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Education, aging, and health: to what extent can the rise in educational level relieve the future health (care) burden associated with population aging in the Netherlands?

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Abstract

This article describes to what extent the expected rise in the educational level of the Dutch population can counterbalance the increases in the prevalence of ill-health and health care utilization based on the aging of the population for the period 1996–2020. Logistic regression models are used to estimate current differences in health (care utilization) by age, sex, and educational level, using data from the Netherlands Health Interview Survey. The current differences in health (care utilization) are applied to national projections of the composition of the population by age, sex, and educational level. Also, scenarios have been made in which the health differences by educational level are assumed to converge and diverge. The rise in the educational level counteracts the expected increases in ill-health based on population aging to a substantial degree (10–100%). We therefore recommend that in projections of ill-health also changes in educational level are taken into account.

Keywords: Projections; Scenarios; Educational level; Aging; Perceived health; Health care utilization

1. Introduction

In projections of future rates of ill-health and health care utilization the association between demographic developments and health outcomes usually is modelled in a very simple way: only changes in the age and sex structure of the population are taken into account. The Population Forecast of Statistics Netherlands shows that the proportion of people older than 65 years of age is expected to increase from 13.3% in 1996 to 18.4% in 2020 [1]. Because of this aging of the population, which is larger in the Netherlands than in most other Western countries, it can be expected that health care needs will increase substantially in the coming decades [2–4].

However, many other socio-demographic factors have been demonstrated to be causally related to health. In most countries it has for instance been shown that people with a high educational level have lower morbidity rates than people with a lower educational level [5–8]. It can therefore be assumed that future changes in the composition of the population by educational level also will affect the health of the population. As in most other Western countries, large changes in the educational level of the Dutch population are expected in the coming decades. This anticipated rise in educational level might counterbalance (some of) the effects of aging.

In this study we estimate the effect that the expected changes in the composition of the population by educational level will have on the health and health care utilization of the Dutch population during the period 1996–2020. The future composition of the population in the older age groups by educational level can easily be deduced from the current composition by educational level in the young and middle-aged age groups (cohort-wise). The effect of taking changes in the educational level into account, is compared to projections in which only age is modelled. Several scenario projections are made in which it is assumed that current health differences by educational level will remain unchanged, will decrease or will increase.

2. Data

In this study we consider the health and health care utilization of the population of 25–84 years of age during the

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period 1996–2020. We chose for the lower limit of 25 years because it can be assumed that the vast majority of people will have attained their final educational level by that age. The upper limit of 84 years was chosen because up to this age reliable estimations of health and health care utilization could be made with the available data.

The Population Forecast of 1996 of Statistics Netherlands was used as the basis of the projections of health and health care utilization in this study [1]. The Population Forecast gives the most likely future composition of the Dutch population by age and sex. For data on the future composition of the Dutch population by educational level, projections of the Netherlands Bureau for Economic Policy Analysis (CPB) and data of the Netherlands Health Interview Survey (HIS) were used. The CPB has made projections of the expected composition of the Dutch potential labour force by age, sex and educational level for the period 1991–2020 [9,10]. The potential labour force includes all persons aged 15–64 years who are not enrolled in full-time education. For the purpose of our study the projections of the CPB have been extended to the 65–84 age groups. We have assumed that the relative composition of birth cohorts by educational level remains constant from the age range 60–64 onwards. Thus, it is assumed that the birth cohort born between 1927–1931 has the same relative educational composition in 1996 (then aged 65–69), in 2001 (then aged 70–74), etc., as in 1991 (then aged 60–64, for whom the relative educational composition is given by the CPB projections). Since the CPB projections start in 1991 and has as oldest age range 60–64 years, the oldest birth cohort for which information was available in the CPB projections was the cohort born between 1927–1931. For the older birth cohorts (those aged 65 and older in 1991) the composition by educational level was estimated from the educational level of respondents to the Netherlands Health Interview Survey (HIS) in the years 1991–1995 [11]. Also for these birth cohorts we have assumed that the relative composition by educational level remains constant in later years. In the analysis educational level is classified in 4 categories: primary (primary school); lower (lower vocational and lower general secondary school); intermediate (intermediate vocational and intermediate/higher general secondary school); higher (higher vocational school and university).

Fig. 1 shows the relative composition of the Dutch population by sex and educational level for selected years. Both among men and women there are substantial changes in highest attained educational level between 1996 and 2020. For example, the proportion men with only primary school decreases from 14.0 to 8.2%, whereas the proportion with higher vocational school and university increases from 17.8 to 21.6%. The changes in educational level are larger among women than among men: the proportion women with only primary school decreases from 21.7 to 10.7, whereas the proportion with a higher education increases from 13.2 tot 19.5%. While the educational level of women was considerably lower than that of men in 1996, women have almost caught up with men in 2020.

Table 1 shows the relative composition of the total Dutch population by sex and educational level in 1996 and 2020 for several age groups. Among men there are only small differences in the educational level of those aged 35–39 in 1996 and in 2020. There are, however, large differences in the educational level of those aged 65–69 and 80–84 in 1996 and 2020, respectively. Inspection of the male birth cohorts shows there are only small changes in educational level among men born after 1950 (those younger than 46 in 1996 and those younger than 70 in 2020). Thus, among male birth cohorts the educational level increases up to the birth cohort of 1950. Among women, the educational level in 2020 is higher in all age groups shown in table 1 than in 1996. Inspection of the female birth cohorts shows that educational level will improve at least until the birth cohort of 1976.

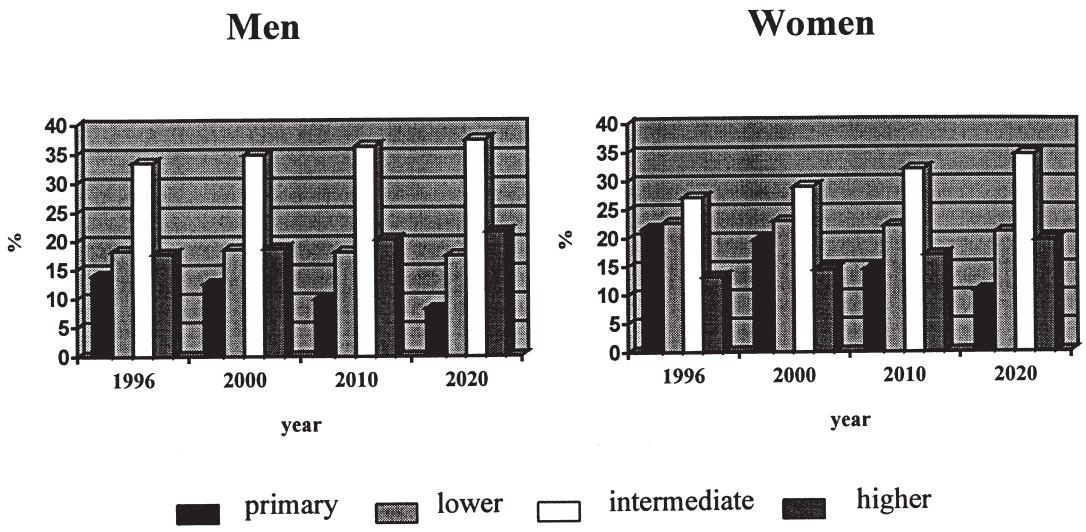

Fig. 1. Relative composition of the Dutch population by educational level for selected years.

Table 1
Relative composition of the Dutch population by sex and educational level in 1996 and 2020 for selected age groups

		Educational level							
		Men				Women			
Age	Year	Primary	Lower	Intermediate	Higher	Primary	Lower	Intermediate	Higher
35–39	1996	9.3	19.4	43.8	27.5	11.3	22.3	42.3	24.2
	2020	8.7	23.3	41.2	26.8	8.1	22.6	41.9	27.4
65–69	1996	27.2	22.7	34.1	16.6	44.5	30.3	18.3	6.9
	2020	10.7	16.7	43.5	29.1	15.7	27.6	36.8	19.9
80–84	1996	47.3	15.8	23.4	13.5	65.8	17.7	10.1	7.0
	2020	22.8	23.0	35.5	18.7	29.5	35.9	24.0	10.6

Tremendous changes can be seen in the older age groups. Whereas of women aged 65–69 years in 1996 45% have primary school and 7% have higher vocational school or university as their highest attained educational level, these percentages are 16 and 20%, respectively, among women aged 65–69 years in 2020.

Pooled data from the Netherlands Health Interview Survey (HIS) for 1993, 1994, and 1995 have been used to determine the current relationships of sex, age and educational level with health and health care utilization [11]. Each survey is based on a national representative sample of the non-institutionalised Dutch population and contains approximately 8000 respondents. In the HIS yearly a sample of approximately 6700 households is drawn. Up to 4 household member are interviewed, including the "head of the household," his/her partner and 2 additional members (or 3 if there is no partner). The response ranged from 55.0% in 1993 to 58.6% in 1995. The non-response is caused by refusal (27%), inability to answer (5%) or because nobody was found at home (11%). In spite of the fairly high non-response, the sample is a reasonable adequate representation of the Dutch population [11]. Also, in nonresponse research of the HIS no clear relation was found between the non-response rates and socio-economic status [12]. This non-response research suggests that the effects of any non-response bias on the estimates of health differences by educational level will be modest.

The health indicators included in this study are perceived general health (dichotomized[1] into "very good" or "good" versus "fair," "sometimes good and sometimes bad" and "bad"), chronic conditions (reporting at least one of the 25 listed chronic conditions) and long-term disabilities (reporting to have great difficulty or to be unable to perform 7 tasks mentioned in the OECD indicator of long-term disabilities). Together, these variables cover both objective and subjective dimensions of health. The indicators of health care utilization included are general practitioner contacts (whether the general practitioner has been consulted during the past 2 months), specialist contacts (whether a medical specialist has been consulted during the past 2 months), use of prescription medicines (whether prescription medicines were used during the past 14 days) and hospital admissions (whether the respondent has been admitted to the hospital during the past year). Together, the indicators of health care utilization cover almost 50% of the total costs for health care in the Netherlands [13].

3. Methods

Logistic regression models were used to determine the current differences in health and health care utilization by age and educational level [14]. Separate models were fitted for men and women. Dummy variables have been constructed for age (12 5-year age groups) and for educational level (4 dummy variables), using the deviation coding scheme. In this coding scheme the effect of each category is compared to the average effect of all categories [15].

In the basic scenario it has been assumed that the current differences in health and health care utilization by educational level will remain unchanged between 1996 and 2020. The current differences by age and educational level are applied to the projections of the composition of the future Dutch population. First, the outcomes of the logistic regression models have been used to calculate the expected proportion of ill-health or health care utilization for each specific category of sex, age and educational level. Applying these proportions to the number of people in the appropriate age and educational level specific stratum, summing up over the strata and dividing by the total population yields the projected proportion of ill-health or health care utilization within the total population. These projections in which both changes in the composition of the population by age and educational level are taken into account are compared to projections in which only the aging of the population and in which only the increase in educational level of the population are taken into account.

[1]An issue concerning the data analysis is the choice to dichotomize the outcome variables in order to enable a comprehensive presentation of the results. The most common used cut off points for the respective outcome variable have been used. This of course means that information is lost. If other cut off points would have been chosen, this generally would have meant distinguishing more selective groups with respect to illness/disease or health care utilization, with even larger differences between educational groups, and thus, even larger beneficial effects of taking changes in educational level into account in the predictions (data not shown).

Additionally, scenarios have been made in which it is assumed that the current differences in health and health care utilization by education level will increase and decrease, respectively, in the coming 25 years. We chose to make both a divergent and convergent scenario, because neither the past trends in morbidity or mortality differences by educational level nor other expected societal changes provide clear evidence that one alternative is more likely to occur than the other.

Trends in mortality differences by educational level have most frequently been studied. Depending on the country, time period and sex under study, mortality differences by educational level have been reported to increase [16–19], or remain unchanged [16,18]. Unfortunately, there have been no studies of trends in mortality differences in the Netherlands.

Studies of trends in morbidity patterns are more scarce. For Finland it has been reported that trends in morbidity differences remained unchanged among women, while they decreased among men [20,21]. For the Netherlands, Swinkels reported that the morbidity differences by educational level remained unchanged, studying differences in perceived general health between 1984–1994 and differences in chronic conditions and long-term disabilities between 1989–1994 [22]. Mackenbach and Kunst, however, found indications that the differences in perceived general health increased in the Netherlands between 1983–1985 and 1992–1993 [23].

Also, other (foreseeable) developments do not unambiguously imply that either increasing or decreasing trends in health differences by educational level are more likely to occur. For instance, the anticipated changes in health behaviors could produce either increasing or decreasing health differences by educational level. In the past, lower educational groups have often imitated the health behaviors of the higher educational groups after some time lag. If this will also happen in the coming decades, the lower educational groups might catch up with higher educational groups by decreasing their smoking rates, increasing their leisure-time exercise, and improving their food habits, which would cause a decrease in the health differences by educational level. On the other hand, if new behavioral risk factors become known, this information is probably more quickly learned and acted upon by the higher educational groups, which would cause an increase in the health difference by educational level.

Since it can not unambiguously be predicted whether the health differences will increase, remain unchanged or decrease, projections have been made in which diverging and converging trends in the health differences are assumed. The diverging trends have been operationalized by multiplying the beta-coefficients found for the current differences by educational level by 1.25 for the year 2010 and by 1.50 for the year 2020. The converging trends have been operationalized by multiplying the beta-coefficients for the current differences by educational level by 0.75 for the year 2010 and by 0.50 for the year 2020.[2] With regard to the size of the multiplication factors, if the previous finding of increasing differences in perceived general health by educational level in the Netherlands [23], which pertained to a ten-year period, is extrapolated to a period of 25 years—the time scope of our projections—this increase would fit within our quantification of diverging health differences.

4. Results

In Table 2 the differences in ill-health and health care utilization between people with primary school and people with higher vocational school or university as their highest level of education are shown, which have been applied in the stable, divergent and convergent scenario. For reasons of convenience the figures for people with a lower or intermediate education have been omitted. In general, the differences by educational level are larger among men than among women and larger for the indicators of health than for the indicators of health care utilization. Especially for specialist consultation only small differences by educational level were found [24].[3]

Table 3 shows the projected prevalence of ill-health and health care utilization between 1996 and 2020 taking into account only the aging of the population, only the increases in educational level of the population, and both the aging and increase in educational level of the population according to the stable scenario. Both among men and women, taking only the aging of the population into account predicts substantial increases in the prevalence of ill-health and health care utilization in the coming decades. When only the increase in educational level is taken into account, decreases

[2] Since a deviation coding scheme was used for the construction of dummy variables in the logistic regression models, multiplying the beta-coefficients of educational level by a certain factor affects both the estimations of health of people with a higher and lower education. For example, using multiplication factors larger than 1.00 means that in the diverging scenario it is assumed that health of people with a high education is better and of people with a low education is worse than health of these groups in the stable scenario. If in stead an indictor coding scheme had been used with either people with a high or people with a low educational level as the reference group, multiplying the beta-coefficients by a certain factor would mean that it is assumed that the health of the reference group remains unchanged throughout both the diverging and converging scenario, and that only the health of the non-reference groups would change. Given the deviation coding scheme, our assumptions for the diverging and converging scenario and assuming that the beta-coefficients for a specific indicator of health are 0.405 for people with only primary school (corresponding odds ratio (OR) is 1.50) and −0.288 for people with higher vocational school or university (corresponding OR is 0.75), the beta-coefficients will become 0.608 (OR = 1.84) and −0.432 (OR = 0.65), respectively, in 2020 according to the divergent scenario, and 0.203 (OR = 1.22) and −0.144 (OR = 0.87), respectively, in 2020 according to the convergent scenario.

[3] People with a lower educational level were found to have only slightly higher rates for specialist consultation than people with a higher educational level. The differences in specialist consultation by educational level seem especially small when taking into account the fact that people with a low educational level have much higher rates of ill-health. This might (partly) be explained by a substitution phenomenon in the Dutch health care system [24]. Consultations of medical specialists might be financially more attractive for those with private insurance (mainly the higher educated) because a substantial part of them have no insurance coverage for the GP. The publicly insured (mainly the lower educated) are completely covered for GP services.

Table 2
Differences in health and health care utilization in 2020 by educational level (odds ratios are shown for people with primary school and for people with higher vocational school or university relative to the whole population) in (respectively) the stable, divergent, and convergent scenarios for men and women

	Scenario					
	Men			Women		
Health, educational level	Stable	Divergent	Convergent	Stable	Divergent	Convergent
Perceived general health (less-than-good)						
Primary	1.96	2.75	1.40	1.78	2.38	1.34
Higher	0.52	0.38	0.72	0.67	0.54	0.82
Chronic conditions (⩾1)						
Primary	1.32	1.52	1.15	1.24	1.38	1.11
Higher	0.86	0.79	0.92	0.87	0.82	0.93
Long-term disabilities (⩾1)						
Primary	2.22	3.32	1.49	2.06	2.96	1.44
Higher	0.44	0.30	0.67	0.52	0.38	0.72
General practitioner consultations (⩾1)						
Primary	1.25	1.39	1.12	1.21	1.34	1.10
Higher	0.74	0.63	0.86	0.87	0.82	0.93
Specialist consultations (⩾1)						
Primary	1.12	1.18	1.06	1.08	1.12	1.04
Higher	0.92	0.88	0.96	1.06	1.10	1.03
Use of prescribed medicines						
Primary	1.29	1.47	1.14	1.41	1.68	1.19
Higher	0.79	0.70	0.89	0.78	0.69	0.88
Hospital admissions (⩾1)						
Primary	1.28	1.45	1.13	1.19	1.29	1.09
Higher	0.79	0.70	0.89	0.87	0.82	0.94

in the prevalence of ill-health and health care utilization are predicted. These decreases are considerable for perceived general health and chronic conditions, but relatively small for the other outcomes, especially among men. When both the aging and the increase in educational level are taken into account, we still see increases in ill-health and health care utilization among men for most outcomes. However these increases are markedly smaller than in the case where only age is taken into account. For instance, with regard to the prevalence of less-than-good perceived general health, in stead of increasing from 21.0 to 24.2% between 1996 and 2020 when only age is taken into account, the prevalence increases from 21.0 to 21.9% when also educational level is taken into account. Thus, for perceived general health the predicted increase when also educational level is taken into account is only 23% of the increase predicted when only age is taken into account ($100 \times (21.9 - 21.0)/24.2 - 21.0$). The comparable percentages of additionally taking educational level into account compared to taking only age into account for chronic conditions, long-term disabilities, general practitioner consultations, specialist consultations, use of prescription medicine, and hospital admissions are 79, 25, 68, 90, 58, and 75%, respectively. Among women these percentages are 74%, 78%, and 60% for chronic conditions, specialist consultations, and hospital admissions, while additionally taking educational level into account for the other outcomes even causes predictions of lower prevalences in 2020 than in 1996.

Table 4 shows the predicted prevalences of ill-health and health care utilization in 2020 according to the three scenarios. In the divergent scenario the predicted prevalences of ill-health and health care utilization are generally lower and in the convergent scenario higher than the prevalences of the stable scenario. In the divergent scenario it is assumed that, in the future, people with a high educational level will be healthier than they are at present, while people with a lower educational level will have more health problems than they have today. Since the number of people with a higher educational level will increase and the number of people with a lower educational level will decrease, the divergent scenario predicts a healthier population than the stable scenario. The divergent and convergent scenario predict prevalences which deviate markedly from the predictions of the stable scenario for perceived general health and for chronic conditions, but which deviate to a lesser extent for the other outcome variables. In general, both when diverging and converging trends by educational level are assumed, taking changes in educational level in the population into account in the projections predicts lower prevalences than taking only aging of the population into account (see also Table 3). Taking changes in educational level into account has larger effects on the predicted prevalences among women than among men, has larger consequences for the indicators of health than for the indicators of health care utilization, has especially large effects for perceived general health and long-term disabilities, but only minor effects with regard to specialist consultations.

5. Discussion

Among Dutch men the expected increases in ill-health in the period 1996–2020, which can be expected to result from

Table 3
Projected prevalences of ill-health and health care utilization between 1996 and 2020 for men and women taking into account only the aging of the population, only the increase in educational level of the population, and both the aging and increase in educational level of the population[a]

	Men			Women		
Health, year	Age	Educational level	Age + educational level (%)	Age	Educational level	Age + educational level (%)
Perceived general health (less-than-good)						
1996	21.0	21.0	21.0	25.3	25.3	25.3
2010	23.0	19.8	21.5	26.8	23.6	24.8
2020	24.2	19.3	21.9 (23)	27.0	22.7	24.8 (−29)
Chronic conditions (≥1)						
1996	45.0	45.0	45.0	54.7	54.7	54.7
2010	47.4	44.6	46.9	56.3	54.1	55.8
2020	48.8	44.4	48.0 (79)	57.8	53.9	57.0 (74)
Long-term disabilities (≥1)						
1996	12.3	12.3	12.3	18.7	18.7	18.7
2010	14.1	11.2	12.7	20.4	16.8	18.2
2020	15.1	10.7	13.0 (25)	21.9	15.8	18.2 (−16)
General practitioner consultations (≥1)						
1996	30.3	30.3	30.3	43.6	43.6	43.6
2010	31.7	30.0	31.2	43.7	43.0	43.1
2020	32.8	29.8	32.0 (68)	44.4	42.8	43.4 (−25)
Specialist consultations (≥1)						
1996	15.4	15.4	15.4	20.1	20.1	20.1
2010	16.5	15.3	16.3	20.5	20.0	20.4
2020	17.5	15.2	17.3 (90)	21.0	20.0	20.8 (78)
Use of prescribed medicines						
1996	11.8	11.8	11.8	16.5	16.5	16.5
2010	12.5	11.6	12.2	16.8	15.8	16.0
2020	13.0	11.4	12.5 (58)	17.2	15.5	16.0 (−71)
Hospital admissions (≥1)						
1996	7.4	7.4	7.4	8.4	8.4	8.4
2010	8.0	7.3	7.8	8.6	8.2	8.4
2020	8.6	7.2	8.3 (75)	8.9	8.1	8.7 (60)

[a]In brackets, the predicted increase when taking both aging and educational level into account as percentage of the predicted increase when only taking aging into account.

the aging of the population, to a large extent might be counteracted by the increase in the educational level. The effects of educational level on the projections of health care utilization are much smaller. Among women the increase in educational level might even nullify the effect of the aging of the population on most outcome measures. Assuming either divergent or convergent trends in health and health care utilization by educational level alters the degree to which the effects of aging are counteracted. However, both in the converging and the diverging scenario the predicted prevalences remain substantially lower than the projections in which only aging is taken into account.

The differences in health and health care utilization by educational level are smaller for women than for men. However, since the increase in educational level among women is much larger than the increase among men in the coming 25 years, taking educational level into account in the projections has larger consequences for women than for men. Although women have almost caught up with men in 2020 with regard to educational level, the predicted prevalences

Table 4
Projected prevalences of ill-health and health care utilization in 2020 for men and women taking into account the aging of the population and assuming successively that the health differences by educational level will diverge, remain stable, and converge

	Men			Women		
	Divergence	Stable	Convergence	Divergence	Stable	Convergence
Perceived general health (less-than-good)	21.4	21.9	22.7	24.4	24.8	25.4
Chronic conditions (≥1)	47.4	48.0	48.6	56.7	57.0	57.3
Long-term disabilities (≥1)	13.0	13.0	13.3	18.3	18.2	18.4
General practitioner consultations (≥1)	31.8	32.0	32.2	43.2	43.4	43.6
Specialist consultations (≥1)	17.2	17.3	17.3	20.7	20.8	20.9
Use of prescribed medicines	12.3	12.5	12.7	15.8	16.0	16.2
Hospital admissions (≥1)	8.3	8.3	8.3	8.7	8.7	8.7

of ill-health and health care utilization of women remain larger than the prevalences of men in 2020, though the difference is smaller than in 1996.

With regard to the interpretation of the results several issues concerning the data and the underlying assumptions on the relationship between educational level and health outcomes should be kept in mind. There are two issues relating to the projections of the population by educational level. Firstly, the predictions of educational level for the younger birth cohorts are more speculative than those for the older birth cohorts. Since the predicted prevalences of ill-health and health care utilization are predominantly based on the prevalences of the older birth cohorts, imprecisions in the projections of the educational level of the younger birth cohort will only have minor consequences for the predicted prevalence of ill-health and health care utilization in the total population. Also, in the projections of educational level of the Dutch population increases in educational level are only assumed among male and female birth cohorts born before 1951 and 1976, respectively. By 1996 the majority of people in birth cohorts for whom increases in educational level are predicted have already ended their educational career. This means that the projected increase in educational level, on which the results of this study are based, is not a speculative event which still has to happen, but an occurrence which already is rooted in the past.

A second issue regarding the projections of the population is that neither the projections of educational level of the CPB nor our extension of this projection to the older birth cohorts did allow for differential mortality by educational level. People with a higher educational level have been shown to have a longer life expectancy than people with a lower educational level. If this differential mortality by educational level would have been taken into account, the projections of educational level would have shown an even higher increase in educational level in the older age groups. In that case the predicted prevalences of ill-health and health care utilization in which both age and educational level are taken into account would have compared even more favorably to the predicted prevalences in which only aging is taken into consideration. On the other hand, a side effect of allowing for differential mortality by educational level would be an increase in the predicted aging of the population, which would have an opposite effect on the predicted prevalences (i.e., larger prevalences of ill-health and health care utilization would have been predicted).

Next, there are three issues relating to the quality and characteristics of the Netherlands Health Interview Survey, which may have affected our results. Fistly, the HIS is confined to the non-institutionalized population. The institutionalized population constitutes only a small part of the total Dutch population (1.6% of the total population in 1997), and not all inhabitiants of institutions remain there for health reasons (e.g., people in religious institutions and in prison). However, the proportion of institutionalized people does increase sharply with age, from 0.7% in the 25–29 age group through 1.2% in the 65–69 age group to 14% in the 80–84 age group [25]. Confinement of estimations of health differences by educational level to the non-institutionalized population might have biased our projections, if rates of institutionalization differ systematically by educational level and health. Unfortunately, we were unable to find any data on the relationship between educational level, health and risk of institutionalization. However, it seems likely that there will be systematic differences by educational level and it seems more likely that these diffences will cause an underestimation of the health differences by educational level than an overestimation. Since people with a low education have more health problems than people with a high education relatively more people with a low education will be institutionalized than with a high education. Additionally, unhealthy people with a high education will, in general, have more resources which enable them to postpone institutionalization for a longer period than people with a lower education with comparable health problems (e.g., employ a housekeeper). Thus, institutionalization might have affected the estimations for the oldest age groups, but will most likely have resulted in an underestimation of the health differences by educational level.

Secondly, the data on differences in health and health care utilization are self-reported. The effects of educational level on the projections of ill-health and health care utilization could be biased if there are systematic differences in answering of the questions by educational level. More specifically, the effect of educational level on the projections would have been overestimated if there is a tendency among lower educated people to overreport their health problems and medical consumption and/or if there is an inclination among higher educated people to underreport their health problems and use of health care facilities. There is some evidence indicating that systematic differences in answering questions on ill-health by educational level might be expected. Neuroticism—a personality trait referring to the tendency to experience negative, distressing emotions which is associated with reporting ill-health—is more common among people with a lower than a higher educational level. Neuroticism was not measured in the data we used to estimate the health differences by educational level, data of the HIS. However, it has been shown that although control for neuroticism will decrease estimations of health differences by educational level, these decreases are relatively small [26]. This would mean that in our projections the effect of educational level is slightly overestimated. It has on the other hand been found that people with a lower educational level are more inclined to underreport chronic conditions [27,28], which would have an opposite effect.

Thirdly, for GP and specialist consultation a recall of two months is used, which might seem rather long, especially for the older age groups, and thus might be susceptible to underreporting. Unfortunately, there have been no studies in which data of the HIS on health care utilization have been checked against medical records. However, the questions on

health care utilization in the HIS were quite elaborate, which might to some extent have overcome the problem of underreporting. People were first asked how often they had consulted their GP or a medicial specialist during the past 2 months. Subsequently, those who answered that they had not consulted their GP or a specialist were asked when they had consulted their GP or a specialist for the last time. Those who answered that they had consulted their GP or a specialist were asked the dates of their subsequent consultations, the reason for each consultation and a number of other questions. Furthermore, in the analyses we have focussed on whether the GP or medical specialist was consulted in the previous period of two months in stead of on the number of consultations in that period. In the former memory effects are believed hardly to play a role [11]. Finally, with regard to our study any underreporting of health care utilization would only have affected our results if there were systematic differences in underreporting by educational level. If there have been systematic differences in the underreporting due to memory effects, it seems more likely that underreporting was higher among people with a lower educational level than among people with a higher educational level, which would cause an underestimation of the differences in health care utilization by educational level.

There finally are several issues concerning the assumptions made on the relationship between educational level and health outcomes. Health differences by educational level could be the result from social causation processes (higher educational level causes good health or a less rapid deterioration of health) or from health selection (healthy people are more likely to reach higher educational levels). Increase in the educational level of the population will only produce lower prevalences of ill-health and health care utilization in so far as the association between educational level and the outcome variables are based on social causation effects of educational level and not on health selection effects. Several studies have shown that the association between socio-economic status and health, and especially between educational level and health, are predominantly the result of social causation effects and only to a small extent based on selection effects [29–31]. Theoretically, removal of the selection effects from the health differences by educational level would have meant that smaller health differences should have been used in the projections than those that were used in the stable scenario. Thus, allowing for the fact that selection effects might account for a small part of the health differences by educational level, the predicted prevalences might be somewhat higher than those predicted in the stable scenario.

Secondly, in estimations of health differences by educational level there is often adjustment for the confounding effects of other socio-demographic variables such as marital status and degree of urbanization. Predictions based on estimations of differences by educational level in which we adjusted for marital status and degree of urbanization hardly differed from those based on estimations of the differences by educational level without adjustment for these socio-demographic variables (results not shown).

Finally, the effect of education on health probably reflects the fact that the attainment of high educational levels endows people with a number of intellectual and similar resources, such as increased knowledge, the ability to benefit from new information, and a sense of mastery and control over one's own life. These resources may help people to better avoid exposure to risk factors for disease. In addition to this direct causal effect of educational level on health, there may be other mechanisms. Perhaps most importantly, people with a high education have better chances to gain a high income and to secure for themselves a comfortable standard of living. If there is a strong direct effect of education on health, an increase in educational levels may be expected to contribute to a better health of the future populations. The expectations for the future are less clear, however, if the effect of education on health is mainly via material standards of living. In that case rising educational levels can have a substantial effect on national health only if they are accompanied by rising national living standards. In the past the national income has risen more quickly than the educational level of the population. Even if the national income would not increase as fast as the educational level in the future, relative differences in income by educational level will remain to exist. Furthermore, we also made scenarios in which the differences in health and health care utilization by educational level were adjusted for equivalent household income (resuls not shown). Adjustment for equivalent household income generates predicted prevalences of ill-health which are higher than those of the stable scenario, but which still compare favorably to those in which only aging is taken into account: after adjustment for equivalent household income there still remains 70–80% of the favourable effects of educational level. With regard to the indicators of health care utilization, the predicted prevalences hardly deviated from those of stable scenario (thus 100% of the favorable effects of educational level remains).

In summary, taking into account the possibility of health selection effects or focusing on the health effects of educational level which do not involve income differences, would result in smaller effects of educational level, i.e., the projections of the stable scenario would have been closer to the projections in which only the aging of the population is taken into account. On the other hand, taking the non-institutionalized population into account, would result in larger effects of educational level, i.e., more favorable projections of health and health care utilization. Additionally, taking the self-reported character of the data into account or allowing for differential mortality by educational level would also have altered the predictions, but these alterations could work in either a favorable of unfavourable direction. The effects of these methodological issues will partly neutralize each other, however, the net effect is difficult to predict, but will likely remain within the boundaries provided by the divergent and convergent scenario.

To conclude, the expected increases in ill-health, and to a lesser extent of health care utilization, in the period 1996–2020, which are assumed to result from the aging of the population, to a large extent might be counteracted by the increase in the educational level of the Dutch population. This outcome will also hold when substantial increases and decreases in the differences by educational level are allowed for in this period, and when it is assumed that the increase in education level will not go hand in hand with a comparable increase in national income. We recommend that in projections of the prevalence of ill-health and the need for health care facilities, besides the ageing of the population, also changes in educational level are taken into account. Comparable differences in health and health care utilization by educational level have been reported for other Western countries. Additionally, to a somewhat larger or lesser extent increases in educational level can also be foreseen for other Western countries. Therefore it is likely that also in other Western countries taking educational level into account will produce more favorable prospects of the future health of the population than can be expected solely on the basis of aging.

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