Epidemiology: Open Access

Baigi et al., Epidemiology (Sunnyvale) 2018, 8:1
DOI: 10.4172/2161-1165.1000336

Research Open Access

Internal Migration and the Risk of Death: Impact of Socio-Epidemiological Factors in a Long Living Swedish Population

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Received date: December 8, 2017; **Accepted date:** December 19, 2017; **Published date:** December 29, 2017

Summary

Introduction: Migration is an important factor that could influence the distribution of disease and death in a population. The majority of studies on migration and health relate to external migration i.e. between different countries and cultures and has been thoroughly investigated in various settings. Studies of health effects related to internal migration, i.e. within the borders of a country however, are much rarer.

Aim: The aim of the current study was therefore to examine, from a socio-epidemiological perspective, the impact of internal migration on the risk of death from different diseases among individuals born in a province in south-west Sweden, living in the province itself or in other parts of the country.

Material and methods: The study comprised the whole population of both Sweden and the province of Halland and had a historical, prospective design which made it possible to follow individuals from 1980 to 1990. The participants were aged between 25 and 55 years in 1980 when the individual background variables were collected for the first of three times by repeated Swedish national questionnaires i.e. the Population and housing census (FoB). All deaths listed in the international classification of diseases (ICD) during the 10-year period from 1980-1990 were included.

Statistical methods: The risk of death was estimated by Poisson regression as a function of age, marital status, educational level and socio-economic classification (SEI) for Sweden as a whole. The expected number of deaths was calculated by taking all of the above-mentioned variables into account. For the hazard rate (HR), 95% confidence intervals were calculated. Comparisons between the observed and expected number of deaths were performed by means of Poisson distribution.

Results: Men born in Halland and still living there had a lower risk of death than other male residents of the province who were born elsewhere (HR 0.89 CI 0.80–0.99). Women showed a similar, although non-significant tendency. The results also revealed that those natives of Halland who had moved to another part of the country retained their advantage compared to Swedes born outside the province and living in other parts of Sweden. This difference was statistically significant among men (HR 0.90 CI 0.81–0.99) while a non-significant tendency in the same direction was seen in women. All these comparisons were adjusted for the background variables as age, marital status, educational level and SEI.

Keywords: Internal migration; Death; Socioepidemiological; Sweden

Introduction

Life expectancy in Sweden is among the highest in the world, for both men and women; 80.08 and 83.79 years, respectively [1]. A major reason is the extremely low infant mortality rate, while another important factor is low mortality in cardiovascular diseases [2]. Halland is the Swedish province with one of the longest life expectancy among both men and women (80.93 and 84.70, respectively) [1]. In previous studies we were able to trace the beginning of this long life expectancy to the early 20th century [3], and the main explanation was a decreasing mortality rate from infectious diseases during the first part of the period and later a lower than national average mortality rate from cardiovascular diseases [4]. Studies in the same population have explored possible contributory factors leading to the low mortality in diseases of the circulatory organs [5-7].

According to these studies a lower mortality from infectious diseases during the period of 1911 to 1950 compared to the country as a whole, could probably contributed to lower child mortality which in turn led to a favourable life expectancy in the province [3,4]. Furthermore, the smaller social gaps in the province compared to the national average together with a healthier life style have probably had an impact on the cardiovascular mortality among the natives of Halland [5-7]. In particular, the lower incidence of acute myocardial infarction has been shown to be related to the internal migration, an advantage in favour of the population of Halland [6]. A recent national survey has shown continued low mortality in heart disease in Halland [8] as well as that the population of Halland performs better in physical activities, has lower tobacco consumption and is less obese according to Body Mass Index (BMI) measurements, compared to the national average [9]. Furthermore, national surveys from previous decades also indicate that the social networks measured by the continuously questionnaire, in Halland are stronger than the average for Sweden [10], which could create conditions for good health in the province.

Migration is an important factor that influences the distribution of disease and death in a population [11,12]. The majority of studies on migration and health relate to external migration, i.e. between different countries and cultures. The role of immigration on morbidity and mortality has been thoroughly studied in various settings [11,12], but studies of health effects related to internal migration, i.e. within the borders of a country, are much rarer.

Historical background

The province of Halland is situated in the southwestern part of Sweden and is approximately 155 kms from north to south and between 15 and 50 kms from east to west where the coast joins the

Kattegat. Due to its proximity to the sea, Halland has a fairly mild climate by Swedish standards, especially in winter. During the 19th century, the population of Halland doubled from 71,000 to 142,000 [13] despite considerable internal and external emigration [14]. The development of agriculture during the second half of the 19th century resulted in a substantial increase in productivity in the province. In this period, agriculture and forestry flourished [14] and increased proportionally at a rapid rate for several decades during the mid 19th century, compared to the national average [15]. Harvest yields also showed a strong increase, mainly due to the introduction of rational farming methods and extensive land reclamation [15]. The province retained its agrarian character until recently, and more so than the country as a whole.

Migration from and to Halland

During the 18th and the first part of the 19th century, there was hardly any migratory activity between Sweden and the rest of the world [14]. In all, some 1,544,000 persons emigrated from Sweden 1851-1930 compared to a total of 400,000 immigrants, which equals a net loss of over 1,144,000 persons [14]. The highest emigration rates during the latter half of the 19th century were from the southern and central parts of Sweden including the province of Halland [14]. The population increase and bad harvests in 1867-68 forced many natives of Halland to join the great wave of emigration that took place during and after these years [16]. The emigrants first went to Denmark but eventually travelled to the USA. From the 1880s onwards, Halland was one of the Swedish provinces most decimated by emigration [16], which situation did not change until after 1930 [14], at which point the external immigration rate became greater than the external emigration rate. With regard to internal migration, this breakpoint was reached in 1961 [14].

Given the computerized population databases available in Sweden, we found it possible to investigate the impact of internal migration on the risk of death in the long living population of Halland.

Thus the aim of this study was therefore to examine the risk of death from all diseases among natives and non-natives of Halland from a socio-epidemiological perspective. We also wished to explore the risk of death among those natives of Halland who migrated to other parts of the country.

Materials and Methods

Socio-economic background factors and causes of death

Study design: The study comprised almost the whole population of both Sweden and the province of Halland and had a historical, prospective design which made it possible to follow individuals from 1980 to 1990. The participants were aged between 25 and 55 years in 1980 when the background variables were collected for the first time by repeated Swedish national questionnaires, i.e. the Population and housing census (FoB) [17].

FoB-register: The National Bureau of Statistics (SCB) carried out a nation-wide survey of the whole Swedish population every five years from 1965 to 1990, which included all inhabitants aged 16 years and over. Based on these surveys, special registers were compiled (the FoB registers), which among other things, comprised the individual registration of profession, educational level and a code for socio-economic classification (SEI). Questions and answers were validated after the completion of each survey. The questionnaire items also dealt with everyday life and had a simple structure and content, which strengthens the reliability of the responses [18].

Socio-economic classification (SEI): The National Bureau of Statistics (Statistics Sweden) has elaborated a socio-economic classification system, (SEI) for persons in the labour force, primarily based on occupation. In its most aggregated form, the classification consists of six groups [18]; two groups (unskilled/semi-skilled and skilled) of workers, one group of low grade non-manual employees, two groups of intermediate grade non-manual employees and self-employed professionals at higher level and one group of enterprise/business owners excluding farmers. Labourers and low grade employees were classified as Low-level, while middle and high grade employees were classified as High-level due to the fact that these two levels were clearly defined in the SEI algorithm. Distinctions between self-employed and employees, and between employees with and with no subordinates were, however, based on additional information included in the algorithm [18]. We also included self-employed farmers in the analysis, in addition to the SEI [18].

Study population: The Swedish inhabitants who answered the first FoB-questionnaire made up the study population and comprised 1,654,744 men and 1,592,467 women in Sweden as a whole for the age group under study. The corresponding figures for the province of Halland were 45,394 men and 43,403 women. The study comprised the 25-55 year age interval, in order to cover the population of working age with socio-economic background variables.

Causes of death: All deaths listed in the international classification of diseases (ICD) during the 10-year period from 1980-1990 were included. The basic data were drawn from the Cause of Death Register of Statistics Sweden (SCB). Natives of Halland who were resident in the province as well as in other parts of Sweden were identified by means of the unique code which forms part of the national social security number.

Procedure: Statistical processing of the raw data was carried out by means of a specially written DOS-based program [19]. Each individual was followed up during a 10-year period. The end line for the participants in the study was death. The background variables were identified by means of the FoB-register. This model was chosen as the basis for the study.

Statistical methods: The risk of death for Sweden as a whole was estimated by Poisson regression [20,21] as a function of age, marital status, educational level and SEI. The expected number of deaths was calculated by taking all of the above-mentioned variables into account. Confidence intervals of 95% were calculated for the hazard rate (HR). Comparisons between the observed and expected number of deaths were made by means of Poisson distribution.

Clarification due to calculation of the death hazard function (mean survival)

If X denotes the time to the event (death, disease, etc.) and f and F the corresponding frequency and distribution function, respectively, we obtain the following mean μ of X:

$$\mu = \int_0^\infty x f(x) dx,$$

which is equal to

$$\int_0^{\infty} (1 - F(x))dx$$

The hazard function h of X is the limit of the quotient between the number of events and person years when the denominator tends to equal zero. The survival function S gives the proportion of individuals not affected by the event. By definition, S(x)=1-F(x). The following is the general relationship between the survival function S and the hazard function

$$S(x) = \exp(-\int_0^{x} h(u)du)$$

which yields

$$\mu = \int_0^{\infty} \exp(-\int_0^{x} h(u)du)dx$$

The expected survival after x0 can be obtained by taking the above integrals from x0, which is a higher value than zero. The hazard function h may be a function of several variables apart from age (or time since the start of follow up), such as current calendar time, body mass index, presence of certain diseases, etc. If we have an estimate of h, we can calculate the mean survival as a function of the various variables included in h by applying the last equation. In order to estimate h as a function of several variables, we can use special Poisson regression models, where the results obtained are in the form of continuous functions [4,20,21].

Causes of death and data reliability

The Cause of Death Register is one of the most complete instruments of its kind in Sweden. Today there is a national database for causes of death, covering the period from 1958 onwards. Death certificates are sent by the doctor to the SCB and are validated prior to publication. The reliability of the register is considered satisfactory.

Data loss

According to the SCB, the FoB response frequency can be considered to exceed 95%. Although the Causes of Death register contains hardly any unregistered cases, there is a degree of discrepancy in diagnoses when death rates are distributed across different causes, due to, among other things, a decrease in autopsy frequency. Moreover, the SEI-codes contain an unknown number of unrecorded cases, where the boundary between different occupations varies somewhat. However, none of these discrepancies have influenced the strength of the study material, which in principle covers the above-mentioned age groups in the total population.

Results

At baseline in 1980, the death rate in the age interval was approximately 6.5% of the total number of deaths in the province. The proportion of people aged 25-55 years born and resident in the province was 51%. Against this background, the following results were selected for presentation.

The impact of background and socio-economic factors

The results of the Poisson distribution highlight the significance of marital and socio-economic status as well as educational level in relation to the risk of death among people born in Halland. Both married men and women had a significantly lower relative risk than their unmarried counterparts (Men: HR 0.54 CI 0.48–0.61; Women: HR 0.73 CI 0.57–0.92). A significantly lower relative risk was also found among divorced women (HR 0.50 CI 0.32–0.79). Men with a high level of education were at less risk compared to those with a low level (HR 0.51 CI 0.36–0.73). In terms of SEI affiliation, the situation was identical among the sexes; high-level" employees had a significantly lower risk of death than workers and low-level employees (Men: 0.82 CI 0.69–0.96; Women: 0.73 CI 0.55–0.97). Self-employed male farmers exhibited a significantly lower risk of death (HR 0.66 CI 0.52–0.83). Pensioners/retired people and those with an unspecified SEI clearly exhibited an above average mortality among both sexes.

The impact of migration

Being born in Halland and still living there carried a lower death risk compared to those who were born elsewhere and had moved to the province. A comparison between natives of Halland and residents of the province who were born elsewhere revealed a significantly lower risk among men (Men: HR 0.89 CI 0.80–0.99). Women showed a similar tendency, although not significant. The results also revealed that those natives of Halland who had moved to another part of the country retained their advantage compared to Swedes born outside the province and who lived in other parts of Sweden. This difference was statistically significant among men (HR 0.90 CI 0.81–0.99). And a non-significant tendency in the same direction was found in women. It should be noted that the comparison between natives and non-natives of Halland was adjusted for the background variables of age, marital status, educational level and SEI (Table 1).

Variables	β	SE	p-value	HR	95% CI
Men					
Civil status					
Single				1	
Married	-0.6157	0.0656	0	0.54	0.48–0.61
Divorced	-0.529	0.2837	0.0623	0.59	0.34–1.03
Widower	0.0505	0.0877	0.565	1.05	0.89–1.25

Educational level					
Low				1	
Middle	-0.108	0.1261	0.392	0.9	0.70–1.15
High	-0.6694	0.1819	0.0002	0.51	0.36–0.73
Unspecified	-0.142	0.1199	0.2364	0.87	0.60–1.10
SEI					
Low-level				1	
High-level	-0.2045	0.0814	0.012	0.82	0.69–0.96
Business owners excl. farmers	0.034	0.0891	0.703	1.03	0.87–1.23
Self-employed farmers	-0.4208	0.1205	0.0005	0.66	0.52–0.83
Retired	1.1699	0.0884	0	3.22	2.71–3.83
Unspecified SEI	0.7637	0.0865	0	2.15	1.81–2.54
Place of birth					
Born outside Halland (resident in the province)				1	
Born in Halland (resident in the province)	-0.1189	0.0542	0.0281	0.89	0.80–0.99
Born outside Halland (resident outside the province)				1	
Born in Halland (resident outside the province)	-0.1101	0.0532	0.0387	0.9	0.81–0.99
Women					
Civil status					
Single				1	
Married	-0.3204	0.1194	0.0073	0.73	0.57–0.92
Divorced	-0.6936	0.2329	0.0029	0.5	0.32–0.79
Widow	0.0936	0.1464	0.5226	1.1	0.82–1.46
Educational level					
Low				1	
Middle	0.1141	0.1972	0.5629	1.12	0.76–1.65
High	-0.1917	0.2776	0.4899	0.83	0.48–1.42
Unspecified	-0.1727	0.1798	0.3368	0.84	0.59–1.20
SEI					
Low-level				1	
High-level	-0.3141	0.1464	0.0319	0.73	0.55–0.97
Business owners excl farmers	-0.1458	0.2155	0.4987	0.86	0.57–1.32
Self-employed farmers	0.1677	0.1655	0.3111	1.18	0.85–1.64
Retired	1.4172	0.1123	0	4.13	3.31–5.14
Unspecified SEI	0.3745	0.0842	0	1.45	1.23–1.72
Place of birth					

Born outside Halland (resident in the province)				1	
Born in Halland (resident in the province)	-0.0367	0.0709	0.6054	0.96	0.84–1.11
Born outside Halland (resident outside the province)				1	
Born in Halland (resident outside the province)	-0.0802	0.0643	0.2122	0.92	0.81–1.05

Table 1: Risk of death among the population of Halland, 25-55 age group, with regard to background variables and place of birth during a 10-year historical follow-up (1980 1990). Poisson regression was employed to estimate the hazard rate (HR) with a 95% confidence interval (CI).

Discussion

Summary

The results reveal that the risk of death is lower among natives of Halland compared to those who migrated to the province from other parts of Sweden. This is also true for natives of Halland who move to other Swedish regions, an advantage that is statistically significant in men. Thus, internal migration carried an increased risk of death independent of socio-economic background for those born in other parts of Sweden and moving to Halland, while natives of Halland retained a lower risk when moving outside the province. Furthermore, clear differences were found between socio-economic groups among the natives of Halland in favour of the higher socioeconomic groups.

Discussion of methods

By using Poisson regression we have been able to calculate continuous hazard functions. The better-known Cox regression model can provide survival functions but not continuous hazard functions. Poisson regression has sometimes been used synonymously with Cox regression [21] but is more rational with regard to analysis of the time aspect. The other practical reason for the choice of Poisson regression is its simplicity when calculating a great quantity of data in a computer environment.

The reliability of the study

In this study, subjects aged 25-55 years were of the greatest interest from a work and socio-economic perspective, i.e. in terms of preventive aspects, since the interval covered the 25-65 year age group due to the fact that the length of the study between two FoB register surveys was ten years. Due to the lack of an SEI- code in the >65 year age group, no investigation of this group was possible, which would have been desirable. As most deaths occur in the elderly it cannot be ruled out that a slightly different result had been found if this age group had been included. An important observation in the study was the comparatively large number of subjects e.g. unemployed, housewives and students, who were excluded from the analysis due to the lack of an SEI-code.

Discussion of results

The results clearly demonstrate the favourable health status of the population of Halland compared to immigrants in terms of mortality risk. This situation is particularly obvious among men, which to some extent supports a previous study that revealed a significantly lower incidence of myocardial infraction among natives of Halland compared to immigrants, despite higher income and socio-economic status among the latter [6]. Furthermore, male farmers born and resident in Halland had a lower mortality risk. This finding agrees with a previous study showing that farmers born in Halland suffered myocardial infarctions to a lesser extent [6].

The present study shows that the superior socio-economic background among migrants compared to natives, which was described in a previous study [6], did not fill the gap between natives and non-natives of Halland even in terms of the overall mortality risk. Natives of Halland retain this favourable position when they migrate to other parts of the country.

An important aspect when studying the significance of migration for death is the length of residence in the geographical location in question. However, this information is lacking in our study, which can be considered a limitation in relation to different exposure factors.

The inclusion of background variables such as marital status and SEI in the analysis, which was also a feature of previous studies by other authors, illuminates the importance of social interaction and a higher SEI, factors that covariate negatively with the risk of death in a normal population. The fact that the spread of disease depends on structural, social, socio-economic and socio-geographic conditions is well known, and previous studies have established them as independent risk factors, mainly in relation to the most common causes of death in a normal population [22-24], a situation that, on the whole, can be said to accurately represent the population of Halland, which is characterised by a high average life expectancy compared to Sweden as a whole [3]. This situation can be traced back to the early 20th century [15]. Average life expectancy, which in socio-epidemiological studies is considered a generic measure of health [25,26], highlights the favourable health situation among the inhabitants of Halland. From a historical perspective, this situation, which is based on low infant mortality in the province [3,4], can probably be attributed to a good nutritional level since 1886 , as a result of a rich agricultural output and a higher yield from fishing compared to the national average [27]. Increased food resources, which contributed to improved public health in the whole of Sweden [28,29], seem of particular relevance in Halland, where the initial conditions were very poor [30]. Another important aspect is the fact that the protective factor against death is not reduced when natives of Halland move to other parts of Sweden. Although data about the duration of residence are lacking, it is important to note that this protective factor is maintained.

In a previous study we demonstrated that the most favourable socio-economic group in the province in terms of not being affected by acute myocardial infarction was self-employed farmers, a group who migrate to a lesser extent. Thus, it can be assumed that the natives of Halland who migrate probably belong to other socio-economic groups with less favourable characteristics in terms of the risk of death but whom, nevertheless, are subject to a lower risk than other Swedes. The causes underlying this finding may very well be multi factorial and

complex in nature but the fact that natives of Halland have historically been more resistant to common causes of death such as diseases of the circulatory organs and cancer can also be assumed to play an important role.

Almost all previous studies that focused on Halland have shown that the health status of the whole population is good [31,32]. However, we were able to show, by means of a special study on the incidence of myocardial infarction, that natives of Halland had the highest resistance, as they had a lower risk of suffering a myocardial infarction [6]. This finding, which can probably be associated with a good nutritional situation in the parental home, in combination with mothers having more time to breast-feed their children [3,33] most likely constitutes a protective factor [6,34-38].

At present, we lack relevant data to study the distribution of causes of death among natives of Halland who have moved to other parts of Sweden but it would be valuable to perform such an analysis in the future.

Conclusion and Implication

The results of the study underline the importance of migration as a probable risk factor for death. The risk is not significantly increased when emigration takes place from a healthy region to other parts of the country. This finding can be considered as a fundamental platform in public health plans with migration approach in the design. The methodological aspects and the obtained results can also be used for educational purposes.

Acknowledgment

Professor Anders Odén has contributed with expert methodological knowledge and scientific approaches. Associate professor, Benkt Högstedt and Associate professor Per Herrström have supported the study by scientific advices.

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