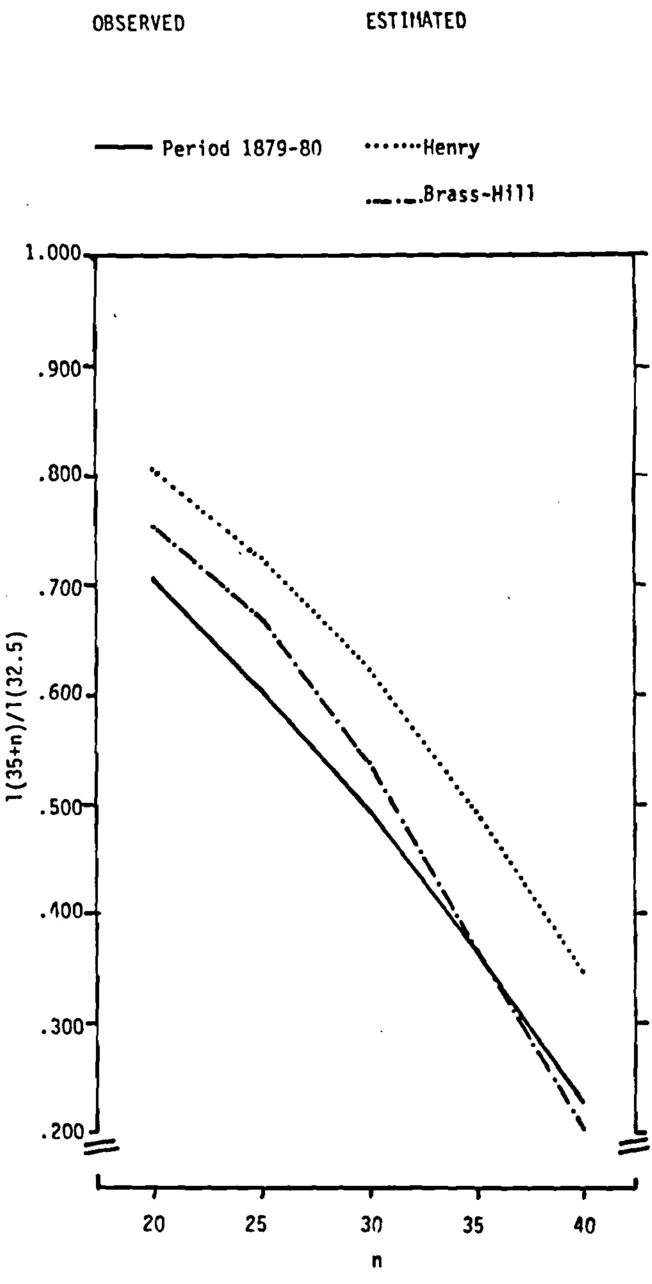


FIGURE 9. OBSERVED AND ESTIMATED FEMALE SURVIVORSHIP VALUES l(25+n)/l(25), THE HAGUE, INTERSURVEY COHORT.

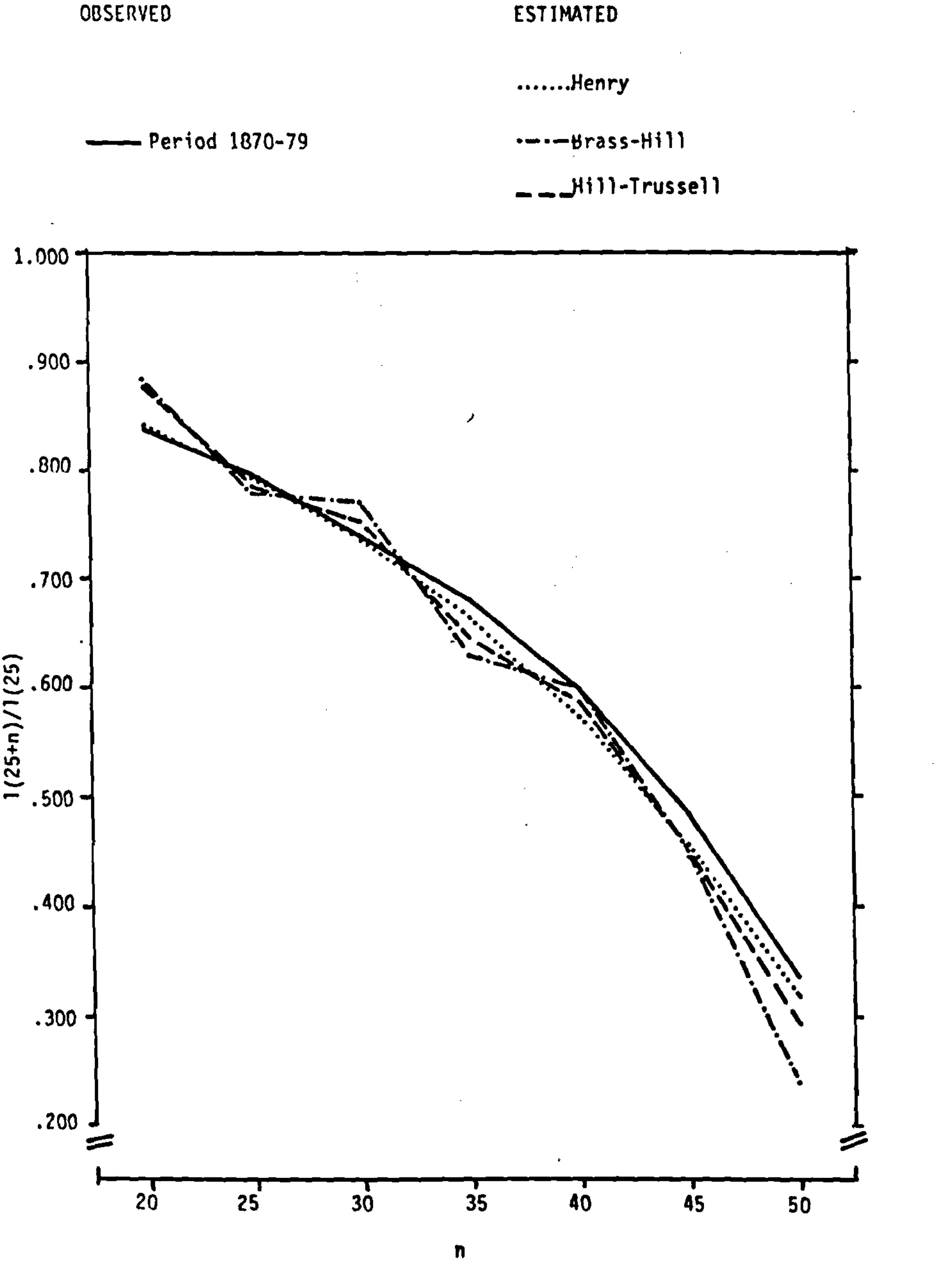
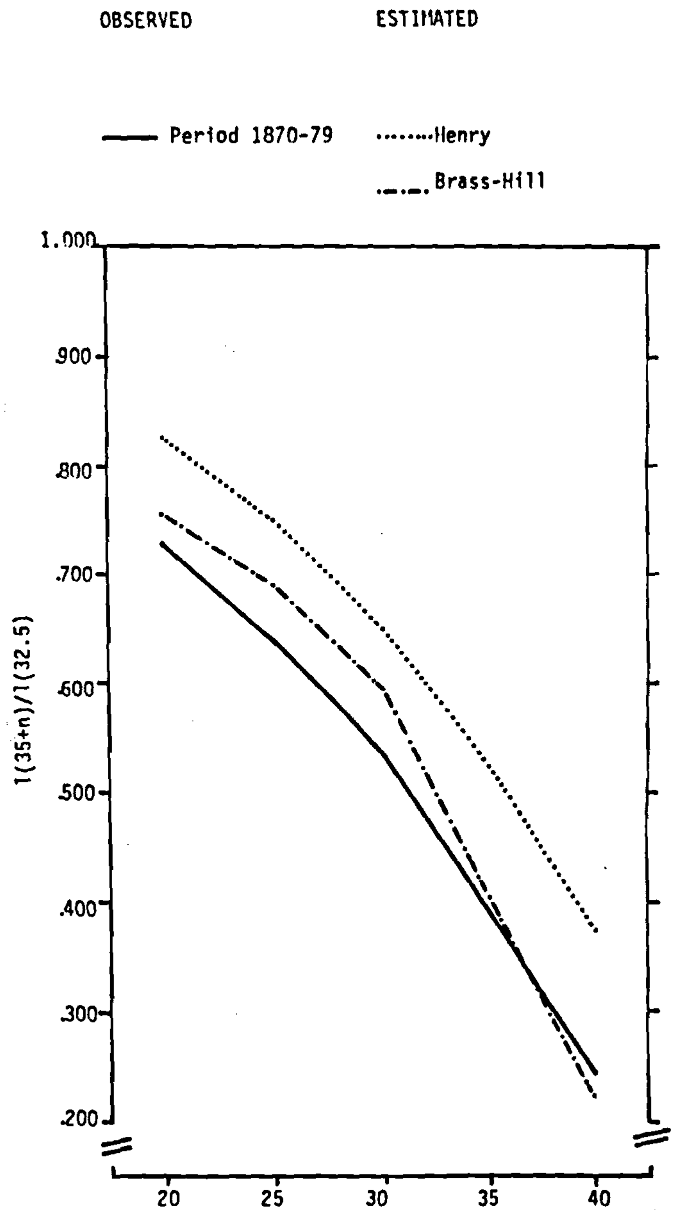


FIGURE 10.OBSERVED AND ESTIMATED MALE SURVIVORSHIP VALUES 1(35+n)/1(3
THE HAGUE,INTERSURVEY COHORT.



6. SOURCES OF VARIABILITY

6.1. Introduction

Deviations between estimates of adult mortality derived from orphanhood data and mortality levels recorded in empirical life tables can have several causes. Table 16 summarizes them.

The table is presented as a framework that will serve as a guideline for the discussion in this paragraph.

Our analysis of the data inspired confidence in the reliability of the empirical life tables, so that we may discard the possibility of differences that might arise due to errors in the yardstick rather than in the object of measurement. The quality of the data, used as ingredients in the indirect mortality estimation recipe, has also received ample attention. The input we need for the application of the technique of adult mortality estimation with data on orphanhood refers to age, parental bereavement of respondents of both sexes and fertility of each sex. In each of these elements reporting errors may occur in the data sources. In section 4, we concluded, however, that the conclusion is warranted that the data quality is quite acceptable for a technique designed to provide crude estimates of adult mortality in situations of defective vital statistics. If the method does not work it is unlikely that the blame lies with the quality of the input data.

The techniques used to estimate adult mortality from proportions not-orphaned are based on simulated values in theoretical populations defined by model fertility and mortality schedules. Two kinds of assumptions are incorporated in the mathematical expressions of proportions not-orphaned constituting the foundation of the method under consideration: about demographic behaviour and about the validity of approximations used in mathematical formulation. It is one thing to assume that a population lies within a premeditated range of demographic experience (levels and patterns of mortality, fertility, migration and their course) and to actually believe that this is close to reality in "typical" situations of application. It is something quite different to simplify matters in the form of an assumption, knowing that it may not be true. It is to be expected that a method will be less robust to deviation from assumptions considered to apply in reality by those who designed it, than from the category of assumptions, for which a certain degree of deviation is not supposed to matter, because the effects on the estimates are thought to be negligible.

TABLE 16. SOURCES OF VARIABILITY OF INDIRECT AND DIRECT ESTIMATION OF ADULT MORTALITY

I.	Baseline :	Quality of life tables used to compare orphanhood estimates with
II.	Data :	A. Report error B. Sampling problems 1. Selectivity 2. Random variation
III.	Estimation procedures:	A. Demographic assumptions B. Inexactitude due to approximations

There is a third kind of assumption made in the method, namely that of which we know it is not true, but have no choice as to whether or not we should make it since the intrinsic characteristics of indirect mortality estimation make it inevitable. These assumptions will be discussed under the effects of selectivity.

After this discussion of point B, we will attempt to get an impression of the robustness of the method from deviation of assumptions on one aspect of demographic behaviour, namely the mean age at childbearing.

6.2. Sampling problems

The elements of the population about which inferences are to be drawn are adult individuals, defined in terms of:

a. demographic characteristics (age, sex, parity etc.)
b. time reference
c. geographical reference.

For maternal orphanhood, for example, the population about which information is sought consists of females only (irrespective of marital status, parity etc.), over a period of about 20 years prior to the time the data were gathered, living in the geographical area where the survey was carried out. Since the units of observation are not synonymous with the elements of the population in indirect techniques of estimation, problems arise with definitional components a and c mentioned above. In the discussion which follows, the perspective of the sampling theory is taken to illustrate problems that arise even in a perfect sampling design of respondents, due to the fact that the information we are interested in does not refer to the respondents themselves, but to their parents. Thereafter, a brief reference to random fluctuations will be made.

6.2.1. Selectivity

a. Demographic characteristics

The elements of our adult population over the period of reference should ideally all have an equal probability of being included in the survey, or, if not equal, then at least a known probability, so that corrective measures, such as weighting, can be taken. It is not possible to live up to these standards, given the intrinsic characteristics of the observational units, which are a sample of the children of the population elements.

The consequence is that the estimated probabilities of survivorship reflect only the mortality experience of parents with surviving children: when the survival of parents is correlated to the probability of their children being respondents in the survey, i.e. correlated to the survival of the child or to the number of children per parent, the estimated probabilities do, by implication, not refer to the entire population. Even a perfect sample design to select respondents among individuals at a given point in time, or for that matter, even gathering information from a whole population of survivors, does not avoid selectivity. In view of the overruling advantages of indirect measures in certain circumstances, for example, when there is no alternative, we shall just have to live with these deviations from the ideal situation and attempt to gauge their effect on the resulting estimates. We shall briefly point out where potential bias is involved.

The fact that the probability of a parent being selected in the sample is proportional to his or her number of children, is usually dealt with by assuming that there is no relation between the mortality of parents and the number of children they have had, so that selectivity with respect to parity does not entail selectivity with respect to mortality of the parents.

Sources from developing and developed countries alike testify, however, that there are mortality differentials among women with different parities. The most prominent differentials recorded refer to the first birth and to births of very high birth orders (8+): both parities are generally associated with higher maternal mortality 37_/. Bartlema concluded, on the basis of a simulation exercise, that an outspoken differential in maternal mortality by parity did not have a significant effect on the estimates in the case discussed here 38_/.
The problem is that in comparisons of mortality by parity women without children (for the most part unmarried women) are not included. Mortality estimates derived from orphanhood data also have this shortcoming; they only refer to the mortality of people who ever had a child in contradistinction to the empirical life tables.

A more precise comparison between the mortality estimates and empirical life tables can, however, be made by calculating a life table for those men and women who have ever been married, thus excluding those men and women who have not had a child 39_/.
The resulting $_nq_x$ values for ever-married males and females are given in Figure 11. Comparing the life tables for the ever-married and the total population reveals interesting differentials. At age 20, the expectation of life for ever-married males is one year higher than for the total male population (in 1870-79 nearly two years), for ever-married females, it is one year lower than for the total population (this difference disappears however in 1870-79). Mortality among ever-married females is higher in the age range in which most of the childbearing takes place but lower elsewhere. For males, mortality conditions among the ever-married are favourable all along the line.

Using the usual goodness-of-fit indicators, table 17 compares the results of the indirect estimation of the values of l(25+n)/l(25) and l(35+n)/l(32.5) according to the methods of Henry, Brass-Hill and Hill-Trussell, with the equivalent values derived from the empirical life tables for the ever-married population of The Hague. For females, Henry's method yields less accurate estimates when comparing the results with the life tables for the ever-married, than when comparing them with the life

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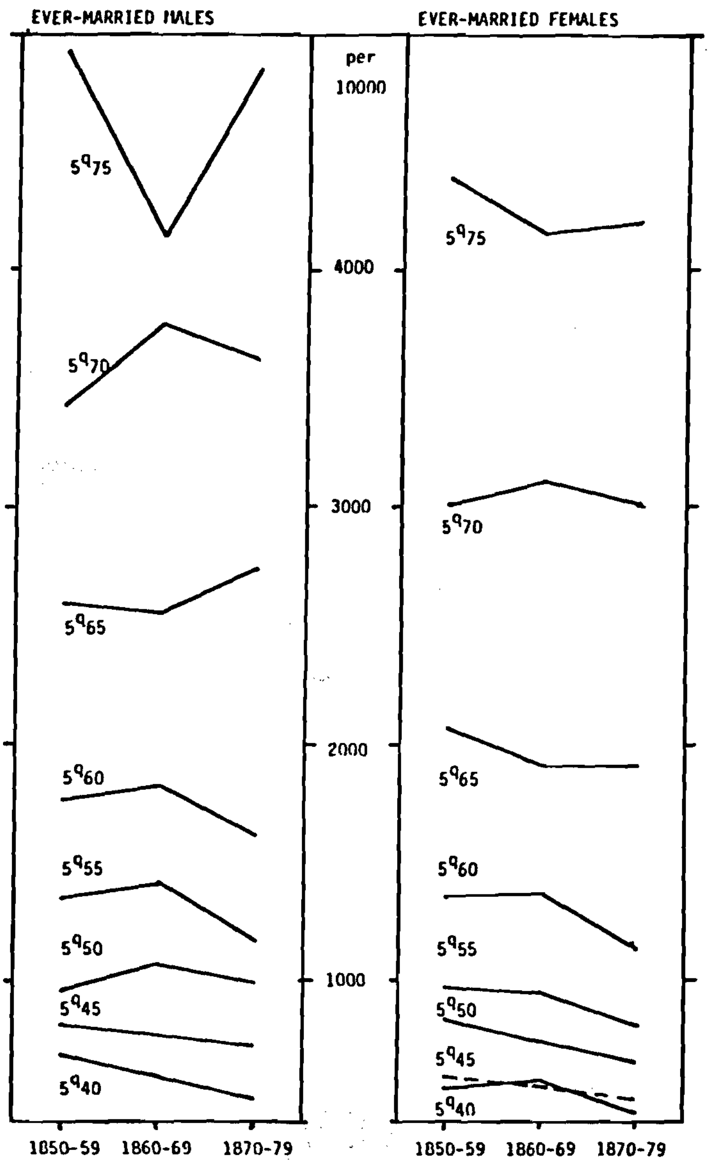
37_/ J.P. Bardet, K-A. Lynch, G.P. Mineau, M. Hainsworth, M. Skolnick, "La mortalité maternelle autrefois: une étude comparée (de la France de l'ouest à l'Utah)", Annales de Démographie Historique, 1981, p. 31-48.
N.M. Kamel, "Determinants and patterns of female mortality associated with women's reproductive role", p. 179-191. In: Sex differentials in mortality. Trends, determinants and consequences. Ed. by A.D. Lopez and L.T. Ruzicka. Miscellaneous Series no. 4, Department of Demography, Australian National University, Canberra,1983.
A.E. Imhof, "Die Ubersterblichkeit verheirateter Frauen in fruchtbaren Alter". Zeitschrift für Bevölkerungswissenschaft, Heft 4, 1979, 5. Jahrgang, p. 487-510.

38_/ J. Bartlema, "Simulation of the effects of mortality differentials by parity on proportions orphaned using data from The Hague, 1880", Tilburg, 1984.

39_/ Life tables for the ever-married population were calculated in the same way as for the total population; deaths as well as the population at risk refer, in this case, only to people who have ever been married. Life tables for the ever-married are available for the periods 1850-59, 1860-69 and 1870-79.

FIGURE 11. VALUES OF $_5q_x$ FOR THE EVER-MARRIED MALE AND FEMALE POPULATION, THE HAGUE, PERIODS 1850-59, 1860-69 AND 1870-79.



tables for the total population. The same applies for the Brass method; this is also the case for the regression method, with the exception of the comparison with respect to the life table for the period 1860-69. For males, on the other hand, both the method of Brass and that of Henry yield more accurate estimates of the values of l(35+n)/l(32.5) for the ever-married than of the equivalent values from the life table for the total population. The pattern of deviations is not, however, affected when the life tables for the ever-married are taken as the point of departure.

TABLE 17. GOODNESS-OF-FIT INDICATORS OF ESTIMATED VALUES OF l(25+n)/l(25) (FEMALES) AND l(35+n)/l(32.5) (MALES) USING THE HENRY, BRASS-HILL AND REGRESSION METHOD AND EMPIRICAL VALUES FOR THE EVER-MARRIED POPULATION

	Estimates of l(25+n)/(l(25) using						Estimates of l(35+n)/(32.5) using			
	Henry's method		Brass method		Regression method		Henry's method		Brass method	
	Estimates for 1869-71 in comparison with life table for									
	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69
Chi square	.00840	.00791	.05167	.05801	.02171	.02789	.00665	.00893	.00340	.00583
MAD	.02716	.02637	.03884	.04285	.03036	.03403	.02546	.02743	.01762	.02174
MAPD	4.66	4.27	8.58	9.24	6.31	6.94	5.66	6.79	3.56	4.94
	Estimates for 1879-80 in comparison with life table for									
	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79
Chi square	.01220	.00295	.05310	.08768	.01579	.03662	.11401	.06103	.01344	.01756
MAD	.03314	.01347	.03972	.04138	.02673	.03754	.10969	.07725	.03369	.02461
MAPD	5.56	2.41	8.22	8.83	4.84	7.46	26.71	18.15	7.41	6.98
	Estimates for intersurvey cohort in comparison with life table for period 1870-79									
Chi square	.00655		.05743		.01701		.10120		.00968	
MAD	.01739		.04187		.02976		.10309		.02462	
MAPD	3.36		8.37		5.56		24.07		5.57	

A second source of selectivity lies in the fact that the parents of those persons who die before the time of observation are not included. The assumption that is introduced here is that no relation exists between mortality of parent and child.
Direct evidence that there is a relation between parental survival and survival of children is, at least for the 19th century, scarce. For the small Dutch town of Hindeloopen, Van Gelder found for the period 1829-1839 that orphans aged 18 or younger had a higher death rate than children living in complete families 40_/. Diederiks calculated that orphans living in the Amsterdam orphanages during the period 1800-1820 had a 30% higher death rate than the total population aged 18 or younger 41_/.
An investigation at the end of the 1860's of the condition of child labourers in factories proved that the health situation of orphans, especially those from the Amsterdam orphanages, was much less favourable (measured by length and vital capacity) than of their contemporaries 42_/. It is reasonable to deduce from this that their mortality was also higher.
Indirect evidence of a relation between mortality of parent and child can be found in the literature concerning mortality differentials by socio-economic status: adverse or favourable socio-economic conditions - a main determinant of mortality in the early industrial period - affect mortality of parent and child alike, though not necessarily to the same degree. Proof of this can be found in data collected in The Hague during the periods 1866-74, and 1875-84, concerning age-specific mortality rates for the 23 districts of the city: the mortality rates for age groups < 1, 1-4 and 5-14 years correlated at district level, positively with those for age groups 20-64 and 65 or over 43_/.
It is thus plausible that reality does not conform to the assumption that parental and child survival are not related. As a consequence, the estimated probabilities of survival will be upwardly biased.
Recently, Palloni et al. concluded from a simulation exercise that the magnitude of this bias is very moderate 44_/. However, they restricted their simulation to populations with expectations of life that were much higher than those characteristic for 19th century The Hague (45 versus 39 and 35 years).

One last factor with a possible distorting effect on the indirect mortality estimates is not related to the method as such but has to do with the fact that the present application is based on data from marriage registers.
Several authors have, for the agrarian and artisan economy, postulated a relationship between death of the father, the consequent availability of a business, a workshop, cottage or a dwelling, and, following from that, earlier and/or more frequent marriages. Ohlin, for instance, wrote: "In such circumstances (that is, where marriage was contingent upon access to a livelihood and inheritance was a frequent occasion for marriage: FvP/JB) one should expect high mortality to occasion earlier inheritance and

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40_/ C.E.M. van Gelder, Hindeloopen in de jaren 1830-1839. Mededeling no. 5 van de afdeling Historische Geografie, Geografisch Instituut Utrecht, 1967.
41_/ H. Diederiks, cited in footnote 11.
42_/ Rapport der Commissie, cited in footnote 9.
43_/ Sterftecijfers van de stad 's-Gravenhage over de jaren 1866-1884. Uitgegeven door de Vereeniging tot Verbetering van den Gezondheidstoestand, 's-Gravenhage 1889.
44_/ A. Palloni et al., cited in footnote 2.

earlier marriage" 45_/. It is tempting to conclude from this that orphans, compared with the population as a whole, are overrepresented among those contracting marriages, thereby introducing an additional source of selectivity, leading to estimates of mortality that are too high. Hollingsworth already formulated this criticism at the end of the sixties, referring to the use that Blayo and Henry made of the orphanhood method. "The only doubt about the method must be sociological: having a dead father may sometimes have greatly increased the chances of a son's marriage, owing to his inheritance. Even so, the same should be less true of daughters with dead mothers" 46_/.

However, the existence of a causal relation on a macro-level between increasing mortality on the one hand and decreasing age at marriage and increasing marriage frequency on the other hand does not signify that orphans marry more frequently and at a younger age than children whose parents are still alive. Data concerning The Hague indicate at least that on average orphans marry at much higher ages than non-orphans, as can be seen from Table 18.
This higher age at marriage does, on the other hand, not imply that orphanhood as such has a postponement effect on marriage (caused for instance by the fact that orphans have to wait for the death of their father before they can take over his position); would that have been case, one would not have found the same increase in age at marriage of the death of the mother of the respondent. It is rather the increasing age of the respondents that leads to a higher proportion of orphans among them and to a higher age at marriage.
It is not clear what effect orphanhood has on marriage frequency. It is plausible, however, that in an urban industrial setting such as 19th century The Hague, the relation between parental mortality and marriage of children is much weaker than in a society based on agrarian and artisan production.
The simulation by Bartlema, referred to above, provides further support for the contention that the bias involved in taking proportions orphaned from the ever-married, as a proxy for those of the total population, is not large at all, at least for the female sex, in the period considered here. For, the calculation of proportions orphaned with the familiar Hill-Trussell expression for the total population gave results that could be compared with those resulting from a calculation specific for women who married and gave birth to children 47_/. With respect to the male sex, little can to our knowledge be said on the basis of available empirical or secondary material. Simulation exercises, such as those carried out with respect to differentials by civil status, could have told us whether the non-validity of this assumption would have made much difference. In the present state of affairs, we must suffice with the statement that a bias might be involved. The resignation in question is due to the

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45_/ G. Ohlin, "Mortality, Marriage and Growth in Pre-Industrial Populations". Population studies, Vol. XIV, no. 3, March 1961, p. 190-197. See also E.W. Hofstee, De demografische ontwikkeling van Nederland in de eerste helft van de negentiende eeuw. Een historisch-demografische en sociologische studie, 1978. Van Loghum Slaterus, esp. p. 94 and J. Dupâquier, "De l'animal à l'homme: le mécanisme auto-régulateur des populations traditionnelles". Revue de l'Institut de Sociologie, 1972/2, p. 177-211.

46_/ T.H. Hollingsworth, Historical Demography. The Sources of History: Studies in the Uses of Historical Evidence. Hodder and Stoughton Limited, London 1969, p. 158.

47_/ See Bartlema cited in footnote 38.

Table 18. MEAN AGE AT MARRIAGE OF BRIDES AND GROOMS BY ORPHANHOOD STATUS, THE HAGUE, PERIODS 1869-71 AND 1879-80.

	Orphanhood status			
Period	Father died	Father still living	Mother died	Mother still living
		Grooms		
1869-71	33.72	27.86	35.20	27.83
1879-80	33.48	26.67	34.29	27.23
		Brides		
1869-71	31.10	26.23	32.12	26.50
1879-80	30.83	25.29	31.19	25.95

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scarcity of time involved, not to the infeasibility of such an undertaking. The purpose of adding the last statement is to underline the utility of simulation as an analytical instrument in a situation in which we know quite a bit about relevant differentials, but not whether or not they have a serious effect.

b. Geographical reference

Thus far, we have discussed problems caused by definitional component a mentioned above 48_/. Time reference is a topic that has received ample attention elsewhere, and will not be discussed in this context. Moving on to the next item of table 16, the geographical area of reference, we reach a subject about which little is to be found in the literature. It is nevertheless a factor worthy of attention when applying the method to areas which are not closed to migration.

If, in an area under investigation, a concentration of immigrants with deceased parents exists, the estimates of parental mortality will be too high. There is little doubt that the proportions orphaned are affected by the influx of migrants. Table 19 shows that of the orphans living in The Hague at the time of marriage, 40-49% were born outside The Hague, whereas only 26-33% of the non-orphans were born outside the city.

48_/ One of the other problems that is often encountered when using the orphanhood method - the misreporting of the orphanhood status because of the adoption of young orphaned children by relatives who report them as being their own children - does, at least in theory,not present itself here: this is guaranteed by the copy of the birth certificate of the bride and groom. Related difficulties, however, occur with illegitimate children legally recognized by a man who is not - biologically speaking - the father of the child. But as long as the age of the biological father does not deviate systematically from that of the judicial father, this has no effect on the outcome. Besides, this will, at most, concern 2% of all births.

The fact that among orphans, people born outside the city are overrepresented, may be due to selectivity of migrants, such that persons with less strong family ties are more apt to migrate 49_/ or to the fact that the area of origin is one of higher mortality than the place of destination.
Besides this overrepresentation, another (related) factor may have a disturbing effect. The indirect mortality estimates presented earlier were based on marriages contracted in The Hague, regardless of the place of birth and/or the place of residence of bride and groom and their parents. In theory, indirect estimates only tell us something about the mortality conditions in the place the respondents' parents live(d), not about the place in which the respondents live: our empirical life tables, with which we evaluate the performance of our estimates, refer, however, to the population living, and the people dying (in practice the resident population) in The Hague.
This situation is problematic because of the fact that in the period 1860-1880 large regional and urban-rural differences in mortality existed. Crude death rates in The Hague were somewhat lower than in the remainder of the province of South Holland (the region most of the migrants came from) but much higher than in the rest of the country (17-40%) 50_/.

It can be argued that among brides and grooms who were born and were still living in The Hague a higher proportion of parents lived and died in The Hague than among respondents born outside of The Hague and than among respondents who, at the time of marriage, lived outside of The Hague (because of their unmarried status, a large majority of the brides and grooms was, at the time of marriage, still tied to a family). The fit between the indirect mortality estimates, based on data pertaining only to the "indigenous" population, (brides and grooms born and living in The Hague) on the one hand, and the empirical life tables on the other must consequently be better than between the empirical life tables and the indirect estimates based on proportions orphaned among the total group of marriages.

Table 20 shows that in almost any age group the proportions not-orphaned among the "indigenous" population of The Hague are higher than among the total group of marriages. It thus seemed useful to infer indirect mortality estimates for the "indigenous" population.

Tables 21 to 24 present the results of the mortality estimates based on the percentages not-orphaned of the indigenous population 51_/. Table 25 compares these estimates with the empirical life tables for the total population and the ever-married

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49_/ H. ter Heide, Binnenlandse migratie in Nederland. 's-Gravenhage, Staatsuitgeverij 1965, p. 107-108; J.J. Macisco Jr., "Algunas Consideraciones sobre un marco analítico para las migraciones rurales urbanas", in: J.C. Elizaga y J.J. Macisco, Migraciones Internas, CELADE, Santiago, Chile, 1975; E.S. Lee, "A Theory of Migration", Demography, vol. 3, no. 7, 1966, p. 47-57 esp. p. 57; L. Soberón, "Condiciones estructurales de la migración rural urbana", Revista Mexicana de Sociologia, 1973.

50_/ E.W. Hofstee, Korte demografische geschiedenis van Nederland van 1800 tot heden. Fibula-Van Dishoeck, Haarlem, 1981, p. 122-123.

51_/ For consistency's sake, the average of the different levels has been used for Henry's method. This average level is 48.38 for females in 1869-71, 48.81 in 1879-80, and 53.11 for the intersurvey cohort; for males it is 49.07, 55.16 and 57.27, respectively.

TABLE 19 BRIDES AND GROOMS LIVING IN THE HAGUE AT THE TIME OF MARRIAGE, ACCORDING TO PLACE OF BIRTH AND ORPHANHOOD STATUS, PERIODS 1869-71 AND 1879-80

	Birthplace of groom			Birthplace of bride		
	The Hague	Elsewhere	Total	The Hague	Elsewhere	Total
Period 1869-71						
Father died	59.6	40.4	100.0	58.4	41.6	100.0
Father still living	73.2	26.8	100.0	72.6	27.4	100.0
Mother died	55.6	44.4	100.0	53.2	46.8	100.0
Mother still living	73.0	27.0	100.0	73.5	26.5	100.0
Total male and female population of The Hague				69.0	31.0	100.0
Period 1879-80						
Father died	53.7	46.3	100.0	55.5	44.5	100.0
Father still living	68.9	31.1	100.0	67.6	32.4	100.0
Mother died	51.1	48.9	100.0	53.0	47.0	100.0
Mother still living	68.7	31.3	100.0	66.9	33.1	100.0
Total male and female population of The Hague				65.6	34.4	100.0

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population of The Hague, using goodness-of-fit indicators.
In comparison with the estimates based on the proportions not-orphaned of the total population, the internal consistency of the estimation for females is much smaller, in both the Brass method and the regression method (except for 1879-80), when based on the indigenous population only.
The values of the variance of the levels amount to 9.5619, 2.1946 and 7.6895 for the Brass method, and 3.9458, 1.2557 and 2.9504 for the regression method. The consistency for males is, with the exception of the first period, greater than for the proportions based on the total group of brides and grooms (σ^2 is 3.7226, 2.9277 and 3.4520, respectively).
In general, mortality estimates based on the proportions not-orphaned among the indigenous population do not yield more accurate estimates of the life table quantities with the exception of the estimation of mortality amongst females, based on the proportions not-orphaned in 1879-80: in both the Brass method and the regression method estimates based on the indigenous population yield in this case smaller deviations with respect tothe empirical life tables than estimates based on the proportions not-orphaned of the total group of brides and grooms.

When estimating male mortality, an improvement of the estimation is noticeable, both from the data for 1869-71 and from the data for 1879-80, yet exclusively in comparison with the life tables for the ever-married.

TABLE 20 DATA ON ORPHANHOOD STATUS AND PROPORTIONS OF RESPONDENTS WITH, RESPECTIVELY, MOTHER AND FATHER ALIVE. RESPONDENTS BORN AND LIVING IN THE HAGUE, PERIODS 1869-71 AND 1879-80.

	Maternal orphanhood						Paternal orphanhood					
	Period 1869-71						Period 1869-71					
Age-group of respondents	Total number of respondents	Number of respondents with mother alive	mother dead	unknown maternal orphanhood status	Proportion with mother alive Indigenous respondents	All respondents	Total number of respondents	Number of respondents with father alive	father dead	unknown paternal orphanhood status	Proportion with father alive Indigenous respondents	All respondents
15-19	88	72	16	0	.8182	.8250	88	61	23	4	.7262	.6930
20-24	1041	838	203	0	.8050	.7831	1041	684	327	30	.6766	.6547
25-29	810	578	232	0	.7136	.6637	810	486	298	26	.6199	.5801
30-34	329	220	108	1	.6707	.5831	329	151	160	18	.4855	.4675
35-39	144	66	78	0	.4583	.4451	144	48	89	7	.3504	.3322
40-44	94	28	66	0	.2979	.3014	94	20	70	4	.2222	.2513
45-49	54	15	39	0	.2778	.1984	54	11	42	1	.2075	.1707
50-54	36	8	28	0	.2222	.1548	36	7	28	1	.2000	.1250
Total	2596	1825	770	1			2596	1468	1037	91		
	Period 1879-80						Period 1879-80					
15-19	117	104	13	0	.8889	.8650	117	86	25	6	.7748	.7756
20-24	986	782	204	0	.7931	.7599	986	712	257	17	.7348	.7054
25-29	622	450	170	2	.7258	.6764	622	361	239	22	.6017	.5872
30-34	228	144	84	0	.6316	.6016	228	118	100	10	.5413	.4748
35-39	97	48	49	0	.4948	.4743	97	32	62	3	.3404	.2992
40-44	79	32	47	0	.4051	.3626	79	15	60	4	.2000	.1963
45-49	35	10	25	0	.2857	.2000	35	5	30	0	.1429	.1098
50-54	35	7	28	0	.2000	.1739	35	2	32	1	.0588	.0909
Total	2199	1577	620	2			2199	1331	805	63		

TABLE 21 FEMALE SURVIVORSHIP PROBABILITIES FROM AGE 25 AND MALE SURVIVORSHIP PROBABILITIES FROM AGE 32.5 USING HENRY'S METHOD. THE HAGUE, PERIODS 1869-71 AND 1879-80 AND INTERSURVEY COHORT. BRIDES AND GROOMS BORN AND LIVING IN THE HAGUE

Central age n	Female survivorship probability l(25+n)/l(25)	Male survivorship probability l(35+n)/l(32.5)
	Period 1869-71	
20	.8551	.7590
25	.8100	.6724
30	.7546	.5652
35	.6856	.4377
40	.5950	.2969
45	.4793	.1650
50	.3402	.0660
55	.1981	
60	.0855	
	Period 1879-80	
20	.8582	.8194
25	.8137	.7417
30	.7591	.6401
35	.6907	.5128
40	.6007	.3639
45	.4852	.2149
50	.3456	.0939
55	.2023	
	Intersurvey cohort	
20	.8865	.8338
25	.8487	.7595
30	.8007	.6607
35	.7387	.5345
40	.6544	.3845
45	.5414	.2311
50	.3988	.1037
55	.2442	
60	.1134	

TABLE 22 FEMALE SURVIVORSHIP PROBABILITIES FROM AGE 25 USING PROPORTIONS WITH SURVIVING MOTHERS AND THE BRASS METHOD. THE HAGUE, PERIODS 1869-71 AND 1879-80 AND INTERSURVEY COHORT. BRIDES AND GROOMS BORN AND LIVING IN THE HAGUE

Period 1869-71

Respondent's age group	Proportion not orphan	Central age n	W(n)	l(25+n)/l(25)	West mortality level
15-19	.8182	20	1.18930	.82070	11.05
20-24	.8050	25	1.35108	.83709	14.90
25-29	.7136	30	1.48186	.73427	12.37
30-34	.6707	35	1.59028	.79608	18.29
35-39	.4583	40	1.63352	.55992	12.20
40-44	.2979	45	1.64004	.31076	7.47
45-49	.2778	50	1.50048	.30563	12.02

Period 1879-80

Respondent's age group	Proportion not orphan	Central age n	W(n)	l(25+n)/l(25)	West mortality level
15-19	.8889	20	1.18930	.90703	17.02
20-24	.7931	25	1.35108	.81673	13.70
25-29	.7258	30	1.48186	.77119	14.22
30-34	.6316	35	1.59028	.71235	14.63
35-39	.4948	40	1.63352	.55163	11.90
40-44	.4051	45	1.64004	.48152	13.61
45-49	.2857	50	1.50048	.32859	12.93

Intersurvey cohort

Respondent's age group	Proportion not orphan	Central age n	W(n)	l(25+n)/l(25)	West mortality level
15-19	.8889	20	1.18930	.90703	17.02
20-24	.7931	25	1.35108	.79471	12.41
25-29	.7885	30	1.48186	.86849	19.17
30-34	.6225	35	1.59028	.66724	12.62
35-39	.5467	40	1.63352	.65484	15.93
40-44	.3760	45	1.64004	.39853	10.58
45-49	.3408	50	1.50048	.38504	15.34

TABLE 23 MALE SURVIVORSHIP PROBABILITIES FROM AGE 32.5 USING PROPORTIONS WITH SURVIVING FATHERS AND THE BRASS METHOD. THE HAGUE, PERIODS 1869-71 AND 1879-80 AND INTERSURVEY COHORT. BRIDES AND GROOMS BORN AND LIVING IN THE HAGUE

Period 1869-71

Respondent's age group	Proportion not orphan	Central age n	W(n)	l(35+n)/l(32.5)	West mortality level
15-19	.7262	20	.70408	.71152	11.66
20-24	.6766	25	.68947	.65899	13.51
25-29	.6199	30	.56468	.56139	14.12
30-34	.4855	35	.36871	.40021	12.82
35-39	.3504	40	.06453	.23047	11.17
40-44	.2222	45	-.24737	.20386	17.07
45-49	.2075	50	-.44848	.19664	N.A.

Period 1879-80

Respondent's age group	Proportion not orphan	Central age n	W(n)	l(35+n)/l(32.5)	West mortality level
15-19	.7748	20	.70408	.76296	14.14
20-24	.7348	25	.68947	.69347	15.08
25-29	.6017	30	.56468	.57541	14.73
30-34	.5413	35	.36871	.41447	13.40
35-39	.3404	40	.06453	.20906	10.16
40-44	.2000	45	-.24737	.12877	11.96
45-49	.1429	50	-.44848	.02108	N.A.

Intersurvey cohort

Respondent's age group	Proportion not orphan	Central age n	W(n)	l(35+n)/l(32.5)	West mortality level
15-19	.7748	20	.70408	.76296	14.14
20-24	.7348	25	.68947	.70598	15.68
25-29	.6420	30	.56468	.61845	16.57
30-34	.5879	35	.36871	.43929	14.45
35-39	.3525	40	.06453	.24932	12.07
40-44	.2422	45	-.24737	.11946	11.29
45-49	.1438	50	-.44848	.03864	N.A.

TABLE 24 FEMALE SURVIVORSHIP PROBABILITIES FROM AGE 25 USING PROPORTIONS WITH SURVIVING MOTHERS, REGRESSION METHOD. THE HAGUE, PERIODS 1869-71 AND 1879-80 AND INTERSURVEY COHORT. BRIDES AND GROOMS BORN AND LIVING IN THE HAGUE

Period 1869-71

Respondent's age group	Proportion not orphan	Central age n	l(25+n)/l(25)	West mortality level
15-19	.8182	20	.82814	11.52
20-24	.8050	25	.83152	14.59
25-29	.7136	30	.75753	13.55
30-34	.6707	35	.73581	15.65
35-39	.4583	40	.53254	11.22
40-44	.2979	45	.37030	9.58
45-49	.2778	50	.35095	13.92

Period 1879-80

Respondent's age group	Proportion not orphan	Central age n	l(25+n)/l(25)	West mortality level
15-19	.8889	20	.90241	16.69
20-24	.7931	25	.81928	13.87
25-29	.7258	30	.77008	14.17
30-34	.6316	35	.69486	13.86
35-39	.4948	40	.57203	12.68
40-44	.4051	45	.49067	13.98
45-49	.2857	50	.36000	14.29

Intersurvey cohort

Respondent's age group	Proportion not orphan	Central age n	l(25+n)/l(25)	West mortality level
15-19	.88890	20	.90241	16.69
20-24	.79310	25	.81928	13.87
25-29	.78850	30	.83458	17.41
30-34	.62250	35	.68533	13.45
35-39	.54670	40	.62818	14.88
40-44	.37600	45	.45799	12.73
45-49	.34080	50	.42311	16.80

TABLE 25 GOODNESS-OF-FIT INDICATORS OF ESTIMATED VALUES OF l(25+n)/l(25) (FEMALES) AND l(35+n)/l(32.5) (MALES) USING THE HENRY, BRASS-HILL AND REGRESSION METHOD AND PROPORTIONS NOT-ORPHANED AMONG THE INDIGENOUS POPULATION, AND EMPIRICAL VALUES FOR THE TOTAL AND THE EVER-MARRIED POPULATION

	Estimates of l(25+n)/l(25) using						Estimates of l(35+n)/l(32.5) using			
	Henry's method		Brass method		Regression method		Henry's method		Brass method	
	Estimates for 1869-71 in comparison with life table for total population									
	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69
Chi square	.01817	.00867	.08184	.09550	.03739	.03786	.03985	.04637	.01564	.01549
MAD	.03812	.02695	.05389	.05236	.04690	.04480	.06341	.06601	.03542	.03228
MAPD	7.09	4.82	9.39	9.33	8.91	8.40	14.70	16.38	7.64	6.60
	Estimates for 1879-80 in comparison with life table for total population									
	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79
Chi square	.01207	.00182	.01715	.01232	.02138	.00956	.16570	.11167	.03456	.01697
MAD	.03172	.01191	.03946	.02956	.04060	.02700	.13535	.10910	.05894	.03896
MAPD	5.72	1.83	5.83	4.26	7.18	4.26	33.36	25.90	12.21	8.57
	Estimates for intersurvey cohort in comparison with life table for total population, period 1870-79									
Chi square	.03652		.05392		.03703		.14812		.02592	
MAD	.05705		.05757		.04738		.12812		.04872	
MAPD	9.97		9.93		8.68		30.42		9.27	

	Estimates of l(25+n)/l(25) using						Estimates of l(35+n)/l(32.5) using			
	Henry's method		Brass method		Regression method		Henry's method		Brass method	
	Estimates for 1869-71 in comparison with life table for ever-married population									
	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69	Period 1850-59	Period 1860-69
Chi square	.02392	.02215	.08441	.09857	.04160	.04505	.03170	.03651	.00218	.00310
MAD	.04553	.04474	.05862	.06123	.05200	.05483	.05554	.05751	.01417	.01669
MAPD	8.22	7.80	10.24	10.55	9.63	9.97	13.00	14.27	2.85	3.59
	Estimates for 1879-80 in comparison with life table for ever-married population									
	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79	Period 1860-69	Period 1870-79
Chi square	.02715	.00227	.03364	.01514	.03847	.01078	.14742	.08673	.01102	.01057
MAD	.04952	.01282	.05178	.03364	.05753	.02835	.12685	.09441	.02812	.02698
MAPD	8.72	1.81	6.93	4.97	10.02	4.27	30.93	22.07	6.25	9.88
	Estimates for intersurvey cohort in comparison with life table for ever-married population, period 1870-79									
Chi square	.03483		.05501		.03654		.11955		.02731	
MAD	.05684		.05811		.04839		.11343		.05215	
MAPD	9.68		9.83		8.64		26.45		10.91	

We shall pass on from item B.1 in table 16, referring to the selectivity of our sample, to item B.2 which deals with the subject of random variation.

6.2.2. Random fluctuations

In historical, as well as in contemporary applications of the orphanhood method, it is possible to gather information from a whole population, defined in terms of demographic characteristics, time and space. The size of such a population can be increased or diminished by shifting the geographical or time limits that define the population.
Since the major objective of this study is to test the usefulness of the orphanhood method in a particular historical context, we strove to gather information on ample numbers of events lest imprecision due to random variation overshadow effects of non-sampling errors.

The importance of collecting information for large numbers of respondents becomes apparent by comparing the proportions not-orphaned of 3 or 2 consecutive years. Although the proportions not-orphaned, for instance in 1869, 1870 and 1871 can all be considered as realisations of the orphanhood pattern existing in the 1870's, the selection of one particular year has a considerable effect on the results.
This is clearly shown for the 1870's in figure 12. Figure 13 gives the values of the survivorship probabilities $l(25+n)/l(25)$ inferred from the proportions orphaned in the different years by using the Brass method: here too deviations are very large.
Logically speaking, taking a whole population, however small, excludes sampling errors, since inference is direct. Random variations are, however, not eliminated by such a procedure, as was shown in figure 13. If we use measures derived from such a population to generate life table segments, it is advantageous to consider the outcome in the population as a sample of all possible outcomes. This will allow the calculation of confidence intervals.

The statistical basis for the calculation of the confidence intervals is laid by the assumption of an underlying mortality and fertility schedule which is realized in a particular population (a city in a given year for example), resulting in a stochastic variable. The estimates of the proportions not orphaned by age, or of fertility rates by age of mother, are regarded as means of a dichotomous population. The standard errors of such statistics, as well as their distribution, are known. The mathematical expressions used all assume simple random sampling.
Approximate formulas are used, since the objective is to get a general idea of the order of magnitude of the confidence intervals in question 52_/.
Table 26 compares 95% confidence intervals for proportions not-orphaned in 1869 and 1869-71. The width of the confidence interval is,in the latter period, much more narrow: the sum of the intervals for instance is halved. Whether the width of the

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52_/ Confidence intervals with a level of significance of 5% are calculated with the approximate expression:

$$p-2\sqrt{p(1-p)/n} \leq P \leq p+2\sqrt{p(1-p)/n}$$

where p refers to the proportion not-orphaned and n denotes the number of respondents.
The width of each age-group-specific confidence interval for the corresponding proportions not-orphaned is indicated as ${}_5D_x$ and their total as D.

confidence intervals is to be considered in absolute terms as broad or narrow is a matter of subjective evaluation, which we will leave to the reader. The point we want to make is that something is to be gained by carrying out this simple additional calculation. In the usual applications of the method it is common practice not to pay too much attention to sampling variability, since demographic surveys and censuses usually guarantee large enough numbers to warrant concentrating on non-sampling errors. In historical applications, however, the available material is often so scarce, and the availability of alternative sources so limited, that use is made of samples, of sizes which generate estimates unquestionably affected by random fluctuations. The procedure we recommend is not to abstain from making the best of what little information we have, but of doing so in full recognition of the strengths and weaknesses of our data. The least we can do is to take a look at approximate confidence intervals. We might also attempt to incorporate the varying degrees of confidence we have in particular data-elements in the final estimates of life table segments, if that may be our goal, for example by using weighted averages in the determination of the final mortality level, the weights being inversely proportional to the width of the confidence intervals. In order to illustrate this, table 26 also contains weights that can be used. These weights are inferred from the proportional distribution of the reciprocals of the confidence intervals themselves, but are restricted to those intervals of which the boundaries are higher than 0 and smaller than 1.000.

6.3. Assumptions on demographic behaviour; the effect of the mean age at childbearing

The average age difference between mother (father) and child in the population which is used as an indicator of the average age at which the parents begin their exposure to the risk of dying is estimated by the mean age at childbearing. The robustness of the different estimation procedures for variation in the average age at childbearing is evaluated in Tables 27 and 28.
First of all, the question was looked into whether the estimated values of l(35+n)/l(32.5) change significantly when the median value is taken instead of the average value (table 27). Table 27 shows that a difference in the value of M of approximately 1.2 years has a reductive effect on the estimation of the values of l(35+n)/l(32.5), both when applying the method of Henry 53_/ and when applying the Brass-Hill method. Therefore, comparison with the empirical life tables for the total population over the years 1860-69 yields more favourable values for the different goodness-of-fit indicators. For Henry's method, the values of MAD and MAPD were halved, and chi square declined by 70% (chi square = 0.00404, MAD = 0.01853 and MAPD = 4.54; when using the Brass method, the choice of the median also results in a considerable reduction of the deviations with respect to the empirical life tables (chi square declined by more than 60% to 0.00310, MAD by almost 40% to 0.01669 and MAPD by more than 40% to 3.59%).

Table 28 examines to what extent the estimated values derived by the Brass method are influenced by the fact that the value of M falls outside of the range proposed by Brass. Table 28 shows that the Brass method, when applied for an M value of 30.0, yields significantly lower values of l(25+n)/l(25) than when applied for an M value of 31.18: in the latter case, the estimates yield much smaller deviations with respect to

53_/ In Henry's method the average mortality level for this period amounted to 43.9.

JRE 12. PROPORTIONS OF RESPONDENTS WITH MOTHER ALIVE PER FIVE-YEAR AGE GROUP, THE HAGUE, 1869, 1870, 1871.

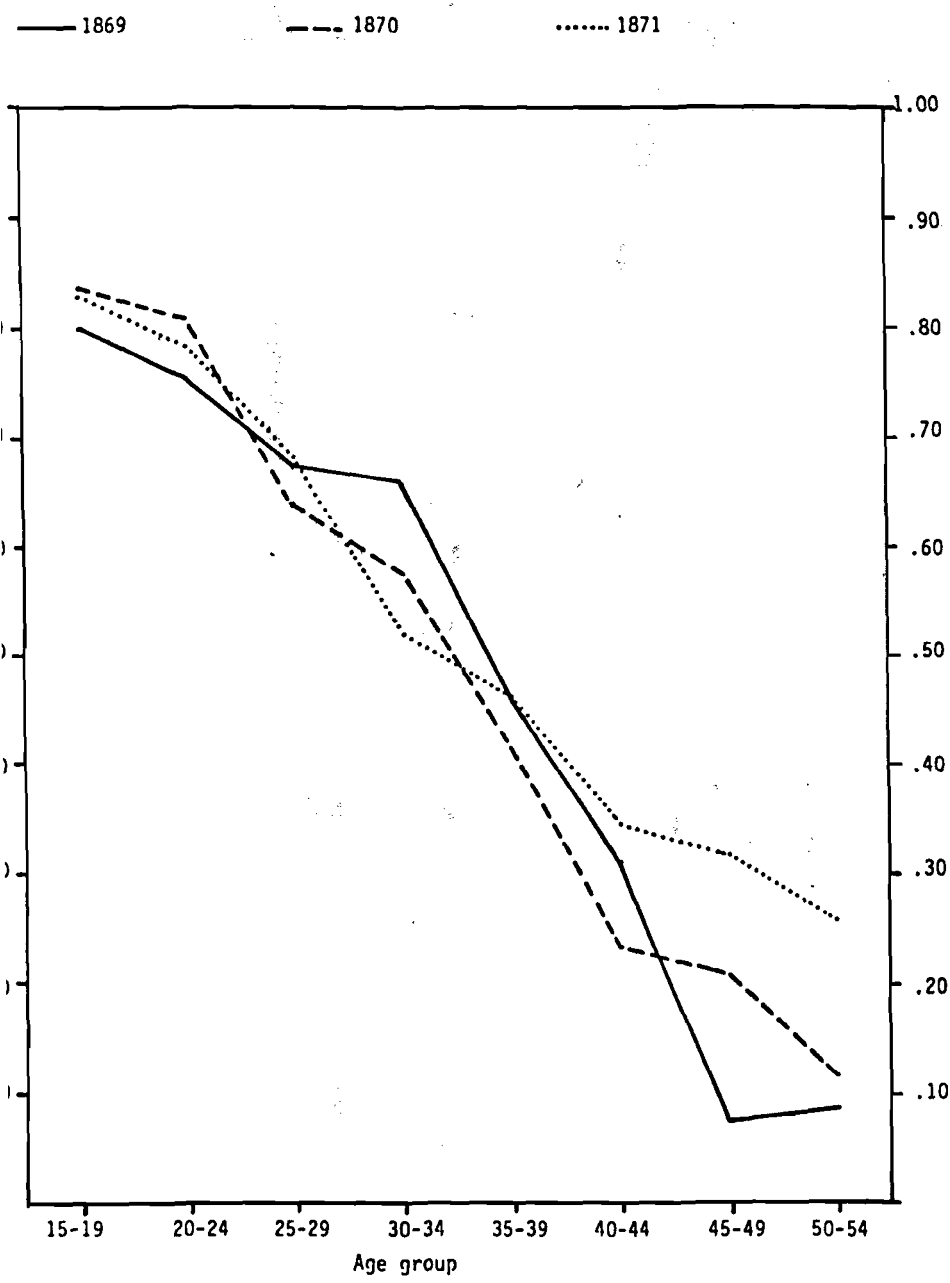

FIGURE 13.ESTIMATED FEMALE SURVIVORSHIP VALUE l(25+n)/l(25),USING THE BRASS-HILL METHOD,THE HAGUE,1869,1870,1871.

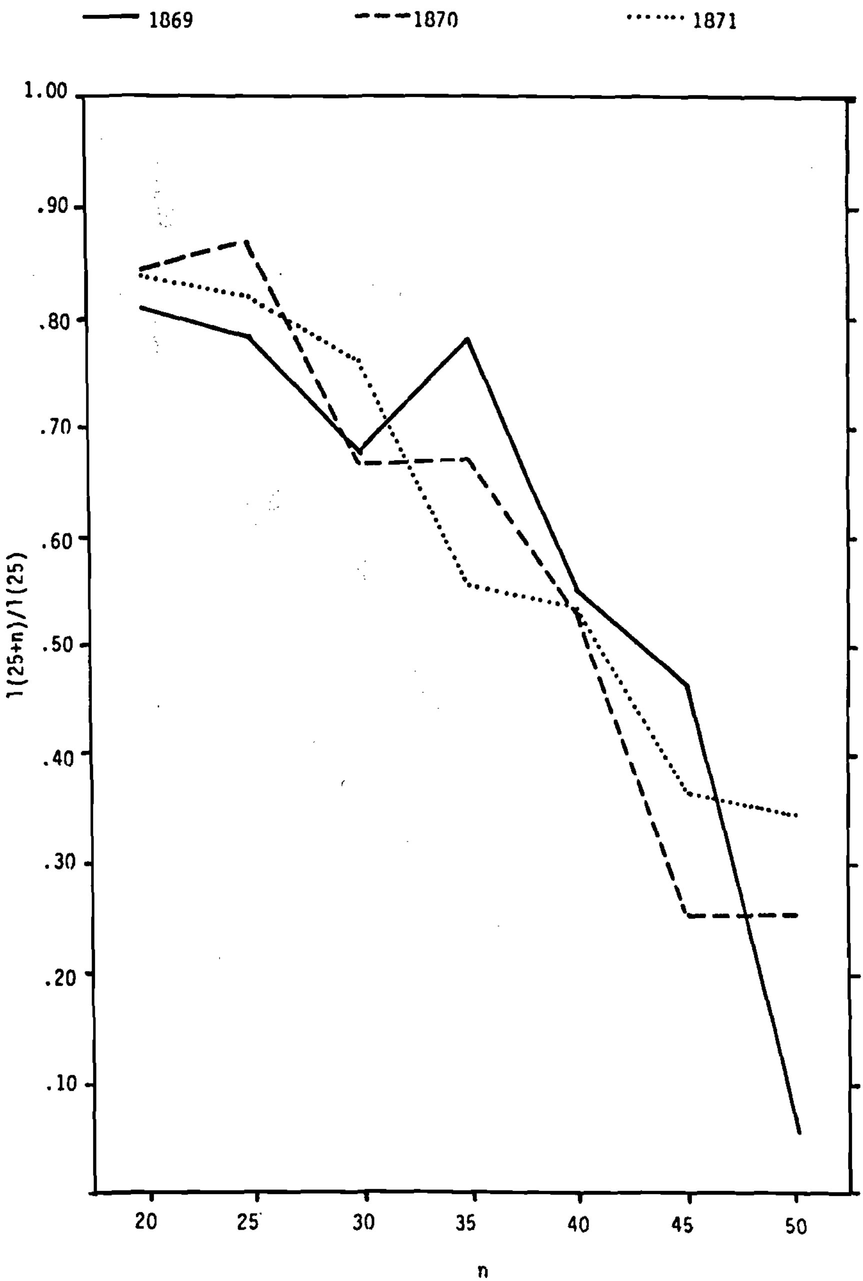

TABLE 26 APPROXIMATE CONFIDENCE INTERVALS OF PROPORTIONS NOT-ORPHANED IN TWO SUBPOPULATIONS, WITH VARYING NUMBERS OF RESPONDENTS, THE HAGUE, PERIODS 1869-71 AND 1869.

	Maternal orphanhood						Paternal orphanhood					
	Period 1869-71						Period 1869-71					
Age group of respondents	Total number of respondents	Proportion with mother alive	Limits of the 95% confidence interval		Width of the interval $_5D_x$	Weight $\frac{_5D_x^{-1}}{\Sigma\, _5D_x^{-1}}$	Total number of respondents	Proportion with father alive	Limits of the 95% confidence interval		Width of the interval $_5D_x$	Weight $\frac{_5D_x^{-1}}{\Sigma\, _5D_x^{-1}}$
15-19	120	.8250	.756	.894	.138	.078	114	.6930	.607	.779	.172	.067
20-24	1346	.7831	.761	.806	.045	.241	1306	.6547	.628	.681	.053	.216
25-29	1368	.6637	.638	.689	.051	.213	1329	.5801	.553	.607	.054	.212
30-34	674	.5831	.545	.621	.076	.142	646	.4675	.428	.507	.079	.145
35-39	319	.4451	.389	.501	.112	.097	307	.3322	.278	.386	.108	.106
40-44	209	.3014	.238	.365	.127	.085	199	.2513	.190	.313	.123	.093
45-49	126	.1984	.127	.269	.142	.076	123	.1707	.103	.239	.136	.084
50-54	84	.1548	.076	.234	.158	.068	80	.1250	.051	.199	.148	.077
55-59	32	.0625	.0	.148			31	.0323	.0	.096		
60-64	27	.0370	.0	.110			27	.0000				
Total	4305				.849*	1.000	4162				.873	1.000
	Period 1869						Period 1869					
15-19	30	.8000	.654	.946	.292	.079	29	.6552	.479	.832	.353	.060
20-24	407	.7543	.712	.797	.085	.272	397	.6474	.599	.695	.096	.220
25-29	422	.6730	.627	.719	.092	.252	407	.5921	.543	.641	.098	.216
30-34	209	.6603	.595	.726	.131	.177	201	.4677	.397	.538	.141	.150
35-39	109	.4587	.363	.554	.191	.121	103	.3301	.237	.423	.186	.114
40-44	61	.3115	.193	.430	.235	.099	59	.2712	.155	.387	.232	.091
45-49	40	.0750	.0	.158			37	.1622	.041	.283	.242	.087
50-54	23	.0870	.0	.205			21	.1905	.019	.362	.343	.062
Total	1301				1.026	1.000	1254				D=1.691	1.000

* Up to age group 40-44 the sum of the widths is .549

TABLE 27 MALE SURVIVORSHIP PROBABILITIES FROM AGE 32.5 USING PROPORTIONS WITH SURVIVING FATHERS AND THE HENRY METHOD, RESPECTIVELY THE BRASS METHOD FOR MEAN AGE AT MATERNITY 33.59 YEARS RESPECTIVELY MEDIAN AGE AT MATERNITY 32.40 YEARS. THE HAGUE, PERIOD 1869-71

Henry method

	Mean age at maternity 33.59 years	Median age at maternity 32.40 years
Central age n	l(35+n)/l(32.5)	l(35+n)/l(32.5)
20	.7382	.7229
25	.6439	.6260
30	.5317	.5125
35	.4024	.3837
40	.2646	.2487
45	.1411	.1301
50	.0531	.0477

Brass method

	Mean age at maternity 33.59 years			Median age at maternity 32.40 years		
Central age n	W(n)	l(35+n)/l(32.5)	West mortality level	W(n)	l(35+n)/l(32.5)	West mortality level
20	.70408	.68167	10.34	.56900	.67649	10.11
25	.68947	.63153	12.34	.52880	.61955	11.85
30	.56468	.53108	12.91	.38140	.51045	12.08
35	.36871	.38209	12.08	.17300	.35561	11.04
40	.06453	.25652	12.42	-.13540	.24035	11.65
45	-.24737	.15076	13.50	-.43300	.13580	12.42
50	-.44848	.10450	N.A.	-.60020	.09757	N.A.
55	-.52290	-.01617	N.A.	-.63060	-.02616	N.A.

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the empirical life tables (chi square declined by 30%, MAD and MAPD by 40%). The values of these indicators, where M = 30.0, amounted to 0.09108, 0.06901 and 15.47%, respectively.

TABLE 28 FEMALE SURVIVORSHIP PROBABILITIES FROM AGE 25 USING PROPORTIONS WITH SURVIVING MOTHERS AND THE BRASS METHOD FOR MEAN AGE AT MATERNITY 30.0 RESPECTIVELY 31.18 YEARS. THE HAGUE, PERIOD 1869-71

Brass method

	Mean age at maternity 30.0 years			Mean age at maternity 31.18 years		
Central age n	W(n)	l(25+n)/l(25)	West mortality level	W(n)	l(25+n)/l(25)	West mortality level
20	1.08500	.82856	11.54	1.18930	.83293	11.80
25	1.21800	.80913	13.28	1.35108	.82502	14.21
30	1.32300	.68973	10.42	1.48186	.70254	10.96
35	1.41200	.63996	11.53	1.59028	.66456	12.51
40	1.44200	.50862	10.38	1.63352	.53614	11.34
45	1.44700	.34744	8.77	1.64004	.36732	9.48
50	1.31800	.21226	8.23	1.50048	.22022	8.57
55	1.08300	.16246	11.37	1.23940	.17690	12.16

7. CONCLUDING REMARKS

For the estimation of adult mortality in a population characterized by an almost constant mortality level and a high migration rate, the indirect method based on the proportions not-orphaned appeared to be very useful. For the estimation of both the male and female mortality, the applicability of the method decreased with increasing age of the respondents. Yet estimated values of the probabilities of survival between age 25 and 65 (females) and between age 32.5 and 75 (males) coincided well with the empirical values. The method developed by Henry yielded better results for females than the regression method, which in its turn, was better than the Brass-Hill method. For male mortality, Henry's method was useless, but reasonable estimates could be made by the Brass method. By combining the proportions not-orphaned of 2 consecutive surveys, the mortality level of a well-defined period could be estimated. Once again, the results appeared to be comparable with those of the empirical life tables, again with the exception of the male mortality derived by Henry's method.

We pointed out earlier, that mortality estimates are sensitive to relatively small deviations in the basic data: the way of calculating the proportion not-orphaned for the method of Henry, and the choice of a particular observation year appeared to influence the resulting mortality estimates. The manner in which the average age at childbearing was determined also influenced the results, in particular amongst males. Although one may assume that, in theory, the estimates of the mortality level which are based on the proportions not-orphaned refer primarily to the mortality level of the ever-married, in practice, there is greater agreement between the empirical life tables for the ever-married and the estimates than between the estimate and the life table for the total population amongst males only. Estimates based on the proportions not-orphaned among the indigenous population appeared to yield more accurate estimates of the mortality level only for the period 1879-80 for female mortality.

It is difficult to compare our results with those reached in different periods and at different places by other authors: a standard practice for the evaluation of the performance of indirect mortality estimation techniques is still lacking 54_/.

54_/ Compare for instance
J.L. Somoza, "An evaluation of the performance of indirect estimation techniques in the analysis of defective data". International Population Conference. I.U.S.S.P. Manila 1981, Vol. 3, p. 375-396 and
G. Pison and A. Langaney. "The Level and Age Pattern of Mortality in Bandafassi (Eastern Senegal): Direct Estimates and Evaluation of Indirect Techniques". BIB. Materialien zur Bevölkerungswissenschaft. Heft 38. Referate zum deutsch-französischen Arbeitstreffen auf dem Gebiet der Demographie vom 17. bis 21. Oktober 1983 in Reims. Wiesbaden 1984, p. 189-273.

SUMMARY

The Dutch city of The Hague is the seat of the government of the Netherlands and the capital of the province of South Holland. In March 1811 The Hague numbered 42350 inhabitants; almost 70 years later there were almost 70000 more. Table 1 shows the population trends of the time. Table 2 gives the population growth, in five-year periods, which was brought about by migration and by natural increase. Natural increase appears to have been the reason for the population growth in The Hague until the mid 1850's. In the years to follow, migration became extremely important. Figure 1 gives a detailed picture of the marriage, death and birth rate for the years 1840-1880. Table 3 gives more detailed information on patterns of marriage and family formation. Data concerning respectively the number of respondents with a mother (or father) alive (or dead), classified by age, and concerning the number of births classified by age of mother and father were extracted from the separate sections of the vital registration system (the birth, death and marriage register) and from the population register. Proportions not-orphaned were calculated for the years 1869-71 and 1879-80. It was possible to determine whether the father and/or mother of 8272 brides and grooms were still alive at the time of marriage. The mothers' (fathers') mean age at the birth of their children has been estimated using data over 1880; this age stands at 31.18 respectively 33.59 years.
The indirectly estimated survival probabilities were compared with empirical life tables for the total and for the ever-married population for the periods 1840-49, 1850-59, 1860-69 and 1870-79. These life tables were deduced from aggregated statistical data and from census data. Table 4 shows both the number of deaths for several important age groups and the size of the midperiod population. Abridged life tables have been constructed on the basis of the age-specific mortality rates per five-year group. Figures 2 and 11 present the resulting $_nq_x$ values. It appears that, apart from the period 1840-49, $_nq_x$ values are fairly stable, especially for females.
The internal consistency of the data concerning the number of deaths and those concerning the population at risk was evaluated by applying the Brass Distribution of deaths method (Table 5) and by carrying out an intercensal evaluation. In order to obtain an idea about the degree in which the mortality of The Hague is 'exceptional' an attempt was made to fit the Brass relational logit system to the observed values and goodness-of-fit indicators were calculated (Table 6). The residuals of the fitted versus the observed $l(x)$ and $_nq_x$ values are presented in Figure 3.
Table 7 shows, for age-groups with 20 or more respondents, the raw data collected in The Hague for the periods 1869-71 and 1879-80 and the proportions of respondents whose mother or father was alive at the time of marriage. In Figure 4 these figures are given as the proportions of respondents whose mother or father is no longer alive.
Table 8 gives, for both males and females, the different stages in the calculation of the level of mortality using Henry's method. Resulting probabilities of survival are given in Table 9. Table 10 gives the goodness-of-fit of the estimates derived by the method of Henry and empirical life tables. The estimated values for females appear to coincide very well with the empirical values; for males the estimates deviate very strongly from the empirical life table values.
Tables 11 and 12 give the estimates of female and male mortality resulting from the Brass-Hill method. According to table 13, the relative deviations between estimated and empirical life tables are very small up until age 65. For males the relative deviations are, on average, slightly lower. As could be expected from the t-values, comparison of the estimate with the life table generally yields smaller deviations with respect to the periods preceding the time of observation by more than 10 years.
Table 14 shows the results of the application of the Hill-Trussell technique. Compared with the Brass method, the levels of the West family model life tables coincide with

each other more strongly by the regression method. As shown in Table 15, the external validation also gives better results. The level of the goodness-of-fit indicators is primarily driven up by the deviations above age 70.

Comparison of the tables 10, 13 and 15 shows that for females, the method of Henry yields the best estimates. For males, the Brass method is superior. Figures 5 to 10 summarize these results.

Table 16 summarizes the causes of the deviations between the indirect estimates and the empirical life table values. Table 17 compares the results of the indirect estimation methods with the values of the life tables for the ever-married population. For males, this yields more accurate results. Tables 20 to 24 present the results of the mortality estimates based on the proportions not-orphaned of the indigenous population (brides and grooms born and living in The Hague). Table 25 compares these estimates with the empirical life tables, using goodness-of-fit indicators. In general these estimates do not yield better fits with the empirical values. Random fluctuations are discussed in Table 26 and Figures 12 and 13. The effect of the value of the mean age at childbearing on the indirect mortality estimates is discussed in the Tables 27 and 28.