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Twenty years of socio-economic inequalities in type 2 diabetes mellitus prevalence in Spain, 1987–2006

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Background: To analyse trends in socio-economic inequalities in the prevalence of diabetes among men and women aged $\geq$35 years in Spain during the period 1987–2006. **Methods:** We analysed trends in the age-standardized prevalence of self-reported diabetes and obesity in relation to level of education using data from the Spanish National Health Survey for the years 1987, 1993, 1995, 1997, 2001, 2003 and 2006 (86 345 individuals aged $\geq$35 years). To assess the relationship between education level and diabetes and obesity, we computed the Slope Index of Inequality and the Relative Index of Inequality (RII) for each year. Additional models were fit to take into account mediator variables in socio-economic position (SEP) diabetes inequalities. **Results:** The prevalence of self-reported diabetes was higher among persons of low educational level, increasing more rapidly over time among people with lower education level (5.0–12.6% in men, and 8.4–13.1% in women between 1987 and 2006) than among those with higher education level (6.3–8.7% in men and 3.8–4.0% in women). Relative inequalities showed a weak tendency to increase. In women, the RII of self-reported diabetes increased from 3.04 (1.95–4.74) in 1987 to 4.28 (2.98–6.13) in 2006, while in men were constant since 1993. Trends in SEP inequalities in diabetes prevalence were attenuated when mediator variables were taken into account in women but not in men. **Conclusion:** SEP inequalities in diabetes existed >20 years ago and have increased, especially among women. These patterns may be explained by trends in health behaviours and obesity, but only to a limited extent.

Introduction

Diabetes has become an important worldwide health problem due to its high prevalence and associated mortality rate. In Europe in 2000, 6.5% and 5.1% of all deaths among men and women, respectively, were due to diabetes.[1] Moreover, the global burden of diabetes is expected to increase from 171.2 to 366.2 million cases between 2000 and 2030 (2.8–4.4% of total population).[2]

Several European studies have observed health inequalities related to socio-economic position (SEP),[3] and individuals with low SEP or who live in deprived areas have higher Type 2 Diabetes Mellitus (T2DM) incidence, prevalence, and mortality.[4–6] Further, it has been reported the variation in the magnitude of these inequalities between different regions of Europe.[4–6]

Icks *et al.*[7] and Imkampe *et al.*[8] examined trends in SEP inequalities in T2DM and observed an increase in inequality among Germans during the 1990s, and a similar increase among English women but not men in the period 1994–2006. The authors argue that these trends are driven by SEP-related differences in obesity, health behaviours or improvements in diagnosis. While, these studies have described trends in SEP inequalities in T2DM in central and northern Europe, no similar work has been reported for southern European countries, which generally have different social characteristics. For example, south European countries have higher prevalence of obesity and higher prevalence of diabetes as well as different diet patterns and other lifestyles, such as less physical activity.[9,10]

At the beginning of the 21st century, Spain was one of the European countries with the largest inequalities in obesity and in T2DM in women.[11] Since the prevalence of T2DM is increasing,[12] it is important to understand how trends in inequality in T2DM prevalence can be expected to develop. As a complement studies performed in northern Europe, we report on trends in inequalities in Spain. Especially because of differences in lifestyles in southern European countries,[9,13,14] such a trend study may help to better understand an European overview of the trends in SEP-related inequalities in T2DM. Therefore, the aim of this study was to analyse trends in SEP-related inequalities in the prevalence of T2DM in Spanish men and women aged ≥35 years during the period 1987–2006.

Methods

Design, study population and information sources

We used a trend design analysing seven versions of the Spanish National Health Survey (NHS). NHS is a nationally representative survey of the Spanish population, which aims to provide data about nation's health; the prevalence of specific health conditions and the prevalence of risk factors for disease. The study population consists of non-institutionalized men and women living in Spain in the years of the surveys. Subjects were selected by means of a stratified multi-stage sampling strategy and the information was collected through personal interviews in the subjects' homes. More information about the methodology used in these surveys is described in detail elsewhere.[15] In this study, we used data from seven different NHS over 20 years (1987, 1993, 1995, 1997, 2001, 2003 and 2006). A subsample of people aged ≥35 years was taken (individuals <35 years old were excluded because diabetes is less frequent and type 1 diabetes represents a higher proportion of cases at young ages). Due to their relatively small sample sizes, data from the 1995 and 1997 surveys were analysed jointly; this approach is valid since these surveys used the same methodology and sampling scheme.[15] Survey sample sizes were 17 855 individuals in 1987, 13 025 in 1993, 7851 in 1995–97, 13 593 in 2001, 14 208 in 2003, 19 813 in 2006.

Variables

Dependent

Diabetes and obesity were examined as dependent variables. T2DM status was self-reported, based on the question 'Has your doctor told you that you have diabetes?'. The same question was used in each NHS, except for 2006, when the diabetes-related question was 'Have you had diabetes ever in your life?' Individuals with body mass index (BMI, computed from self-reported height and weight) $\geq 30\,kg/m^2$ were considered to be obese.

Independent

The main independent variable, education level (as an indicator of SEP), was determined on the basis of the reclassification of national educational schemes into three categories according to the International Standard Classification of Education (ISCED): no formal education (ISCED 1), primary education (ISCED 2) and secondary or higher education (ISCED 3-4-5-6). Data for educational level was missing in 0.6% of subjects.

Age was analysed as a potential confounding variable, and a series of further variables were included in the analysis as possible mediators of the relationship between diabetes and SEP[4]: for the 1993–2006 surveys, these variables were smoking (daily, non-daily, former or never smoker), workplace physical activity (measured using a Likert scale ranging from 1 to 4 corresponding to less and more effort) and leisure time physical activity (regular or not); for the 2001–06 surveys the frequency of vegetable and sweet consumption (daily, ≥3 times, 1–2 times or less than once per week, or never). All these variables were self-reported using the same question in each year.

Data analysis

All analyses were performed separately for men and women. Sampling weights derived from the sample design were used in all calculations.[15]

The age-standardized prevalence of T2DM and obesity was calculated for each survey year and each educational level using the direct method[16] with the 2006 survey population as the reference population. The Slope Index of Inequality (SII) and the Relative Index of Inequality (RII) were used to quantify socio-economic inequalities in T2DM and obesity.[17] These can be interpreted as the ratio and absolute difference, respectively, in prevalence at the extremes of the spectrum of SEP (highest compared with lowest). The association between T2DM and obesity and educational level for each survey year was calculated using a robust Poisson regression model. Educational level was introduced as a continuous variable with values for each educational level corresponding to the cumulative proportion of its population, so the variable ranges between 0 and 1. The RII corresponds to the exponent of the coefficient of the term for educational term derived from the regression model. The SII was derived form the RII and the overall prevalence rate (PR) using the following formula:[18]

$$\mathrm{SII} = \frac{2 \cdot \mathrm{PR} \cdot (\mathrm{RII} - 1)}{(\mathrm{RII} + 1)}$$

where PR is the overall prevalence rate and RII is the Relative Index of Inequality.

Finally, to examine how the RII of T2DM changed according to the possible mediator variables, we fit multivariate robust Poisson regression models, adjusted for possible mediator variables. BMI was entered in the model as a quadratic factor. We checked for effect modification between education and each possible mediator variables including the interaction term in the robust Poisson regression models for each year.

Results

Trends in characteristics of the Spanish sample between 1987 and 2006 are shown in table 1. We observed an increase in the proportion of men and women aged >65 years from 19.9% and 23.4% in 1987 to 24.4% and 30.1%, respectively, in 2006. The proportion of men and women aged ≥35 years without formal education decreased from 39.5% and 53.7% in 1987 to 12.3% and 18.6%, respectively, by 2006. We also observed changes in the lifestyle and dietary habits during the study period: the proportion of daily smokers decreased among men but increased slightly among women; other unhealthy behaviours, such as sweet food consumption have increased while healthy behaviours, such as leisure time physical activity and vegetable consumption increased or remained stable; finally, the proportions of men and women whose work involves little physical activity increased from 34.1% and 26.3% in 1993 to 37.9% and 28.7% in 2006, respectively.

Men with lower SEP and women with higher SEP smoke more. Smoking increased over time in women with primary or no formal education [percentage of daily smokers increased from 9.6% and 5.1% (1993) to 18.6% and 19.4% in women with primary and no formal education, respectively] but decreased in women with at least

Table 1 Study sample stratified by independent variables (total number of cases and column percentages) by year of survey

	Men						Women					
	1987	1993	1995–97	2001	2003	2006	1987	1993	1995–97	2001	2003	2006
Number of cases	8312	6099	3672	6390	6751	9477	9543	6926	4179	7203	7457	10 336
Diabetes												
Yes	4.8	5.2	6.4	8.0	8.4	9.4	7.0	7.7	8.5	8.7	8.9	8.5
Obesity												
Yes	9.4	12.0	14.7	15.2	16.8	19.1	12.5	14.6	17.6	19.6	17.7	18.9
Age group (years)												
35–64	80.1	78.6	76.8	73.7	75.0	75.6	76.6	74.4	71.6	69.2	69.1	69.9
>65	19.9	21.3	23.2	26.3	25.0	24.4	23.4	25.6	28.4	30.8	30.9	30.1
Educational level												
No formal education	39.5	19.1	19.5	15.8	15.0	12.3	53.7	29.0	25.2	22.2	21.0	18.6
Primary	36.4	53.2	51.7	52.5	57.1	51.0	33.8	55.1	56.5	55.9	57.4	53.8
Secondary or higher	23.1	27.2	28.1	31.4	28.0	36.7	11.6	15.0	17.7	21.7	21.6	27.6
Smoking												
Daily smoker	–	41.6	40.6	36.9	32.5	30.1	–	11.3	13.8	17.4	17.3	17.8
Non-daily smoker	–	3.5	2.7	2.6	2.9	2.6	–	2.0	1.2	1.4	1.6	1.8
Former smoker	–	28.6	32.1	34.2	34.4	37.9	–	4.5	6.2	8.8	11.2	13.5
Never smoker	–	25.6	24.5	26.0	30.2	29.4	–	81.3	78.7	72.2	69.9	66.9
Physical activity in work place												
Little effort	–	34.1	35.7	35.5	35.6	37.9	–	26.3	22.0	25.3	28.6	28.7
Physical activity in the leisure time												
Yes	–	42.9	52.7	53.8	59.8	60.2	–	31.0	43.5	46.2	63.5	57.1
Vegetables consumption												
Never or almost never	–	–	–	1.5	2.6	1.7	–	–	–	0.5	0.8	0.7
Sweets consumption												
Every day	–	–	–	28.7	30.0	31.4	–	–	–	30.7	30.0	33.7

The categories do not sum 100% because of their missing values. Men and women ≥35 years.

Table 2 Age-adjusted prevalence (%) of each health behaviour in each educational level by year of Survey

	Men					Women				
	1993	1995–97	2001	2003	2006	1993	1995–97	2001	2003	2006
Daily smokers (%)										
No formal education	41.8	41.5	43.3	37.9	39.8*	5.1	9.7	9.5	12.8	19.4**
Primary	40.3	41.4	36.9	33.2	31.0**	9.6	12.4	17.0	18.1	18.6**
Secondary or higher	38.9	36.1	33.2	27.1	25.9**	23.5	25.9	24.0	21.1	21.3**
Who undertake little work time physical activity (%)										
No formal education	30.7	30.6	29.3	31.7	27.4*	31.1	22.6	22.9	25.3	25.9**
Primary	29.8	30.8	29.7	29.5	30.8	23.6	18.2	21.1	21.6	22.4
Secondary or higher	45.3	46.9	45.0	48.7	51.0**	29.6	26.0	29.6	38.3	34.7**
Who undertake little leisure time physical activity (%)										
No formal education	69.8	59.3	59.6	24.1	52.0**	81.2	71.8	67.0	23.3	51.2**
Primary	57.7	51.2	50.1	37.9	41.2**	68.3	56.5	54.0	37.4	41.4**
Secondary or higher	53.0	34.0	31.2	54.4	27.9**	48.4	38.4	40.0	45.5	33.7**
Who eat vegetables less than once per week (%)										
No formal education	–	–	12.1	12.0	11.4	–	–	9.5	9.3	3.7
Primary	–	–	6.2	7.1	5.4**	–	–	2.5	2.5	2.4*
Secondary or higher	–	–	3.9	5.0	3.0	–	–	1.7	1.7	1.5
Who eat sweet foods every day (%)										
No formal education	–	–	25.1	31.5	39.3	–	–	27.2	28.3	35.0
Primary	–	–	28.8	29.7	33.0**	–	–	32.1	29.8	35.3**
Secondary or higher	–	–	31.2	30.3	30.3**	–	–	29.6	30.9	33.5**

The categories not sum 100% because of their missing values. Men and women ≥35 years
*Trend $P > 0.05$, **trend $P < 0.01$

secondary level education (from 23.5% in 1993 to 21.3% in 2006). People with higher SEP undertook more leisure time physical activity, while the percentage of people doing less physical activity decreased over time irrespective of education levels, although a greater decrease was observed in people without a formal education. While consumption of sweet foods in 1987 was greatest among people with higher SEP, we observe a significant increase over time in sweet food consumption in people with no formal education, while levels of consumption of this type of food remained stable over time (table 2).

Trends in RII, SII and age-standardized prevalence of T2DM for each educational level are shown in table 3. In 2006, T2DM prevalence was higher among people without a formal education (men: 12.6, 95% CI 10.4–15.4; women: 13.1 95% CI 11.3–15.3) than among those with at least a secondary education (men: 8.7, 95% CI 7.4–10.2; women: 4.0, 95% CI 3.0–5.4). Moreover, this inequality has increased over time, with RII for T2DM increasing from 0.91 (95% CI 0.56–1.50) and 3.04 (95% CI 1.95–4.74) in men and women, respectively, in 1987 to 1.45 (95% CI 1.01–2.09) and 4.28 (95% CI 2.98–6.13), respectively, in 2006. During this period, the greatest inequalities in T2DM were observed in 2003, with a slight decrease in 2006. A similar pattern of results was observed for obesity (table 3). Among men, the magnitude of inequality in obesity was quite similar to that observed for T2DM, while the social gradient among

Table 3 Age-standardized prevalence of T2DM/obesity (%) and association of education level with T2DM/obesity prevalence (Relative Index of Inequalities (RII) and Slope Index of Inequalities (SII) and their 95% CI) by year of Survey

Educational level / year	1987	1993	1995–97	2001	2003	2006
Diabetes—Men						
No formal education % (95% CI)	5.0 (4.2–5.8)	6.6 (5.1–8.6)	6.9 (5.1–10.3)	10.9 (8.7–14.4)	14.0 (11.4–17.1)	12.6 (10.4–15.4)
Primary % (95% CI)	5.5 (4.6–6.6)	6.0 (5.1–7.0)	7.5 (6.2–9.0)	8.4 (7.4–9.5)	8.8 (7.9–9.9)	10.1 (9.3–11.1)
Secondary higher % (95% CI)	6.3 (4.7–8.3)	3.5 (2.4–5.1)	4.4 (2.8–6.7)	7.0 (5.3–9.0)	6.1 (4.8–7.7)	8.7 (7.4–10.2)
RII (95% CI)**	0.91 (0.56–1.50)	1.93 (1.19–3.14)	1.91 (1.18–3.08)	2.05 (1.38–3.05)	2.19 (1.43–3.36)	1.45 (1.01–2.09)
SII (95% CI)	−0.45 (−2.71 to 1.92)	3.30 (0.91–5.38)	4.00 (1.06–6.53)	5.51 (2.55–8.10)	6.27 (2.97–9.09)	3.45 (0.09–12.91)
Diabetes—Women						
No formal education % (95% CI)	8.4 (7.7–9.3)	11.8 (10.3–13.7)	12.5 (10.2–16.0)	12.7 (10.9–15.5)	14.9 (12.9–17.4)	13.1 (11.3–15.3)
Primary % (95% CI)	6.0 (5.0–7.1)	6.3 (5.5–7.3)	7.0 (6.0–8.1)	7.0 (6.3–7.9)	7.5 (6.7–8.3)	7.5 (6.8–8.2)
Secondary higher % (95% CI)	3.8 (2.2–6.2)	2.9 (1.5–5.3)	2.3 (1.0–4.5)	3.5 (2.1–5.5)	2.2 (1.1–4.0)	4.0 (3.0–5.4)
RII (95% CI)**	3.04 (1.95–4.74)	4.89 (3.22–7.43)	5.17 (3.37–7.92)	6.09 (4.18–8.85)	7.54 (5.09–11.16)	4.28 (2.98–6.13)
SII (95% CI)	7.07 (4.51–9.12)	10.17 (8.10–11.75)	11.49 (9.22–13.19)	11.76 (9.44–13.50)	13.63 (11.95–14.87)	10.56 (8.46–12.23)
Obesity—Men						
No formal education % (95% CI)	11.1 (9.7–12.5)	13.6 (11.2–16.5)	18.7 (14.3–24.8)	25.5 (19.8–32.8)	20.6 (17.4–24.6)	20.4 (17.0–24.6)
Primary % (95% CI)	10.4 (9.0–11.9)	13.6 (12.3–15.0)	15.1 (13.3–17.2)	15.8 (14.5–17.3)	18.0 (16.6–19.4)	21.0 (19.7–22.4)
Secondary higher % (95% CI)	6.4 (5.0–8.2)	8.0 (6.3–10.1)	11.4 (8.9–14.6)	11.8 (9.9–14.1)	11.4 (9.6–13.5)	16.8 (15.1–18.6)
RII (95% CI)*	1.99 (1.41–2.81)	2.15 (1.56–2.95)	2.14 (1.53–3.00)	2.35 (1.75–3.15)	2.58 (1.94–3.43)	1.66 (1.28–2.14)
SII (95% CI)	6.22 (3.20–8.93)	8.76 (5.25–11.85)	10.67 (6.16–14.70)	12.25 (9.72–16.68)	14.83 (10.74–18.43)	9.62 (4.76–14.09)
Obesity—Women						
No formal education % (95% CI)	17.2 (15.6–18.9)	24.5 (21.1–28.4)	24.7 (20.3–30.5)	36.0 (29.9–43.5)	30.6 (26.8–35.1)	32.6 (28.4–37.4)
Primary % (95% CI)	11.2 (9.6–13.1)	14.4 (13.0–16.0)	18.0 (16.1–20.1)	20.2 (18.7–21.8)	17.4 (16.2–18.7)	19.8 (18.6–21.1)
Secondary higher % (95% CI)	4.8 (3.3–7.2)	4.9 (3.1–7.7)	8.2 (5.5–12.0)	10.1 (7.8–13.0)	8.6 (6.5–11.3)	10.4 (8.8–12.2)
RII (95% CI)*	3.98 (2.78–5.68)	4.77 (3.47–6.57)	4.05 (3.00–5.49)	4.35 (3.37–5.62)	4.99 (3.82–6.51)	4.25 (3.35–5.39)
SII (95% CI)	14.96 (11.77–17.51)	19.08 (16.14–24.49)	21.26 (17.60–24.35)	24.55 (21.26–27.36)	23.71 (20.83–26.12)	23.40 (20.42–25.97)

Men and women $\geq$35 years
*P-value of interaction between SEP and year <0.05; **P-value of interaction between SEP position and year <0.01

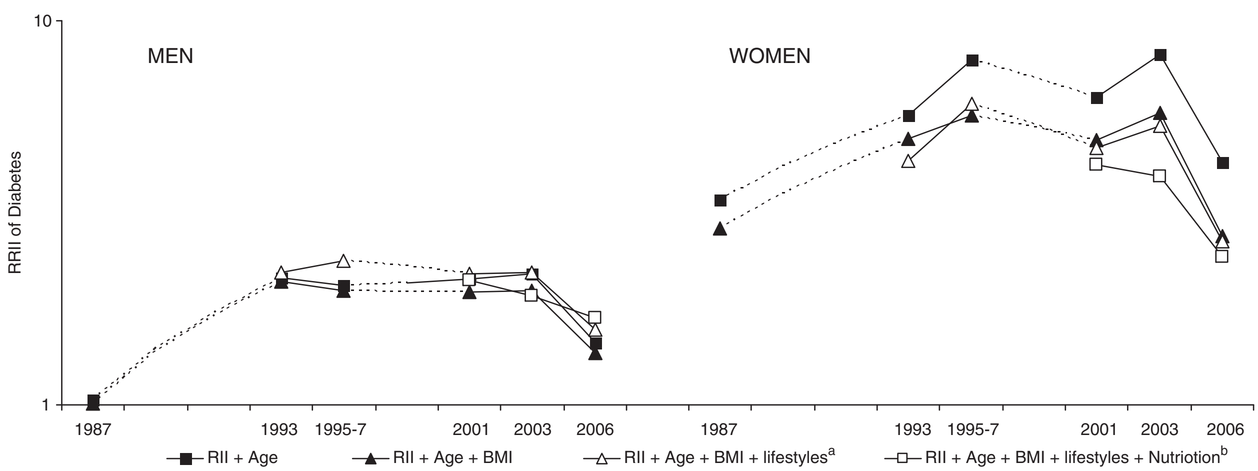

Figure 1 Relative Index of Inequalities (RII) of the association between educational level and T2DM (multivariate log-binomial regression model), models adjusted by possible mediators for year of survey Men and women $\geq$35 years. This analyses includes only individuals not missing in BMI categories [a]Plus smoking status, physical activity at work, physical activity in leisure time: [b]Plus intake vegetables and intake sweet food

women in recent years appears to be larger for T2DM than obesity. Between 1987 and 2006, absolute differences changed concordantly with relative differences. Among men, the SII increased from −0.45 (95% CI −2.71 to 1.92) to 3.45 (95% CI 0.09 to 12.91). Among women, it increased from 7.07 (95% CI 4.51–9.12) to 10.56 (95% CI 8.46–12.23) (table 3).

In 2006, the RII for T2DM among women decreased from 4.28 (95% CI 2.98–6.13) in the age-adjusted model to 2.74 (95% CI 1.78–4.21) after additional adjustment for BMI, and to 2.44 (95% CI 1.60–3.73) after adjustment for age, BMI, lifestyle and diet (figure 1). Using the formula proposed by Brotman *et al.*,[19] BMI, lifestyle and diet, explain 39% of the SEP inequalities in T2DM in women in the year 2006. These risk factors, particularly BMI, explain part of the social differences in the trends observed in inequalities in prevalence of T2DM among women, but not among men. No interactions were found since all the interaction terms between BMI, lifestyle and diet and SEP were not statistically significant ($P > 0.05$).

Discussion

One of the main results of this study is the observation that T2DM prevalence has increased in all educational levels. In general, SEP inequalities in T2DM existed >20 years ago and have increased, especially among women. Since 1993, new inequalities seem to have emerged among men. Moreover, SEP-related inequalities in T2DM prevalence were greater among women than among men throughout the period examined. Among women these relative inequalities and increases were attenuated when BMI and other risk factors were taken into account.

Limitations

A possible limitation of this study is the fact that self-reported data were used as a measure of the prevalence of T2DM. It is well known that health survey respondents report only diagnosed T2DM, which represents between 30% and 50% of total T2DM prevalence.[20,21] However, educational level may not be associated with undiagnosed T2DM[22] and self-reported T2DM in health interview surveys thus seem to be a good instrument to evaluate SEP inequalities in T2DM prevalence.[23] Moreover, since the majority of cases are diagnosed by general practitioners and there were no major inequalities in access in Spain between 1993 and 2006,[24] we do not expect major SEP-related inequalities in diagnosis.

Another limitation could be the fact that the question used to collect data on T2DM status in the 2006 survey was different to that used in previous years. However, estimates of inequalities in T2DM and obesity, and the question used to collect data on the latter, were consistent across all survey years, suggesting that this question did not markedly affect the estimate of inequalities (table 3). Finally, another limitation could be that the confounding effect of obesity may have been underestimated by the fact that weight loss is recommended in people with T2DM. As a result, in the analyses of our data, we may have underestimated the association between obesity and T2DM, and therefore the contribution that obesity makes to inequalities in T2DM. It is worth to mention that although we have considered the risk factors as possible mediators (obesity, BMI, lifestyles and nutrition), some of them may not be part of the causal chain between SEP and T2DM and therefore should be better considered as confounders.[25]

Differences in SEP inequalities in T2DM between men and women

In agreement with previous studies, SEP-related inequalities in T2DM were found in both men and women. As in other European countries, inequalities in T2DM prevalence in Spain are more marked among women than men,[6] as observed for other chronic diseases. It has been suggested that this may be due to corresponding gender differences in health behaviours.[6,8] However, we observed that differences in inequality remain even after adjusting for some of these health behaviours. This may be due to other psychosocial factors, such as power inequalities expressed as stress or work-related factors (overtime, shift-work, tense working conditions, low salaries, etc.).[26,27] In this sense, women with lower SEP have higher prevalence of obesity, lower levels of physical activity and poorer health habits than similar men. This is not the case in higher SEP groups, where domestic responsibilities may be more evenly shared between men and women or may be done by someone else. That implies that women of these groups have more free time (e.g. to do physical or other healthy activities).

Trends in SEP inequalities in T2DM

In this study, SEP inequalities in T2DM in Spain have emerged in men and grown in women since 1987, in agreement with studies carried out in London and Germany.[7,8] In the German study,[7] the increase in T2DM inequalities was due to an increase in the prevalence of T2DM among disadvantaged SEP groups and a decrease among advantaged SEP groups, which could perhaps be attributable to a better adherence to diet and physical activity recommendations in the latter, improvement in treatment options for deprived SEP groups, or better detection of disease among deprived SEP groups.[8] In our study, the increase in T2DM inequalities among women is partly explained by increased obesity-related inequalities, as shown by the multivariate models. Therefore, understanding trends in the inequalities of obesity may help to understand the trends in inequalities in T2DM. During the 20 years of these surveys, changes in the patterns of physical activity, diet and other social behaviours have occurred in the population, and these may influence trends in obesity. In the following sections, we hypothesize how these trends could effect to SEP inequalities in Spain.

Changes in eating behaviours

Changes in the patterns of food consumption may have had different effects according to SEP, with lower SEP groups having more limited access to healthy food. Spain has experienced important socio-economic transitions and consequently dietary changes in the post-dictatorship period. The Spanish diet is now characterized by a very high level of energy intake from fat, increased meat consumption, high fruit consumption and low vegetable consumption.[9] Increasing numbers of people started to eating outside home, and availability of cheap fast-food increased. The frequency of fast-food consumption has been associated with obesity and T2DM.[28] Lower SEP groups tend to have greater fast-food consumption than higher SEP groups.[29] Consumption of healthy foods depends on availability[30] as well as their proximity and variety on offer.[29] Studies carried out in the USA have shown that deprived neighbourhoods tend to have more food stores,[31] which tends to attract more fast-food outlets and convenience stores compared with more advantaged areas, which attract the best restaurants and freshest products.[32] In addition, food purchase choices are partly made on the basis of cost time availability and low-cost foods are generally energy dense and nutrient poor.[31,32]

Changes in physical activity

It should be noted that physical activity is an economic and time cost activity, which creates social inequalities in the use of sports facilities.[32,33] Interventions to promote physical activity should focus on modifiable determinants such as social support or facilities, providing information, behavioural management skills and other resources.[34] Changes in patterns of work and leisure time physical activity may also have different effects according to SEP. Spain has the lowest rate of physical activity in the European Union[10] and physical activity prevalence has been decreasing between 1995 and 2008 because of reduced occupational physical activity,[35] and a lack of compensation through increased leisure time physical activity.[14] Women with deprived SEP have the worst indicators in leisure time physical activity and that may be due to greater domestic responsibilities, poorer health and more financial problems.[36] In our study, we found that inequalities in physical activity among women are constant throughout the study period. So the increase in SEP inequalities in T2DM can not be explained by changes in physical activity. For this reason, more studies focused on this issue are needed.

Changes in social structure

In Spain, changes in social structure and rapid changes in the distribution of education levels may perhaps contribute to the greater increase in T2DM inequalities observed among women than among men. Between 1987 and 1993, inequalities among Spanish women increased more than among men for some common chronic illness, including T2DM.[37] During this period, women have entered the educational system.[13] Therefore, since low educational level probably reflects a lower SEP in 2006 than in 1987, women with a low level of education are becoming an increasingly marginal population,[38] and this might contribute to our finding of worse health behaviours from 1993 to 2006 among women with a lower level of education.

Changes in mortality

Since, increases in T2DM prevalence in developed countries have been found to be mainly due to decreases in mortality,[12] changes in mortality among people with diabetes could play an additional role. Borrell *et al.*[39] found that inequalities in T2DM mortality between 1992 and 2003 tended to increase among men and decrease among women, although these trends were not statistically significant. A decrease in inequalities in women mortality over time might result in an increase in inequalities in the prevalence of T2DM. The reduction in SEP-related inequalities in T2DM mortality in women since 1987 is partly due to improved access and use healthcare services among women of lower SEP.[24]

Conclusions

SEP inequalities in T2DM existed >20 years ago and have increased, especially among women. These trends could be partly explained by inequalities in obesity conditioned by a combination of changes in eating behaviours, physical activity or patterns of mortality. Underlying these changes are far-reaching transitions that Spain has experienced since 1975.

The American Diabetes Association's recommendations for prevention of T2DM are healthy eating habits and physical activity (http://www.diabetes.org/). However, programmes to reduce social inequalities need to go further and focus on structural changes such as personal contexts, and social environments, and have to take personal situation into account.[40,41] The results of this study suggest that the socio-economic inequalities in T2DM and obesity among Spanish women, which are now greater than in other European countries, have existed for >20 years.

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Conflicts of interest: None declared.

Key points

What is already known on this subject

- SEP inequalities in the prevalence of T2DM are present throughout Europe.
- In Germany as well in the UK, SEP inequalities in the prevalence of T2DM have been rising in recent years.

What this study adds

- In Spain, a country in Southern Europe, T2DM prevalence has increased during the past 20 years in all educational levels.
- SEP inequalities in T2DM exist and have increased during this period, especially among women.
- In women, BMI and other risk factors explain part of the SEP inequalities in the prevalence of T2DM and account for part of the increase in these inequalities.

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Trends in educational inequalities in mortality, seven types of cancers, Norway 1971–2002

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Background: Knowledge about educational disparities in deaths from specific cancer sites is incomplete. Even more scant is information about time trends in educational patterns in specific cancer mortality. This study examines educational inequalities in Norway 1971–2002 for mortality in lung and larynx, colorectal, stomach, melanoma, prostate, breast and cervix uteri cancer. **Methods:** A data file encompassing all Norwegian inhabitants registered some time during 1971–2002 while aged 45–74 was constructed with linked information from administrative registers. During an exposure of more than 40 millions person-years, about 87 000 deaths in the analysed cancer types were registered. Absolute and relative inequalities during three periods were analysed by age-standardized deaths rates, hazard regression odds ratios and Relative Index of Inequality. **Results:** Educational inequalities in lung and related cancer mortality widened considerably from the 1970s to the 1990s for both sexes. The moderate educational gradient for stomach and cervix uteri cancer persisted, as did the weak gradient for colorectal cancer. No educational differences in prostate cancer were observed in any of the time periods. The modest inverse educational gradients in deaths from breast cancer and melanoma remained at the same level. **Conclusion:** Among the seven cancer types examined in this study, only lung cancer mortality showed a clear widening in educational disparities. As lung cancer mortality constitutes a large proportion of all cancer deaths, this increase may result in larger disparities for overall cancer mortality. Some explanations for the observed patterns in cancer mortality are suggested.

Introduction

Cancers cause a large proportion of the premature deaths in Europe,[1] and cancers contribute to the patterns of socio-economic mortality inequalities, but in intricate and partly contradictory ways. Mortality from lung cancer in particular, but also from stomach and (among women) cervix uteri cancer have been found to be higher among low-educated persons.[2–5] Mortality in breast cancer, a major cause of death among middle-aged women, is on the other hand usually found to be higher among the highly educated.[2–4,6] Moreover, the socio-economic and educational gradient varies in several ways. Social differences in male lung cancer mortality appear large in Central and Eastern Europe and considerable in the Nordic countries. In several South European countries, however, studies have found a reversed educational gradient in women's lung cancer mortality.[3,4,7,8] The educational gap in alcohol-related cancers seems on the other hand clearly larger in some South European countries than in North Europe.[9] Adding all cancer deaths, educational disparities in overall cancer mortality during the 1990s among men were substantial in the North and West of Europe and even larger in Central and Eastern Europe,[3] but in Slovenia and some Spanish provinces, overall cancer mortality among women was actually higher among the highly educated.[2–4]

A further addition to these complexities is that the socio-economic gradient changes over time, but not necessarily in a uniform manner. Increasing socio-economic disparities in lung cancer mortality have been observed in the USA,[10] France,[11] Norway[12] and Australia,[13] but not in Finland 1981–95[14] nor in Barcelona 1992–2003.[15] As for breast cancer, a levelling off as regards the previous higher mortality among highly educated women has been observed in Finland[16] and France.[17] Among French men, increasing occupational inequalities occurred in mortality from upper aerodigestive tract cancers.[11] A study from Barcelona found, on the other hand, only small changes over time in educational inequalities in mortality for a number of cancer sites.[15] Several studies have suggested that socio-economic disparities in overall cancer mortality are on the increase,[10,13,18,19] but a recent study from The Netherlands found actually a narrowing socio-economic gap in overall cancer incidence during 1996–2008.[20]

All in all, few studies have analysed how socio-economic inequalities in cancer mortality have evolved in recent decades. The aim of the present study is to increase knowledge about developments in educational inequalities in mortality from specific cancer sites. In Norway, overall