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To what extent do socioeconomic inequalities in SRH reflect inequalities in burden of disease? The HELIUS study

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ABSTRACT

Background Self-rated health (SRH), an attractive measure for health monitoring, shows persistent inequalities with regard to socioeconomic status (SES). However, knowledge on the extent to which inequalities in SRH reflect inequalities in disease burden is lacking.

Methods Data come from the multi-ethnic HEalthy LIfe in an Urban Setting study (Dutch, South-Asian Surinamese, African Surinamese, Ghanaian, Turkish or Moroccan origin, $N = 19\,379$, aged 18–70). SES was defined by educational and occupational level. Disease burden was operationalized as chronic diseases, physical and mental functioning (measured with SF-12) and depressive symptoms (measured with PHQ-9). We applied logistic regression analyses and reported average marginal effects (AME).

Results Dutch origin participants with low educational or low occupational level had higher probabilities of reporting fair/poor SRH, compared to the highest levels (AME = 0.20 95% CI: 0.13;0.27; and 0.12 (0.09;0.15), respectively). Associations were attenuated after adjusting for all disease burden indicators, to AME = 0.03 (0.01;0.04) and AME = 0.02 (−0.00;0.04). In all the non-Dutch origin groups, a larger part of the inequalities remained after adjustment.

Conclusion Socioeconomic inequalities in SRH are for a large part explained by higher disease burden in lower socioeconomic groups, but less so in those with non-Dutch origin. Future research should examine if our conclusions also hold for trend data on inequalities in SRH.

Keywords chronic diseases, HELIUS study, mental health, self-rated health, socioeconomic inequalities

Introduction

Self-rated health (SRH) is an often used instrument to assess health status in health monitoring. It measures the perception of health and thus incorporates various aspects of health that people may have in mind, such as the absence or presence of chronic or acute diseases, problems with physical functioning, lifestyle factors and psychosocial factors.[1–5] The fact that this single item health measure is relatively easy to measure and that it captures a wide range of health aspects whilst performing well in predicting mortality[6,7] makes SRH an attractive health indicator in monitoring population health.

Socioeconomic inequalities in health, to the advantage of those with a higher socioeconomic status (SES), are also shown for SRH. For example, large inequalities in SRH[8] and in healthy life expectancy (i.e. number of years expected to live in good SRH)[9] exist between groups with high and low educational level, and these inequalities are persistent over time.[10] It is, however, poorly understood what these inequalities in SRH reflect.

Since many studies confirmed associations between SRH on the one hand, and morbidity or mortality on the other hand,[11–13] it is easily and often implicitly assumed that inequalities in SRH reflect inequalities in what is often called 'objective' or 'actual' health status. However, it is unclear to what extent socioeconomic inequalities in SRH can be explained by conventional measures of more objective health, such as the presence of chronic diseases and limitations in everyday functioning. Does the gap in SRH reflect the higher actual burden of disease in lower socioeconomic groups, or does it merely reflect poorer living conditions, or other

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environmental or social conditions,[14] which may also be incorporated in health assessments?

Two studies indeed concluded that inequalities in SRH largely reflect the higher disease burden in lower socioeconomic groups, by investigating the explanatory value of chronic diseases and problems with functioning for socioeconomic inequalities in SRH.[15,16] Both studies also showed that significant inequalities remained. It is unsure, however, whether results are similar in a general population sample, since Leão *et al.* have included people aged 50 and over, and Simon *et al.* included a sample with chronic disease patients over-represented.[15,16]

The current study aims to assess the extent to which inequalities in SRH reflect burden of disease across socioeconomic groups: chronic diseases, physical and mental functioning and depressive symptoms. Previous research has indicated that associations between SRH and its determinants may differ across demographic groups.[17,18] Therefore, we use data from a multi-ethnic cohort study based in Amsterdam and primarily perform analyses on respondents with Dutch ethnic origin, both in total and stratified by age and sex. In addition, we analyse whether results differ in non-Dutch origin groups.

Methods

Sample

The aim and design of the HEalthy LIfe in an Urban Setting (HELIUS) study have been described in detail elsewhere.[19,20] In brief, the HELIUS study is a multi-ethnic cohort study conducted in Amsterdam, the Netherlands. Subjects were randomly, stratified by ethnicity, selected from the Amsterdam municipal register and sent an invitation letter by mail. We were able to contact 55% of those invited, either by response card or after a home visit by an ethnically matched same-sex interviewer. Of those, 50% agreed to participate (60% amongst Dutch, 51% amongst Surinamese (South-Asian Surinamese and African Surinamese), 61% amongst Ghanaians, 41% amongst Turks and 43% amongst Moroccans). Non-response analysis revealed small differences in SES between participants and non-participants.[20] After a positive response, participants received a confirmation letter of the appointment for the physical examination, including a digital or paper version of the questionnaire. Participants who were unable to complete the questionnaire themselves were offered assistance from a trained ethnically matched interviewer.

Of all participants who completed the questionnaire and who took part in the physical examination (N = 22 165), we first excluded those not belonging to the six largest ethnic groups (n = 548). We further excluded those with missing educational level (n = 195, 0.9%). Participants with missing occupational level (n = 3273, 15.1%), of whom 38% had no education or elementary education, were retained in the analysis as a separate category. Further excluded were those with missing values on SRH (n = 57, 0.3%) or on measures of disease burden (see next section): chronic diseases (n = 1264, 5.8%), other SF-12 items (n = 624, 2.9%) and PHQ-9 items (n = 100, 0.5%). Women, older participants, those from non-Dutch ethnic origin groups, those with lower educational or occupational level and with poorer physical or mental health more often had missing data on one or more of these variables. The final sample consisted of 19 377 participants, 4372 of Dutch, 2772 of South-Asian Surinamese, 3674 of African Surinamese, 1906 of Ghanaian, 3184 of Turkish and 3469 of Moroccan origin. The Medical Ethics Committee of the Amsterdam Academic Medical Center approved the study protocols. Written informed consent was obtained from all participants involved in the study.

Measurements

SRH was indicated by the first item of the SF-12: 'In general, would you say your health is: Excellent, Very good, Good, Fair, or Poor'. SRH was dichotomized into fair/poor[1] versus good/very good/excellent (0) SRH.

SES was measured by educational level and occupational level. Educational level was based on the highest educational qualification obtained, either in the Netherlands or in the country of origin, and categorized into four groups, (i) 'none, or only primary education', (ii) 'lower vocational or lower secondary education', (iii) 'intermediate vocational or intermediate or higher secondary education' and (iv) 'higher vocational education and university'.

Occupational level was classified according to the Dutch Standard Occupational Classification system,[21] which provides an extensive systematic list of all professions in the Dutch system. Occupational level consisted of five categories, based on job title and job description, including a question on fulfilling an executive function. Because of low numbers, the lowest two categories were combined, resulting in these four categories: (i) elementary/lower, (ii) intermediate, (iii) higher and (iv) academic. Missing occupational level was included as a separate category, as this category may also include respondents who never had a job. Since there were no cases with fair/poor SRH in higher and academic levels in the Ghanaian group, levels 2, 3 and 4 had to be combined in this group.

Disease burden was operationalized as the number of chronic diseases, level of physical and mental functioning and depressive symptomatology.

The first disease variable represented the number of chronic diseases, based on self-reported presence of a list of 20 chronic disease(s) in the past 12 months (Appendix 1). A second disease variable was created with additional information that was available in HELIUS on a selection of diseases. This information was used to define additional diseases (obesity), or to add to self-report (hypertension, myocardial infarction, angina and diabetes). These four conditions were coded as 'yes' if one or both of the self-reported and measured definitions were positive and as 'no', if both were negative. As a result, the second disease variable theoretically ranged from 0 to 21. *Hypertension* was defined as systolic BP ≥140 mmHg, or diastolic BP ≥90 mmHg, or being on antihypertensive medication or self-reported hypertension. *Diabetes* was defined on the basis of self-report, elevated fasting glucose (≥7 mmol/l), and/or the use of glucose lowering medication. *Obesity* was defined as a body mass index higher than 30 kg/m^2 (measured weight divided by measured height squared). *Myocardial infarction* and *angina pectoris* were defined according to the Rose questionnaire.[22]

As indicators of physical and mental functioning, we used two sub scales of the SF-12.[23] *Physical and Mental Component Summary Scores* (PCS and MCS) were calculated using previously published scoring coefficients,[24] and were used for descriptive purposes. Because the sub scales PCS and MCS cannot be calculated without the first item of SF-12 (SRH; the main outcome measure of this study), the 11 remaining items of the SF-12 were included individually in all regression models.

Depressive symptoms were measured with the PHQ-9.[25] The PHQ-9 consists of nine items, with a response scale varying from zero (never) to three (nearly every day), and was used as a sum score for this study (range 0–27). If one of the items was missing, the mean score of the other eight items was used to replace the missing item. If more than one item was missing, the variable was considered missing.

Statistical analysis

Descriptive statistics include means (SD), medians (IQR) and percentages. Logistic regression analysis was conducted with fair/poor SRH as the outcome measure. Educational level and occupational level were the main predictors, in models that included a different number of health variables as covariates in each subsequent step. The first model and all subsequent models included age and sex. The final model included all health variables as covariates. Average marginal effects (AME) for each educational and occupational level on fair/poor SRH were reported for all models.[26] AMEs can be interpreted as the average increase in probability of fair/poor SRH over all values of the covariates. We based conclusion regarding group differences on a comparison of AMEs and their associated 95% confidence intervals.

Because the magnitude and meaning of socioeconomic inequalities in health might depend on ethnicity,[27] and this may affect analyses stratified by age and sex, we performed analyses in two samples. First, we conducted regression models in those with Dutch ethnic origin in men and women and in those aged up to 49 and 50 and over. Second, regression models were conducted on all participants, stratified by ethnicity.

Analyses were conducted using IBM SPSS Statistics for Windows (Armonk, NY: IBM Corp) and STATA (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LP). The level of statistical significance was set at $P < 0.05$.

Results

Table 1 shows characteristics of the study sample, by ethnicity. Rather large inequalities were found within the Dutch origin group according to educational and occupational level (Appendix Table S1). For example, highest and lowest prevalence of fair/poor SRH was 30.5% (educational level 1) and 5.3% (educational level 4). Compared to the number of chronic diseases, PHQ-9 and physical component of the SF-12, the mental component score of the SF-12 showed a less clear gradient across socioeconomic groups.

In the Dutch origin sample, we observed a substantial reduction in the inequalities in fair/poor SRH, after adjustment for burden of disease (Table 2). The AME for lowest versus highest educational level decreased from 0.20 to 0.03, and the AME for lowest versus highest occupational level decreased from 0.12 to 0.02. This indicates that having the lowest versus the highest educational level is associated with a 20% higher probability of rating one's health as fair or poor, and this decreases to 3% if the differences in disease burden are taken into account. This 3% higher probability was no longer statistically significant. Remarkably, the number of chronic diseases attenuated the socioeconomic inequalities in SRH to about the same extent as the physical SF-12 items. Mental SF-12 items and the PHQ-9 sum score contributed least to the explanation of inequalities in SRH.

Across Dutch origin subgroups according to age and sex, AMEs from models before and after adjustment for health variables appeared quite similar (Fig. 1). This was indicated by largely overlapping confidence intervals for men versus women and for the younger versus older age group. In ethnic minority groups, overall larger inequalities between the higher

Table 1 Characteristics of the sample

N = 19379	*Dutch origin, N = 4372*	*South-Asian Surinamese origin, N = 2772*	*African Surinamese origin, N = 3674*	*Ghanaian origin, N = 1906*	*Turkish origin, N = 3184*	*Moroccan origin, N = 3469*
	Mean (SD)/n (%)/median [IQR]	*Mean (SD)/n (%)/median [IQR]*	*Mean (SD)/n (%)/median [IQR]*	*Mean (SD)/n (%)/median [IQR]*	*Mean (SD)/n (%)/median [IQR]*	*Mean (SD)/n (%)/median [IQR]*
Age	46.0 (14.0)	45.1 (13.5)	47.5 (12.6)	44.4 (11.2)	39.9 (12.2)	40.1 (12.9)
Female sex	2372 (54.3)	1504 (54.3)	2222 (60.5)	1144 (60.0)	1750 (55.0)	2108 (60.8)
Educational level						
Level 1 (lowest)	141 (3.2)	373 (13.5)	193 (5.3)	542 (28.4)	967 (30.4)	1044 (30.1)
Level 2	605 (13.8)	908 (32.8)	1266 (34.5)	762 (40.0)	792 (24.9)	607 (17.5)
Level 3	958 (21.9)	823 (29.7)	1343 (36.6)	471 (24.7)	930 (29.2)	1179 (34.0)
Level 4	2668 (61.0)	668 (24.1)	872 (23.7)	131 (6.9)	495 (15.5)	639 (18.4)
Occupational level missing	253 (5.8)	310 (11.2)	318 (8.7)	266 (14.0)	735 (23.1)	910 (26.2)
Level 1 (lowest)	683 (15.6)	1095 (39.5)	1386 (37.7)	1420 (74.5)	1469 (46.1)	1308 (37.7)
Level 2	960 (22.0)	772 (27.8)	1195 (32.5)	149 (7.8)	599 (18.8)	757 (21.8)
Level 3	1612 (36.9)	460 (16.6)	675 (18.4)	52 (2.7)	277 (8.7)	409 (11.8)
Level 4	864 (19.8)	135 (4.9)	100 (2.7)	19 (1.0)	104 (3.3)	85 (2.5)
Fair/poor SRH	393 (9.0)	822 (29.7)	784 (21.3)	369 (19.4)	1043 (32.8)	1247 (35.9)
Median no of chronic diseases	1 [0–2]	2 [1–5]	2 [1–4]	2 [1–3]	3 [1–6]	2 [1–4]
Median PHQ-9 score	3 [1–5]	4 [1–7]	3 [0–5]	2 [0–5]	5 [2–9]	4 [2–8]
SF-12 physical component	51.0 (7.6)	46.9 (9.6)	48.5 (8.9)	48.1 (8.6)	45.8 (10.4)	46.3 (10.1)
SF-12 mental component	51.0 (8.6)	47.6 (10.9)	50.2 (9.9)	49.3 (9.5)	45.1 (11.0)	45.8 (10.7)

and lower SES groups were observed, whereas smaller proportions were explained by the specific health factors (Fig. 2). An exception was the group with Ghanaian origin, probably due to the different categorization of SES. In particular in Turks the inequalities were largest, and in Ghanaians the proportion that could not be explained by specific health factors was largest (i.e. small difference in AME between unadjusted and adjusted models).

Sub group models that include each health variable separately are shown in Appendix Tables S2–S10. These results confirm that the patterns that were found for educational level also apply to occupational level.

Discussion

Main finding of this study

This study examined to what extent socioeconomic inequalities in SRH reflect inequalities in the burden of disease. Generally, inequalities in SRH were for the most part explained by inclusion of more specific measures of disease burden. However, the extent to which this was true varied across demographic sub groups. Results in particular suggested that in ethnic minority groups, inequalities in SRH are relatively less accounted for by the specific health factors that were included in this study.

What is already known on this topic

SRH is an often used instrument in population health monitoring. Therefore, in view of the development of policies aiming to reduce inequalities in health, it is important to have knowledge on what differences in SRH represent and what interventions are needed to reduce inequalities in SRH. Research over the past decades has pointed to inequalities in the development of diseases[28,29] and in physical and mental functioning.[30–32] In addition, inequalities were observed in health behavior[33] and recovery from health problems.[34] Two previous studies have focused on the explanation of SES inequalities in SRH in specific populations, in particular older people and in those with chronic diseases.[15,16] Simon *et al.* observed that in a sample with predominantly chronically ill participants, subjective health aspects (psychosomatic symptoms and perceived discomfort/stress) explained more of the

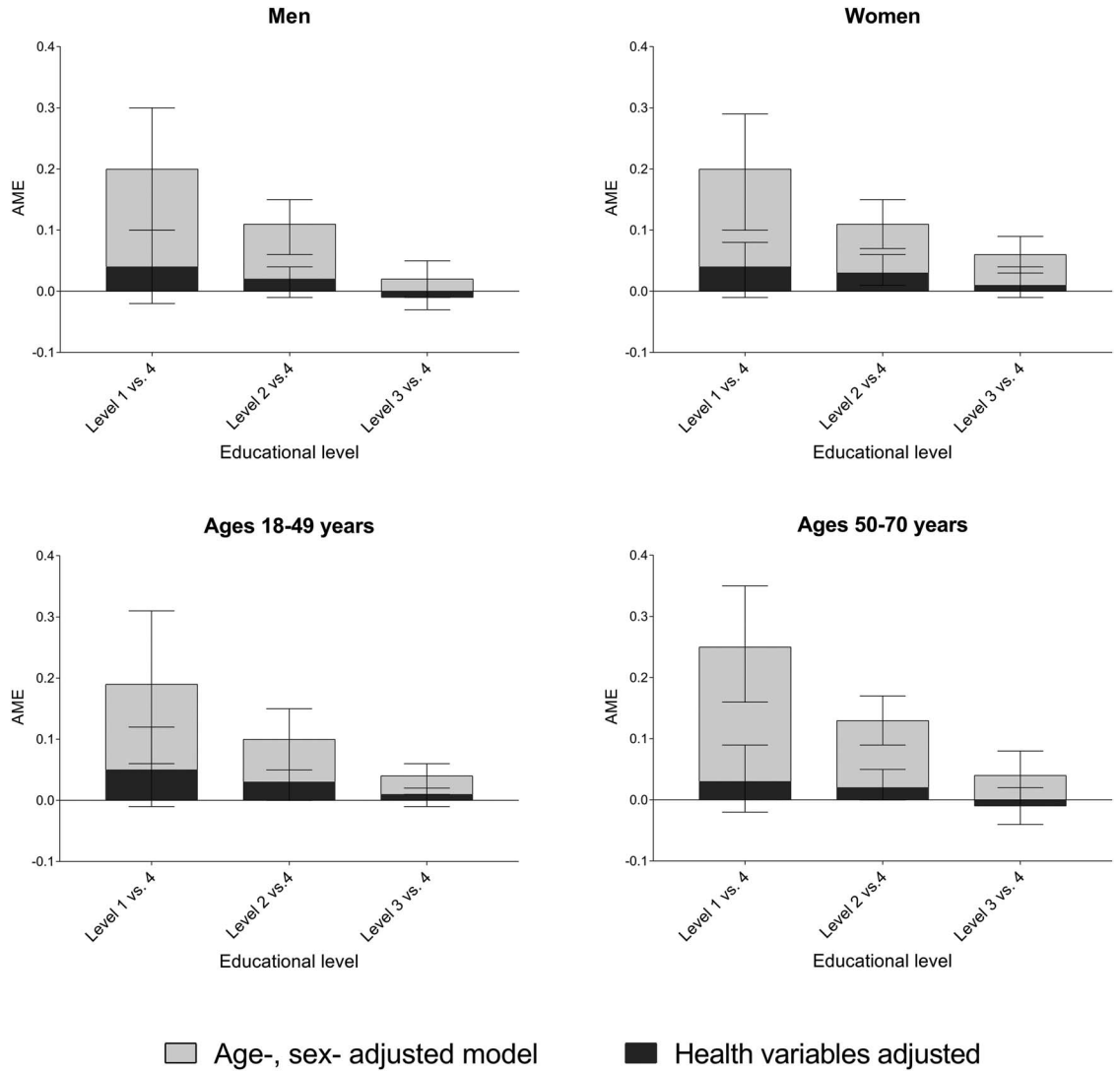

Fig. 1. AME for educational level on fair/poor SRH, in Dutch respondents by sex and age.

inequalities than objective health aspects (chronic diseases and functional limitations).[15]

What this study adds

The current study was performed in a general population sample, as opposed to previous studies on this topic. In contrast to the results of Simon *et al.*,[15] we observed that chronic diseases and physical functioning explained most of the SES inequalities in Dutch origin respondents, which might be related to the inclusion of predominant chronically ill people in their study, and to a different operationalization of health aspects.

Regarding the population groups with non-Dutch origin, we found that inequalities in SRH more often persisted after taking into account the distribution of chronic diseases and problems with physical and mental functioning across socioeconomic groups. Reasons for a significant remaining association of educational and occupational level with SRH may include that physical and mental disease burden was not measured optimally, or that other, unmeasured, health factors play a role. For example, if anxiety was measured as in-depth as was depression with the PHQ-9, or if the severity of chronic diseases would have been measured this might have led to a better explanation of socioeconomic health inequalities.

The remaining part of inequalities in SRH could further be due to structural unfavourable circumstances in the low SES groups, such as an unsafe environment or unfavourable financial situation, or to individual factors such as lifestyle factors and personality. In particular in African Surinamese,

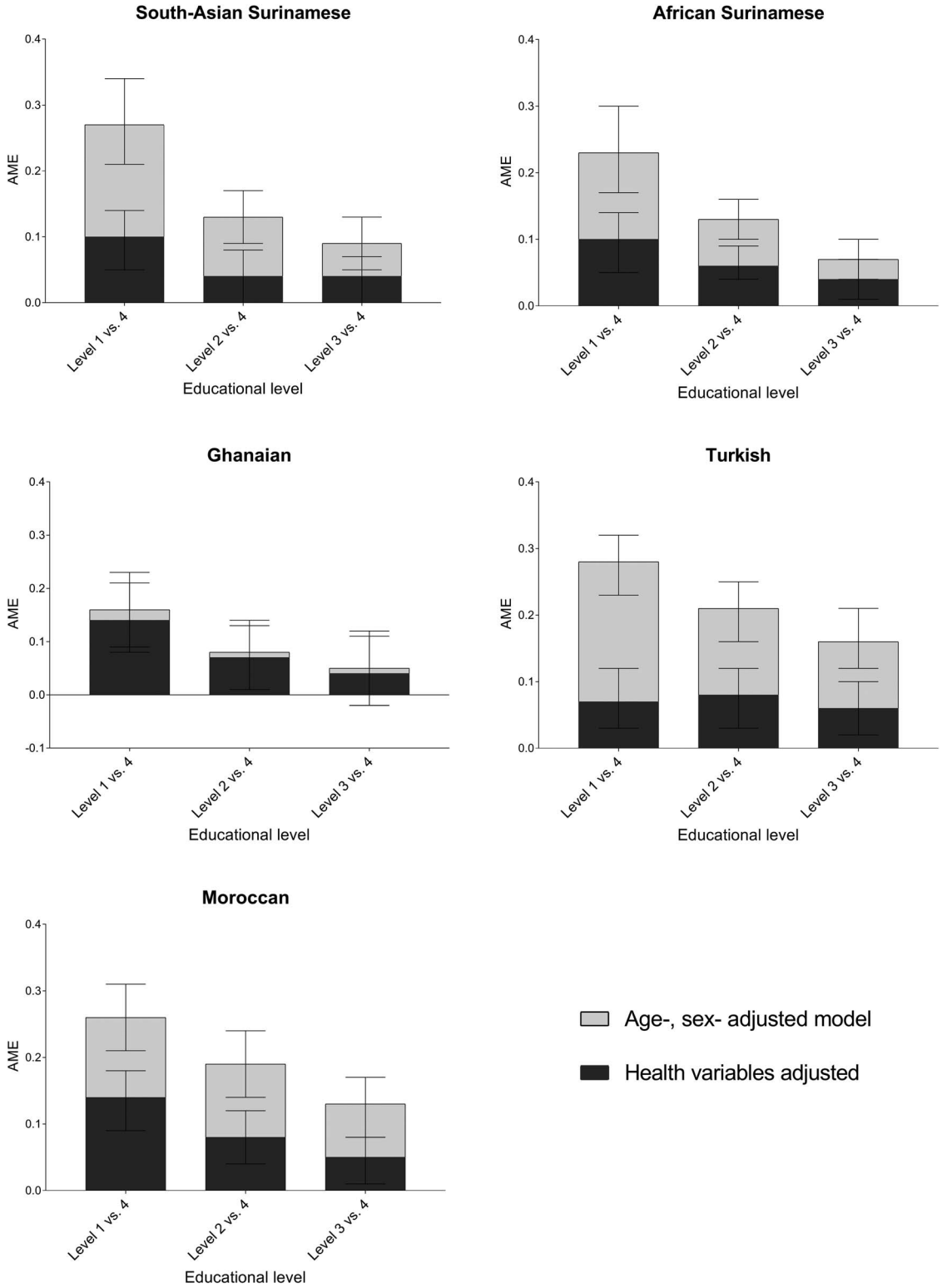

Fig. 2. AME for educational level on fair/poor SRH, non-Dutch respondents by ethnicity.

Table 2 Association between SES (educational and occupational level) and fair/poor SRH, Dutch origin sample, *n* = 4372

		Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*
	Adjusted for	*Age, sex*	*Age, sex, chronic diseases self-report*	*Age, sex, chronic diseases self-report + measured[a]*	*Age, sex, sf-12 physical*	*Age, sex, sf-12 mental*	*Age, sex, phq-9*	*Age, sex, chronic diseases self-report + measured[a], sf-12 physical, sf-12 mental, phq-9*
		AME (95% CI)	*AME (95% CI)*	*AME (95% CI)*	*AME (95% CI)*	*AME (95% CI)*	*AME (95% CI)*	*AME (95% CI)*
Education	Level 1	0.20 (0.13;0.27)	0.06 (0.02;0.11)	0.04 (0.00;0.08)	0.07 (0.03;0.11)	0.10 (0.05;0.14)	0.11 (0.06;0.16)	0.03 (−0.00;0.06)
	2	0.11 (0.08;0.14)	0.05 (0.03;0.08)	0.04 (0.02;0.07)	0.04 (0.02;0.06)	0.06 (0.04;0.09)	0.08 (0.05;0.11)	0.03 (0.01;0.04)
	3	0.04 (0.02;0.06)	0.01 (−0.00;0.03)	0.01 (−0.01;0.03)	0.01 (−0.00;0.03)	0.02 (0.01;0.04)	0.03 (0.01;0.05)	0.00 (−0.01;0.02)
	4 (ref)							
Occupation	Missing	0.08 (0.03;0.13)	0.04 (−0.00;0.08)	0.03 (−0.01;0.07)	0.03 (−0.00;0.07)	0.04 (−0.00;0.07)	0.04 (0.00;0.08)	0.01 (−0.02;0.05)
	Level 1	0.12 (0.09;0.15)	0.05 (0.02;0.07)	0.04 (0.01;0.06)	0.05 (0.02;0.07)	0.06 (0.03;0.08)	0.08 (0.06;0.11)	0.02 (−0.00;0.04)
	2	0.07 (0.04;0.09)	0.03 (0.01;0.06)	0.03 (0.01;0.05)	0.03 (0.01;0.05)	0.04 (0.02;0.07)	0.05 (0.03;0.07)	0.02 (−0.00;0.04)
	3	0.02 (0.00;0.04)	0.01 (−0.01;0.03)	0.01 (−0.01;0.03)	0.01 (−0.01;0.03)	0.01 (−0.01;0.03)	0.02 (−0.00;0.04)	0.01 (−0.01;0.03)
	4 (ref)							

Moroccan and Ghanaian participants, a quite small proportion of fair/poor SRH ratings were accounted for by a higher disease burden in lower socioeconomic groups. This result might point to the relevance of other health aspects, not measured in this study, or to a different view on health, where non-health related factors are needed to explain why lower socioeconomic groups have poorer SRH.

It has been argued that SRH measures something different in individuals according to their SES, hampering the validity of SRH as a proxy measure to compare their physical and mental health status.[35–39] Our results show that in those with Dutch origin, the 20% elevated risk on poorer SRH for the lower educated was reduced to 3% if their higher disease burden was taken into account. Due to its non-specific wording, SRH captures a range of different health problems, as well as their accumulation. SRH may thus be useful for obtaining insight in socioeconomic health inequalities, for example, in the context of complex health interventions that are targeted at multiple health aspects. At the same time, this conclusion might not hold for ethnic minority populations, and this should be examined in further research. It should also be noted that our findings apply to one moment in time. Its validity for monitoring health inequalities over time should be examined with longitudinal or trend data.

Limitations of this study

Our findings should be viewed in light of some limitations. First, disease burden was almost only measured by self-report, except for some of the chronic diseases. If there would be relevant health-related reporting differences between socioeconomic groups, this would influence both the outcome SRH and the selected explanatory variables. Previous research, however, is not consistent with regard to reporting differences (i.e. differential associations between SRH and indicators of disease burden according to SES) and their direction.[37,40–42] Thus, the extent to which reporting differences have influenced our results is expected to be limited. Second, those who did not participate in the study, or were excluded because of missing data had slightly lower SES,[20] were more often members of ethnic minority groups and had poorer physical and mental health. Inclusion of a healthier sample probably influenced representativeness of our descriptive data, but probably not the strength of the associations that were found. Third, we have not included more specific questions on functional limitations, which are major health problems in older age groups. In HELIUS, questions on activities of daily living (ADL) and on functional limitations were only measured in those aged 55 and over. In the 1422 Dutch respondents that responded to those questions, we found that the remaining AME for the lowest educational level was 0.02 (instead of

0.03), and the remaining AME for lowest occupational level was 0.00 (instead of 0.02). There is thus a substantial overlap between these additional questions and the variables that were included in our study, but some additional variance could have been explained by additional questions on daily functioning.

Conclusion

SRH is a concise health measure that has shown consistent predictive value for morbidity and mortality.[6] The results of this study showed that more specific indicators of disease burden account for most of the educational and occupational inequalities in SRH in people with Dutch origin. Future studies should examine whether these conclusions also hold for trend data on inequalities in SRH. In respondents with non-Dutch origin, larger part of the inequalities remained after adjustment for specific health aspects. It should be examined which health aspects influence SRH in these groups.

Supplementary data

Supplementary data are available at the *Journal of Public Health* online.

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