The effect of age at immigration and generational status of the mother on infant mortality in ethnic minority populations in The Netherlands

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Background: Migrant populations consist of migrants with differences in generational status and length of residence. Several studies suggest that health outcomes differ by generational status and duration of residence. We examined the association of generational status and age at immigration of the mother with infant mortality in migrant populations in The Netherlands. Methods: Data from Statistics Netherlands were obtained from 1995 through 2000 for infants of mothers with Dutch, Turkish and Surinamese ethnicity. Mothers were categorized by generational status (Dutch-born and foreign-born) and by age at immigration (0–16 and >16 years). The associations of generational status and age at immigration of the mother with total and cause-specific infant mortality were examined. Results: The infant mortality rate in Turkish mothers rose with lower age at immigration (from 5.5 to 6.4 per 1000) and was highest for Dutch-born Turkish mothers (6.8 per 1000). Infant death from perinatal and congenital causes increased with lower age at immigration and was lowest in the Dutch-born Turkish women. In contrast, in Surinamese mothers infant mortality declined with lower age at immigration (from 8.0 to 6.3 per 1000) and was lowest for Dutch-born Surinamese mothers (5.5 per 1000). Generational status and lower age at immigration of Surinamese women were associated with declining mortality of congenital causes. Conclusions: Total and cause-specific infant mortality seem to differ according to generational status and age at immigration of the mother. The direction of these trends however differs between ethnic populations. This may be related to acculturation and selective migration.

Keywords: acculturation, ethnic groups, immigration, infant mortality, nativity status

In The Netherlands, as in more western countries, infant mortality risk is elevated in migrant populations.1 These populations consist of migrants with differences in generational status and length of residence. Several studies in the United States suggest that health outcomes differ by generational status and duration of residence. Foreign-born black and Hispanic mothers have, despite their socio-economic disadvantaged status, more favourable birth outcomes compared with US-born blacks and Hispanics.2–4 A lower infant mortality risk is also observed in foreign-born black mothers compared with US-born blacks.5 North African immigrant women in France and Belgium have good birth outcomes compared with the native populations.6 However, the effect of generational status on birth outcomes seems to be different in ethnic populations. In contrast with the foreign-born black and Hispanic women, foreign-born Asian women in the US have an increased risk for low birth weight.6,9 Length of residence might also be related to changes in the risk profiles of migrant mothers. Longer length of residence in Mexican immigrants is associated with a change in health status and birth outcomes.10 Previous studies indicate that the favourable birth and health outcomes of foreign-born migrant women might be explained by the ‘healthy migrant effect’ and by the relatively healthy life styles that these mothers maintained from the country of origin. A change to an unhealthier life-style could contribute to the decreased health outcomes of native-born migrants and migrants with longer residence duration. It is uncertain, however, whether selection effects and health behaviour play a role in migrant groups in other industrialized countries.

In the present paper, we conducted an explorative study to the association of generational status and age at immigration of the mother with total and cause-specific infant mortality in the Turkish and Surinamese populations. We described the total and cause-specific infant mortality levels in relation to generational status and age at migration of the mother and we explored to what extent these associations could be explained by obstetric, demographic, and socio-economic variables.

Methods

We analyzed the linked data of the birth registry, cause of death registry and the Municipal Population Registers of Statistics Netherlands for the period 1995–2000. The birth registry contained the date of birth and sex of all live born infants from which the parents were registered as inhabitants of The Netherlands at time of birth (1 178 949 live-borns). It also contained data of postal code, marital status, age, and parity of the mother. The cause of death registry consisted of all deceased inhabitants of The Netherlands and contained the date of mortality and cause of death according to the International Classification of Diseases (ICD). The Municipal Population Registers contained data on the country of birth of the parents and grandparents. The registries were linked by the national personal identification number of infants and parents.

We compared live-borns of mothers of Dutch, Turkish and Surinamese descent (973 162 live-borns). A mother was considered non-native Dutch if one of the parents was born abroad (definition of Statistics Netherlands). We made a distinction within each ethnic minority population according to

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generational status and age at immigration of the mother. Mothers from Turkish and Surinamese descent were classified as Dutch-born if she was born in The Netherlands and as foreign-born if the mother was born abroad. Foreign-born mothers were subdivided by their age at immigration (0–16 and >16 years). This cut-off point was chosen because children in The Netherlands are obliged to go to school until they reach the age of 16 years. Of 1959 live-borns (3.7% of the studied foreign-born population) the age at immigration of the mother could not be assessed, because of lack of data on date of immigration. These mothers were excluded from analysis.

The causes of death were classified according to the ICD-9 for 1995 and according to the ICD-10 for the years 1996–2000. Because of small numbers of deaths, causes of death were categorized into broad groups: conditions originating in the perinatal period (ICD-9 codes: 760–779, ICD-10 codes: P00–P96); congenital anomalies (ICD-9 codes: 740–759, ICD-10 codes: Q00–Q99) and other causes (ICD-9 codes: 001–676, 780–799, E800–E999, ICD-10 codes: A00–O99, R00–R99, V01–Y98). Of one case the cause of death was missing in the dataset. This case was omitted from the cause-specific mortality regression analysis.

The following types of variables were used in the data-analysis.

**Obstetric variables**
Parity was defined as the number of children a woman gave birth to. If the index infant in the data set was the first-born parity was zero. Parity was divided into categories ranging from 0 to >8.

**Demographic variables**
Maternal age was calculated at the date of birth of the infant and divided in 5-year categories, with <20 years as lowest and >40 years as highest category. Marital status of the mother was categorized as married or unmarried.

Socio-economic status
With 6-position postal code, our data were linked to another file, the Regional Income Register 1993, which is a national study that contains information on income-levels of neighbourhoods based on fiscal information of its inhabitants. This study provided information on mean equivalent household income of neighbourhoods in The Netherlands, which we used as an indicator of socio-economic status in our study. Mean equivalent household income was classified into five categories. The characteristics of the live-borns are shown in table 1.

**Statistical analysis**
We calculated the infant mortality rates (number of infant deaths per 1000 live births) according to generational status and age at immigration of the mother. We estimated the relative total and cause-specific infant mortality risks with Cox proportional hazard regression analysis. We related the number of infant deaths, defined as those live born infants who died before reaching the age of 1 year, to the observed person time as offset variable, and to ethnic origin as independent variable. Infants that emigrated under the age of 1 year were censored at the date of emigration. Sex of the infant and age of the mother were included in all models. In additional models we adjusted for mean neighbourhood income, parity and marital status of the mother to study their effect on the observed associations. We performed a log linear trend analysis to study differences in trends in total infant mortality. In these we used generational status and age at immigration as predictors. All statistical analyses were performed using the Statistical Package of Social Sciences version 11.0 for Windows (SPSS Inc, Chicago, IL, USA).

**Results**
Infant mortality rates according to generational status and age at immigration of the mother are shown in figure 1. The infant mortality rate among native Dutch mothers was 4.8 per 1000 live

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**Table 1** Subject characteristics of live-borns according to ethnicity mother and age at immigration

<table>
<thead>
<tr>
<th>Gender infant (%)</th>
<th>Dutch (n = 912 165)</th>
<th>Turks (n = 35 455)</th>
<th>Surinamese (n = 25 542)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;16 years</td>
<td>0–16 years</td>
<td>Dutch-born</td>
</tr>
<tr>
<td>Boy</td>
<td>51.2</td>
<td>51.7</td>
<td>51.9</td>
</tr>
<tr>
<td>Maternal age (years) (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>0.8</td>
<td>4.5</td>
<td>3.9</td>
</tr>
<tr>
<td>20–24</td>
<td>7.2</td>
<td>32.5</td>
<td>32.5</td>
</tr>
<tr>
<td>25–29</td>
<td>34.1</td>
<td>34.2</td>
<td>39.3</td>
</tr>
<tr>
<td>30–34</td>
<td>42.3</td>
<td>19.3</td>
<td>20.4</td>
</tr>
<tr>
<td>35–39</td>
<td>14.1</td>
<td>8.3</td>
<td>3.9</td>
</tr>
<tr>
<td>&gt;40</td>
<td>1.6</td>
<td>1.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Marital status (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unmarried</td>
<td>16.2</td>
<td>2.1</td>
<td>3.7</td>
</tr>
<tr>
<td>Mean equivalent income (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low</td>
<td>14.2</td>
<td>61.3</td>
<td>60.0</td>
</tr>
<tr>
<td>high</td>
<td>20.9</td>
<td>2.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Parity (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;4</td>
<td>1.4</td>
<td>3.2</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Births. Among Turkish mothers the infant mortality increased from 5.5 per 1000 live births for Turkish-born mothers who migrated after the 16th birthday, to 6.4 per 1000 for Turkish-born mothers who migrated at younger ages, and to 6.8 per 1000 for Dutch-born Turkish mothers. Among Surinamese mothers an opposite pattern was observed. Surinamese-born mothers who immigrated at higher age had an infant mortality rate of 8.0 per 1000 live births. Among Surinamese-born mothers who migrated under 16 years, the infant mortality rate was 6.3 per 1000 and it was 5.5 per 1000 among Dutch-born Surinamese mothers.

The estimated hazard ratios (HR) of total infant mortality according to generational status and age at immigration (table 2) showed the same pattern as seen in the infant mortality rates, even though the differences were not statistically significant. In the Turkish mothers the infant mortality risk seemed to rise with lower age at immigration. In Surinamese mothers the opposite trend was observed, in which infant mortality risk declined with lower age at immigration. Adjustment for parity, marital status, and mean neighbourhood income did not substantially change the estimated hazard ratios. The log linear trend analysis showed a significant difference in trend between Turkish and Surinamese mothers (P = 0.04).

Results for specific causes of death are shown in table 3. In Turkish mothers an increase in mortality with lower age at immigration was observed both for perinatal and congenital causes. In Surinamese mothers the opposite trend was observed both for congenital causes and the group of other causes. The differences between the Turkish and Surinamese populations with regards to the trends for causes of death did not reach statistical significance.

Our study is limited to the Turkish and Surinamese populations because of the small number of Dutch-born live births in other migrant populations. However, for people from Moroccan descent, we could analyze the association between infant mortality and age at immigration among Moroccan-born women. The results showed the same trend as observed among Turkish-born mothers. The infant mortality risk in Moroccan mothers with age at immigration <16 years was elevated compared with the reference group of mothers who migrated at older age [HR = 1.28; 95% confidence intervals (95% CI), 0.94–1.74; results not shown].

Discussion
This study suggests that associations of infant mortality with generational status and age at immigration are different among Turkish and Surinamese mothers. Among Turkish mothers...
The process of acculturation of Surinamese migrants is a multidimensional phenomenon from which language components, dietary intake and smoking are important indicators of their effect on birth outcomes.\textsuperscript{13} In the US, acculturation is associated with a decrease in protective cultural behaviours in Hispanics.\textsuperscript{14–16} In The Netherlands, the Turkish migrant population seem to resemble the Hispanic migrant population in the US with respect to their low socio-economic status, healthy diet and lifestyle, and language problems.\textsuperscript{17–19} The higher infant mortality of Turkish migrants who are more integrated into Dutch society (i.e., Dutch-born and Turkish migrants with younger age at immigration) might be due to adaptation of unhealthy western life-styles. This suggestion is supported by a Dutch report showing a rising trend of tobacco use especially among younger Turkish women.\textsuperscript{17} We hypothesize that this change to an unhealthy life-style possibly could outweigh the favourable effects of increased integration, such as better literacy and other relevant aspects of the host society. Besides, young migrants will be more likely to have adopted the life styles prevailing in host countries than people who migrated at older ages. Despite these theoretical advantages, we found that the choice was less important in practice. In a separate analysis, we studied the effect of mothers’ residence duration (classified in 10-year intervals) on infant mortality in foreign-born mothers. For both Turkish and Surinamese mothers, we observed the same pattern as observed in relationship to age at immigration of the mother [residence duration <10 years used as reference; HR and 95% CI in Turkish mothers: residence duration >10 years: 1.14 (0.83–1.57) Dutch-born: 1.31 (0.83–2.07); HR and 95% CI in Surinamese mothers: residence duration >10 years 1.04 (0.73–1.49), Dutch-born 0.79 (0.48–1.31)].

A common framework for the interpretation of these patterns is provided by this acculturation theory. Acculturation is a multidimensional phenomenon from which language components, dietary intake and smoking are important indicators of their effect on birth outcomes.\textsuperscript{13} In the US, acculturation is associated with a decrease in protective cultural behaviours in Hispanics.\textsuperscript{14–16} In The Netherlands, the Turkish migrant population seem to resemble the Hispanic migrant population in the US with respect to their low socio-economic status, healthy diet and lifestyle, and language problems.\textsuperscript{17–19} The higher infant mortality of Turkish migrants who are more integrated into Dutch society (i.e., Dutch-born and Turkish migrants with younger age at immigration) might be due to adaptation of unhealthy western life-styles. This suggestion is supported by a Dutch report showing a rising trend of tobacco use especially among younger Turkish women.\textsuperscript{17} We hypothesize that this change to an unhealthy life-style possibly could outweigh the favourable effects of increased integration, such as better mastery of the Dutch language.

The process of acculturation of Surinamese migrants seems to differ from that of Turkish migrants. The Surinamese migrant population is much more familiar with the Dutch language and the Dutch educational system than the Dutch Turkish migrant population. Also a higher prevalence of marriages with native Dutch men is seen among Surinamese women.\textsuperscript{18} Compared with other migrant populations, Surinamese migrant women gain most profit from their education in The Netherlands.\textsuperscript{19} It is therefore likely that Surinamese migrants, including those who arrived in The Netherlands at adult age, have adequate

| Table 3 HR for cause-specific mortality according to generational status and age at immigration of the mother |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|          | Turks     | Surinamese |          | Turks     | Surinamese |          |
| Perinatal causes (n) | >16 years | 0–16 years | Dutch-born | >16 years | 0–16 years | Dutch-born |
| HR (model 1) | 1.00 | 1.46 (0.82–2.53) | 2.03 (0.90–4.57) | 1.00 | 0.95 (0.60–1.48) | 1.04 (0.58–1.89) |
| HR (model 2) | 1.00 | 1.42 (0.79–2.56) | 1.60 (0.69–3.74) | 1.00 | 1.02 (0.64–1.60) | 1.08 (0.59–2.00) |
| Congenital causes (n) | 44 | 31 | 11 | 19 | 15 | 4 |
| HR (model 1) | 1.00 | 1.17 (0.74–1.86) | 1.48 (0.75–2.94) | 1.00 | 0.60 (0.30–1.20) | 0.32 (0.10–1.04) |
| HR (model 2) | 1.00 | 1.19 (0.75–1.89) | 1.58 (0.78–3.18) | 1.00 | 0.60 (0.30–1.22) | 0.33 (0.10–1.11) |
| Other causes (n) | 36 | 20 | 6 | 12 | 15 | 4 |
| HR (model 1) | 1.00 | 0.95 (0.55–1.65) | 0.81 (0.33–1.96) | 1.00 | 0.80 (0.37–1.74) | 0.40 (0.12–1.32) |
| HR (model 2) | 1.00 | 0.97 (0.56–1.69) | 0.93 (0.37–2.30) | 1.00 | 0.77 (0.35–1.71) | 0.37 (0.11–1.26) |

Age >16 years as reference
Model 1: HR adjusted for sex of infant and age of the mother
Model 2: HR adjusted for sex of infant and age, parity, marital status, and mean neighbourhood income of the mother

Infant mortality diverged from the infant mortality level of Dutch mothers. Infant mortality increased with lower age at immigration and infant mortality was highest for Dutch-born Turkish mothers. This trend was also observed for perinatal causes and congenital causes. Among Surinamese mothers a convergence of infant mortality toward the infant mortality level of Dutch mothers was observed. Infant mortality declined with lower age at immigration of the mother and was lowest for Surinamese mothers who are born in The Netherlands. This trend was especially observed for congenital causes and the group of other causes. Adjustment for differences in parity, marital status, and mean neighbourhood income did not change these associations.

Strengths of our database include complete national coverage of all births and infant deaths (including deaths abroad of babies born in The Netherlands) and accurate registry of generational status and age at immigration. The results of this study should however be evaluated against some potential data problems. First, although we had nation-wide data on infant mortality during an observation period of 6 years, the numbers of live-borns and infant deaths were small, resulting in rather large confidence intervals. However, also given the consistency in most of the patterns, the results may be taken as suggestions of true associations with generational status and age at immigration that should be confirmed in further studies. Second, the data that were available from national registries lack information on several important risk factors of infant mortality, such as birth weight, gestational age, prenatal care use, and lifestyle factors. As a result, we were not able to explore the causal pathways underlying the observed patterns. In addition, our socio-economic measure was an ecological one (neighbourhood income) and therefore was only a proximate measure of individual and household level socio-economic status. It may be that fuller adjustment for socio-economic status would have shown larger effects.

We choose to use age at immigration of the mother as the key parameter of interest instead of length of residence. Other studies have described an association of duration of residence with health and birth outcomes in migrants.\textsuperscript{16,11} Age at immigration of the mother may be more appropriate from a life course perspective as it allows us to locate the critical event (migration to a new country) within the life course of a woman. Women who migrate at an young age receive education in the host country and may therefore be more familiar with the language, the health care system and other relevant aspects of the host society. Besides, young migrants will be more likely to have adopted the life styles prevailing in host countries than people who migrated at older ages. Despite these theoretical advantages, we found that the choice was less important in practice. In a separate analysis, we studied the effect of mothers’ residence duration (classified in 10-year intervals) on infant mortality in foreign-born mothers. For both Turkish and Surinamese mothers, we observed the same pattern as observed in relationship to age at immigration of the mother [residence duration <10 years used as reference; HR and 95% CI in Turkish mothers: residence duration >10 years: 1.14 (0.83–1.57) Dutch-born: 1.31 (0.83–2.07); HR and 95% CI in Surinamese mothers: residence duration >10 years 1.04 (0.73–1.49), Dutch-born 0.79 (0.48–1.31)].
access to and utilization of (perinatal) health care services. This more optimal use of perinatal care, including the use of prenatal screening, might be reflected by the declining rates of infant death of congenital causes. From previous studies it is known that the Surinamese population has an increased risk of preterm births and low birth weight infants. The lack of a decline in infant death of perinatal causes suggests that acculturation does not result into a decline in the high proportion of preterm births and low birth weight infants.

In addition to acculturation, selective immigration might contribute to the observed patterns, such as those among the Turkish population. Turkish women that migrated above the age of 16 years for a large part consist of women who migrate to get married in The Netherlands. These women will have had relatively good health and their health potential may have contributed to a lower mortality risk of their children. Thus, the relatively low levels of mortality of children born to Turkish-born mother who migrated at older ages suggests that ‘healthy migrant effects’ play a role.

In contrast, the Surinamese-born women that migrated at older age to The Netherlands are characterized especially by a relatively low socio-economic position (60% of these women are in the lowest income group compared with 45% of the Dutch-born Surinamese migrants). Thus, the high levels of mortality of children born to Surinamese-born women that migrated at older age suggest an effect of selective immigration of socio-economic disadvantaged women.

In conclusion, these results suggest that generational status and age at immigration of the mother are associated with infant mortality. We hypothesize that these associations might be determined by both acculturation processes and by selection upon migration. We further hypothesize that these associations may radically differ between ethnic populations. The results for Surinamese migrant women suggest that increased acculturation and social integration could result in improving health outcomes of their children. The inverse patterns observed for Turkish migrant women are worrisome as they suggest increasing inequalities in infant mortality between the Turkish and native Dutch population.

Key points
- The association of generational status and age at immigration of the mother with infant mortality in migrant populations is examined.
- The infant mortality rate in Turkish mothers rose with lower age at immigration and was highest for Dutch-born Turkish mothers.
- In Surinamese mothers infant mortality declined with lower age at immigration and was lowest for Dutch-born Surinamese mothers.
- The results suggest that generational status and age at immigration of the mother are associated with infant mortality and that the direction of these trends and the effects of integration and selective migration might differ between ethnic populations.
- The adaptation of unhealthy western life-styles by migrants should be prevented.

References

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