

## Socioeconomic status (SES) for epidemiology of health risk

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### ABSTRACT

The legal framework of the Austrian social insurance system distinguishes 566 entitlement conditions, which are determined by current occupation or living conditions. A person may fulfil more than one entitlement condition at the same time as well as they may change over time. A unique ID number is assigned to each insured person, which makes it possible to file all entitlements of a certain person in a central database. We ranked these 566 entitlement conditions according to the WHO social determinants of health and developed an index-value for each entitlement condition to calculate a socioeconomic index value, which is the mean of all entitlements a person has gained in the last 30 years. In order to take this time span into account, a weighted mean was applied with the recent past carrying more weight than the distant past. The socioeconomic

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value calculated in this way may be used to identify population groups at special (social) risk, who need to be given more attention as regards their health care.

**Keywords.** Socioeconomic status, health insurance, determinants of health

## 1. Introduction

The Austrian social security system comprises compulsory health, pension and accident insurance for all citizens whereby occupation or place of residence determines the applicable law. Approximately 99% of the Austrian citizens are covered by social health insurance. Children and relatives of insured persons who live in the same household are jointly insured without additional contributions. Retired persons are still covered by health insurance and are entitled to a pension according to their social insurance qualifications gained in their working life. Several different social insurance laws determine the amount of contributions and benefits. Each person has a unique social insurance number which remains unchanged throughout lifetime and is not even reallocated after the person's death. The unique ID number thus allows a computerised system the calculating pensions and various other allowances. Each entitlement condition of the social security system depends on certain parameters such as kind of occupation, being unemployed, self-employed, on maternity leave, part-time working, having more than one job, times of imprisonment or being welfare recipient.

*The WHO social determinants of health [1]:*

These determinants represent the result of extensive research in the burden of social facts and their consequences for health. They include social gradient, stress, early life, social exclusion, work, unemployment, social support, addiction, food and transport.

The aim of our research was to extract these social determinants from the documented social-insurance related entitlements and calculate a socioeconomic value (SES) for health burden on an individual level.

## 2. Methods

### 2.1 Qualitative part

Table 1 depicts the determinants we selected as eligible for extraction from the social-insurance entitlement conditions list of the Austrian system.

Table 1. Qualitative assessment of the social-insurance qualifications

Social determinants of health (WHO)	Description	Value
Social gradient	<ul style="list-style-type: none"> <li>- Professional (self-employed on expert-status like university professors, physicians, ...)</li> <li>- Management and technical leaders (business managers, employees in a leading qualification, politicians, high-ranked executives, ...)</li> <li>- Skilled non-manual employees (administration)</li> <li>- Skilled manual workers (self-employed manufacturer, master</li> </ul>	<p>1 - Professionals, Management and technical leaders (i.e. self employed with indicators of professionalism, Professors, Physicians, company leaders, leading employees, executives, politicians)</p> <p>2 - Skilled non-manual workers (employees)</p> <p>3 - Skilled manual workers, partially skilled manual workers (manufactorers)</p> <p>4 - very low social status (unskilled, prisoners, refugees, asylants)</p>

	<p>craftsmen, assistant craftsmen, health workers, transport facility workers, ...)</p> <ul style="list-style-type: none"> <li>- Partly skilled manual workers (employed manufacturer, craftsmen, skilled assistant health workers ...)</li> <li>- Unskilled manual workers (blue-collar workers)</li> </ul>	
Stress	<ul style="list-style-type: none"> <li>- Continuing periods of insecurity (search for work, marginal jobs, no income, social assistance, long periods of sick leave)</li> <li>- Lack of control over work and home-life (dependencies, several job-chances and times of unemployment, several changes of home place)</li> </ul>	<p>1 - no indicator of social stress</p> <p>2 - eventually social stress (i.e. gliding retirement, partly retired)</p> <p>3 - social stress (i.e. marginal part-timers, illness)</p> <p>4 - dependency, pension, risk of poverty (i.e. widows, orphans)</p>
Social exclusion	<ul style="list-style-type: none"> <li>- Poverty (low income category, marginal jobs)</li> <li>- Absolute poverty (marginal job or no income, social assistance)</li> </ul>	<p>1 - no indicator for social exclusion</p> <p>2 - eventually social exclusion (i.e. occupation specific rules, shift work, special duty)</p>

	<ul style="list-style-type: none"> <li>- Discrimination (age, gender, ethnicity)</li> <li>- Living in institutions (prison)</li> <li>- Time of exclusion (long term facts)</li> </ul>	<p>3 - social insecurity (marginal part-time, poverty, maternal leave - poverty risk)</p> <p>4 - social assistance, prison, time of national service</p>
Work/ unemployment	<ul style="list-style-type: none"> <li>- Job security (employment, self-employment in special qualification, civil service)</li> <li>- Job insecurity (part-time or marginal employment, several changes, unskilled job)</li> <li>- Unemployment (unemployment benefit)</li> </ul>	<p>1 - secure work or constant income</p> <p>2 - work with insecure elements</p> <p>3 - unsecure work</p> <p>4 - no work, unemployment</p>
Level of income	<ul style="list-style-type: none"> <li>- Estimated level of income category in national context</li> </ul>	<p>1 - in Austria usually good paid</p> <p>2 - in Austria usually good middle average income level</p> <p>3 - in Austria usually lower average income level</p> <p>4 - in Austria usually bad paid, no income</p>

Each social-insurance entitlement condition was assessed in terms of these five categories. Ranking ranged from 1 to 4, where 1 was defined as the lowest social-related health burden and 4 as the highest social health-impact. The overall socioeconomic index value is represented by the mean value of the ranks assigned to the five chosen WHO categories.

The assessment of each position on the entitlement conditions list was carried out by two persons according to the concept listed in table 1; diverging opinions were solved by discussion. A database check by nomenclature (same description, same socioeconomic value?) and by law (i.e. farmers always as skilled manual workers?) was done. As a result of the assessment 14 different categories of means were identified in 0.2-steps from 1 to 4 (1, 1.2, 1.4, ..., 3.8, 4). The categories were then tested for logical consistency as a mean of internal quality assurance. A further step of quality assurance was the presentation and discussion of the results within a group of experts in medicine, sociology, social insurance law and health economy, all of them being employees of the Main Association of Austrian Social Security Institutions. Unfortunately we could not acquire a comprehensive point by point check on quality by an external institution such as a university due to the huge workload (516 entitlement conditions \* 5 determinants assessed \* at least 5 different social insurance laws = 12.900 arrays) and the demand for expert knowledge of social insurance law. Therefore, we decided to pursue as much transparency as possible and are still open to discussion.

## *2.2 Implementation of SES*

Each working person in Austria is filed in a central database on the basis of their unique ID number and the corresponding pension entitlements a person has gained over time. We defined an algorithm to calculate the SES index according to our qualitative ranking of the entitlement conditions in the central database.

## *2.3 Calculation into the past*

The social burden attributed to a person is not static but is changing over lifetime. Thus, an uncritical reflection on the current status may create bias and

lead to an inappropriate comparison between older and younger people. The term past was defined as a period of 30 years into the past, assuming that influences of social determinants before that period are insignificant. However, the algorithm allows for calculations up to 50 years in the past.

The social insurance entitlement can be determined on a monthly basis. Therefore, each month in the period defined as past was also determined separately, calculation using a weighted mean beginning with the month prior to the current month. The calculation formula is shown in graph 1.

$$\frac{SES_{359} * a_{359} + SES_{358} * a_{358} + \dots + SES_1 * a_1}{a_{359} + a_{358} + \dots + a_1} = \text{weighted mean over 359 months}$$

a = weight  
 SES = Index value for social determinants of health  
 Footnote = month from 30 years up to 1 month ago  
 End = 359. Month No. 360 = current month.

Figure 1. Calculation into the past.

Assuming that social inequalities of the past and at present influence a person in equal ways, we assigned a probability of 0.5 to the SES endvalue (accumulated SES of month<sub>359</sub> to month<sub>1</sub>) and likewise a probability of 0.5 to the SES of the current month. This results in the mean of the mean endvalue of the past and the mean value of the present.

### 3. Technical solution

All entitlement conditions out of the central database are evaluated per person. Each entitlement condition equals one data set. The data sets have a uniform format including personal ID, entitlement condition, start date of entitlement condition, end date of entitlement condition and health insurance company code. All data sets of the all test persons have to be extracted from database and prepared in a specified notation. The algorithm can only process

the data correct, if the notation is equivalent to a specific interface description and data sets are sorted by personal ID and end date of entitlement condition ascending.

After starting the algorithm customizable variables (duration and weighting of past and present), all entitlement conditions and their socioeconomic index value are imported. The entitlement conditions are unique in combination with the insurance company code. This information is stored in a matrix, which the algorithm uses to look up the socioeconomic index value of a person's entitlement condition. Also all entitlement conditions of the persons are imported and saved in an array. After defining variables the program calculates for each person one after another the social index.

First of all, the program looks up the actual entitlement condition. As all entitlement conditions are sorted by the end date of entitlement condition ascending, the current data sets are the last ordered belonging to a person. If there is a current entitlement condition, the algorithm will look up the index belonging to it. If more current entitlement conditions exist, the algorithm counts them, looks up their index and calculates the arithmetic mean. If no current entitlement condition was found, the algorithm will log this information.

After calculating the current SES, the algorithm starts to calculate the social index of the past. To calculate the weighted mean the algorithm uses a two dimensional array. The lines of this calculation array represent the number of months of the analysis period and the columns represent per month the sum of social indexes, number of social indexes, the weighting of the month and calculated values. The program begins by determining the start and end time of the analysis period. Then it processes the following routine for all data sets belonging to a person beginning with the last bottom up:

- If end time of actual data set is prior to start time of analysis, count this entitlement condition as "not in analysis period" and got to next data set.
- If begin time of actual data set is prior to start time of analysis, then set begin time of actual data set to start time of analysis.



- If end time of actual data set is past to end time of analysis, then set end time of actual data set to end time of analysis.
- Look up the index of current entitlement condition
- Following routine is repeated as long as the difference between begin time and end time of entitlement condition is more than 14 days (half of a month).
- If day of begin time of actual data set is prior to the 15th, then calculate actual month, sum up social index, increment number of social indices and put this information into the correct position of the calculation array.
- Set begin time to the 1st of the following month and repeat routine.

After all data sets for a person are processed the SES of the past is calculated with the stored values in the calculation array.

Afterwards the SES end value with the weighting of past and present is calculated.

The stored results include the SES end value, current SES, SES of the past, months without qualification and number of data sets for every processed individual. Additionally the most important executed steps of the algorithm are logged.

### *3.1 Quality check on test data*

First we tested the algorithm using our own ID-numbers, since this is the only permitted way of investigating data that are not anonymous. The respective data seemed to be valid but were not representative for lack of quantity. Second we extracted data of 1000 insured working persons (no relatives, no retirees) from the central person register of the social insurance, with the sample equalling the distribution of insured persons to the various social insurance organisations and applied our IT solution to them. The SES value was calculated on the basis of anonymous ID-numbers and entries in the

registry-database. The anonymous personal data were linked to claims data from health insurances to investigate if the SES is related to the usage of health-related services.

#### 4. Results

The result of this query is a comparable endvalue, independent of age and duration of work life, ensuring that nobody can be discriminated against due to the fact that the history of the socioeconomic status over lifetime remains unknown.

Automatic quality checks proved valid.

Test data reveal that 67.6% of the sample persons fall in the categories of SES between 1 and 2, 27.9% in the categories between 2 and 3 and only 4.5% in the categories >3 (highest value 4), 54% show a lower and thus better SES value in the past than at present, 20% show a higher and thus worse SES in the past than at present and 26% show an equal value in the past and at present.

The age distribution in the sample is similar to that of all citizens according to the official statistical institute of Austria (Statistik Austria).

There are regional differences of SES values. Statistics on medication prescriptions show dominant influence of age but not of SES whereas the number of pharmaceuticals prescribed correlates with SES. Statistics on sick leave data show a correlation between an increased number of sick leave days per person and higher SES and no influence of age. Having carried out several tests, we are planning to apply the SES to the whole Austrian population.

#### 5. Discussion

So far several attempts have been undertaken to calculate a socioeconomic value in order to link it to the health status on a personal data level gained from structured claims data. Most of these values consider solely income, whereas ours reflects different social entitlement conditions related to working

conditions and national norm values. Limitations to create an identical picture of the WHO social determinants of health are caused by the failure of claims data on a personal level to provide assessment of early life influences, social support from friends and social networks and facts about addiction, nutrition and transport skills. Our test data are further limited in so far as only working persons are taken into account and jointly insured children, other relatives and retired persons are excluded.

When calculating SES, we deliberately did not consider age and gender since such basic characteristics are readily available and this way we are able to examine the impact of age and gender on the SES in a separate survey.

Our first results gained from test data show a linear correlation between the number of different medications and the number of days on sick leave per person and SES. These results comply with the reports on socioeconomic factors influencing sick leave duration, where Allebeck<sup>[2]</sup> discovered moderate evidence for the effects of socioeconomic status as a risk factor for sick leaves. Steenstra<sup>[3]</sup> identified higher disability levels, older age, female gender, more social dysfunction and more social isolation, heavier work, and receiving higher compensation as predictors for a longer duration of sick leave because of low back pain. A larger number of different medication prescriptions might be related to chronic diseases, and chronic diseases are more often related to low income in Austrian women [13] and to lower educational level in men [14].

A more detailed epidemiological evaluation of several diseases and their relation to the SES value is planned.

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