The sick immigrant – healthy immigrant phenomenon among Jews migrating from the USSR to Israel

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**Online Resource 1.** Explanation of the choice of variables in the model and description of the statistical analysis

For the multivariable Cox model to evaluate the relationship between immigration and mortality among the 218,187 individuals in the study population the following base variables were included: gender, age, immigration, income level and marital status (Model 1). A higher mortality rate was found among immigrants compared to non-immigrants and among married people compared to unmarried people. Similarly, in this and all following models described below a higher mortality rate was found for men compared to women and for low- and middle-income earners compared to high-income earners. This model has 6 degrees of freedom (df) and a 2 log-likelihood fit of 493772.46 (p<0.001).

In Model 2, with 10 df, the following interactions were added to the base variables: gender X age, age X immigration and age X gender X immigration, which were non-significant, and gender X immigration, which was significant. This model did not identify either of the relationships between immigration and mortality found in the other models. This model had a 2 log-likelihood fit of 493697.44 (p<0.001). The comparison of goodness-of-fit between Model 2 and Model 1 was significant: dif log likelihood=175.02 (p<0.001).

In Model 3, with 16 df, the following interactions were added to the base variables: gender X age, gender X immigration and age X gender X immigration, which were non-significant, and age X immigration, gender X income, immigration X income and the three-way interaction gender X immigration X income, which was significant. In this model the relationship between immigration and mortality was in the opposite direction to that of Model 1 (AHR = 0.77; 96%CI = 0.63, 0.93). We note that this model had a 2 log likelihood fit of 492388.20 (p<0.001). The comparison of goodness-of-fit between Model 3 and Model 2 was significant: dif log likelihood = 1309.24 (p<0.001).

In Model 4, with 24 df, the following interactions were added to the base variables: gender X age, which was significant, and age X immigration, gender X immigration, age X gender X immigration, age X income and age X immigration X income, which were non-significant and the interactions gender X income, immigration X income, gender X immigration X income, age X gender X income, age X gender X immigration X income, which were significantly different between low income and high income, but not between medium income and high income. Similarly to Model 3, the relationship between immigration and mortality was in the opposite direction to that of Model 1 (AHR = 0.64; 95% CI = 0.43, 0.96). This model had a 2 log likelihood fit of 492066.15 (p<0.001). The comparison of goodness-of-fit between Model 4 and Model 3 was significant: dif log likelihood = 322.05 (p<0.001).

A formal examination of the comparison of model fit found that each model improves its predecessor. However, the most meaningful contribution was that of Model 3. These results led us to classify the study population into six groups by three income levels for each gender separately. This model included the variables: age, immigration and marital status.

Table A1. Models for predicting the relationship between social variables and their interactions and mortality within the entire study population (N=218,187)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Model 1 | Model 2 | Model 3 | Model 4 |
| Model coefficients | 2 Log likelihood | 493772.46 | 493697.44 | 492388.20 | 492066.15 |
| Chi-square | 7676.89 | 8067.43 | 10377.94 | 10610.40 |
| Df | 6 | 10 | 16 | 24 |
| P | <0.001 | <0.001 | <0.001 | <0.001 |
| Change from previous model | dif log likelihood |  | 75.02 | 1309.24 | 322.05 |
| dif df |  | 4 | 6 | 8 |
| P |  | 1.97327E-15 | 1.1E-279 | 8.29E-65 |
|  |  | **HR (95%CI)** | p | **HR (95%CI)** | p | **HR (95%CI)** | p | **HR (95%CI)** | p |
| Gender | Female | 1.00 |  | 1.00 |  | 1.00 |  | 1.00 |  |
| Male | 1.811 (1.745-1.880) | <0.001 | 1.58 (1.42-1.76) | <0.001 | 1.62 (1.43-1.83) | <0.001 | 2.090 (1.673-2.610) | <0.001 |
| Age |  | 1.087 (1.082-1.091) | <0.001 | 1.106 (1.10-1.122) | <0.001 | 1.211 (1.192-1.25) | <0.001 | 1.311 (1.250-1.421) | <0.001 |
| Immigration | Non-immigrants | 1.00 |  | 1.00 |  | 1.00 |  | 1.00 |  |
| Immigrants | 1.297 (1.248-1.348) | <0.001 | 1.09 (0.96-1.22) | 0.178 | 0.77 (0.64-0.93) | 0.005 | 0.638 (0.426-0.956) | 0.029 |
| Highest relative income | Decile 8 – 10 | 1.00 |  | 1.00 |  | 1.00 |  | 1.00 |  |
| Decile 5 -7 | 1.780 (1.689-1.876) | <0.001 | 1.77 (1.70-1.84) | <0.001 | 1.56 (1.43-1.70) | <0.001 | 2.742 (2.160-3.481) | <0.001 |
| Decile 1 -4 | 2.651 (2.513-2.796) | <0.001 | 2.67 (2.57-2.78) |  | 2.02 (1.85-2.20) | <0.001 | 5.257 (4.163-6.637) | <0.001 |
| Marital status | Married | 1.00 |  | 1.00 |  | 1.00 |  | 1.00 |  |
| Unmarried | 1.112 (1.067-1.159) | <0.001 | 1.12 (1.09-1.16) | <0.001 | 1.17 (1.13-1.21) | <0.001 | 1.166 (1.130-1.204) | <0.001 |
| Gender X Age |  |  |  | 1.00 (0.97-1.04) | 0.788 | 1.01 (0.98-1.04) | 0.591 | 0.930 (0.874-0.990) | 0.023 |
| Age X Immigration |  |  |  | 1.02 (0.98-1.05) | 0.378 | 0.95 (0.92-0.98) | 0.001 | 1.052 (0.930-1.190) | 0.420 |
| Immigration X Gender |  |  |  | 1.45 (1.25-1.68) | <0.001 | 1.09 (0.87-1.35) | 0.460 | 0.934 (0.587-1.485) | 0.773 |
| Age X Gender X Immigration |  |  | 0.96 (0.92-1.00) | 0.060 | 0.98 (0.94-1.03) | 0.424 | 1.011 (0.878-1.164) | 0.881 |
| Gender X Income | Decile 8 - 10 |  |  |  |  | 1.00 |  | 1.00 |  |
| Decile 5 – 7 |  |  |  |  | 1.27 (1.14-1.42) | <0.001 | 0.972 (0.725-1.304)  | 0.851 |
| Decile 1 – 4 |  |  |  |  | 0.75 (0.68-0.83) | <0.001 | 0.634 (0.479-0.840) | 0.001 |
| Immigration X Income | Decile 8 - 10 |  |  |  |  | 1.00 |  | 1.00 |  |
| Decile 5 – 7 |  |  |  |  | 1.34 (1.12-1.59) | 0.001 | 1.384 (0.889-2.155) | 0.150 |
| Decile 1 – 4 |  |  |  |  | 2.72 (2.28-3.24) | <0.001 | 3.046 (1.961-4.732) | <0.001 |
| Gender X Immigration X Income | Decile 8 - 10 |  |  |  |  | 1.00 |  | 1.00 |  |
| Decile 5 – 7 |  |  |  |  | 1.19 (1.01-1.40 | 0.004 | 1.373 (0.815-2.313) | 0.233 |
| Decile 1 – 4 |  |  |  |  | 1.57 (1.28-1.94) | <0.001 | 1.823 (1.081-3.073) | 0.024 |
| Age X Income | Decile 8 - 10 |  |  |  |  |  |  | 1.00 |  |
| Decile 5 – 7 |  |  |  |  |  |  | 0.837 (0.783-0.895) | <0.001 |
| Decile 1 – 4 |  |  |  |  |  |  | 0.747 (0.700-0.797) | <0.001 |
| Age X Immigration X Income | Decile 8 - 10 |  |  |  |  |  |  | 1.00 |  |
| Decile 5 – 7 |  |  |  |  |  |  | 0.944 (0.826-1.079) | 0.399 |
| Decile 1 – 4 |  |  |  |  |  |  | 0.922 (0.808-1.053) | 0.230 |
| Age X Gender X Income | Decile 8 - 10 |  |  |  |  |  |  | 1.00 |  |
| Decile 5 – 7 |  |  |  |  |  |  | 1.049 (0.969-1.135) | 0.236 |
| Decile 1 – 4 |  |  |  |  |  |  | 1.087 (1.001-1.180) | 0.047 |
| Age X Gender X Income X Immigration | Decile 8 - 10 |  |  |  |  |  |  | 1.00 |  |
| Decile 5 – 7 |  |  |  |  |  |  | 0.891 (0.762-1.042) | 0.149 |
| Decile 1 – 4 |  |  |  |  |  |  | 1.059 (0.906-1.237) | 0.475 |