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Gender differences in the socioeconomic gradient in self-reported diabetes: Does health service access play a role?

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ABSTRACT

Aims: To investigate the hypothesis that gender difference in the socioeconomic gradient of self-reported diabetes might be partially determined by a detection bias: among low SEP men, but not women, a less frequent use of medical care would result in lower diabetes detection and awareness.

Methods: We conducted a cross-sectional analysis of 2387 (57.1% women) Brazilian university non-faculty civil servants. We quantified the association between educational attainment (a marker of socioeconomic position) and self-reported diabetes through gender-specific logistic regression models adjusting for age. Health insurance coverage (a marker of potential health care access) and never having had serum cholesterol tested (a marker of actual care access) were analyzed to investigate the role of detection bias.

Results: Compared to participants with college education or higher, the adjusted odds ratio (OR) and 95% confidence interval for diabetes for those with less than high school was 2.5 (1.0–6.5) in men and 5.0 (2.1–11.7) in women. Only among men we observed an increment in this OR after an additional adjustment for markers of care access [men 3.5 (1.3–9.1); women 4.9 (1.9–12.1)].

Conclusions: Our findings suggest that health service access may explain some of the gender difference in the socioeconomic gradient of self-reported diabetes.

1. Introduction

An inverse association between low socioeconomic position [SEP] and both prevalent [1–7] and incident [8,9] type 2 diabetes has been shown for women but not men [1,3,4,6–8]. The reasons for this putative effect modification by gender remain unclear, but it has been suggested [6] that it might be explained by gender differences in the association between SEP and several established risk factors for type 2 diabetes, such as obesity, physical inactivity, and unhealthy diet.

Many studies reporting gender differences in the inverse association between SEP and diabetes assessed diabetes status through questionnaires [4,8] or community diabetes registries [7], and thus only evaluated already diagnosed diabetes. Since low SEP is associated with a lower usage of health care [10–14] and so is male gender [12–16], we investigated an alternative hypothesis that such differences might result from a detection

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bias: among low SEP men, but not women, a less frequent use of medical care would result in lower diabetes detection and awareness.

The main objective of this study was to explore the role of health service access in explaining gender differences in the inverse association between socioeconomic position and self-reported history of physician-diagnosed diabetes.

2. Materials and methods

2.1. Study population

Our subjects were 3054 participants aged 30 or older in two stages of baseline data collection (1999–2001) of a cohort study (the Pró-Saúde Study) of non-faculty civil servants at a university in Rio de Janeiro, Brazil. The current analyses excluded pregnant women ($N = 22$), and those with missing data on diabetes status ($N = 96$), educational level ($N = 61$), or other covariates ($N = 478$). The study population comprised 2387 participants (1033 men and 1364 women). This study was approved by the University's Research Ethics Committee.

2.2. Measures

Except for current weight, height and waist circumference, data were collected through a multidimensional self-administered questionnaire. Diabetes status was assessed from the following questions: ''Has a doctor ever informed you that you had or have <diabetes> (yes/no)'' and ''What was your age at the time when the doctor told you for the first time that you had or have <diabetes>?''. For the present analysis we chose educational level (ranked as less than high school, high school and college or higher) as an indicator of SEP.

Health insurance coverage (a marker of potential health care access) and never had serum cholesterol tested (a marker of actual care access) were analyzed to examine the role of detection bias. Among the available data, having had serum cholesterol tested was chosen as a proxy for the possibility of having ever had blood glucose levels measured since it also represents a blood test. In our study population, the employees were not covered by a group health insurance provided by the university. Individuals have to buy their own coverage or obtained it under a spouse's or parent's plan.

Other covariates were: age, gender, leisure-time physical inactivity (LPTI) at age 20 (rarely or never exercising), body mass index (BMI) at age 20 (based on height at study entry and self-reported recall of weight at age 20), current BMI, and waist circumference. Current weight, height and waist circumference were measured according to standardized methods.

2.3. Data analysis

Descriptive analyses for all variables were stratified by gender and educational attainment. Differences by gender were determined by chi-square tests. Differences by educational attainment in each gender were determined by chi-square tests for trend. We calculated crude and age-adjusted prevalence of self-reported history of physician-diagnosed diabetes and the associated 95% confidence intervals (CI) stratified by educational level and gender.

We estimated the association between educational attainment and self-reported diabetes through gender-specific logistic regression models adjusting sequentially for: (1) age; (2) health insurance coverage and never having had serum cholesterol tested. In addition to comparing gender-specific estimates, we also fit a single logistic regression model with education–sex product term to formally test for statistical interaction. Analyses were performed using Stata 8.0/SE [17].

3. Results

Among the 2387 participants, 1364 (57.1%) were women. Professionals (which included professionals or other high-ranked employees such as doctors and managers) comprised 26% of the study population equally among males and females; routine non-manual workers (which had a large proportion of registered nurses and administrative clerical and information technology staff) and manual workers (janitors, cooks, security personnel, or other similar jobs) were, respectively, 58% and 71% of males, and 16% and 3% of female participants.

Characteristics of the study sample, stratified by gender and educational level, are listed in Table 1. An inverse relationship between educational attainment and all established risk factors for diabetes was observed among women ($p < 0.001$ for all variables), whereas among men the gradient was less pronounced (LPTI – current and at age 20 – $p = 0.05$ and 0.024, respectively) or absent (remaining risk factors). Women were more likely than man to have health insurance coverage (62.8% *vs* 51.5%; $p < 0.001$) and less likely to never having had a serum cholesterol tested (9.3% *vs* 17.3%; $p < 0.001$). Among the 856 insured women, 34.2% obtained coverage under a spouse's or parent's plan, whereas among the 532 insured men this proportion was 19.4% ($p < 0.001$). A direct association between educational attainment and health insurance coverage was observed for both men and women ($p < 0.001$), whereas for never having had a serum cholesterol tested an inverse association was observed only among men ($p < 0.001$).

There were 44 cases of self-reported history of physician-diagnosed diabetes among 1033 men and 56 among 1473 women. For both men and women the median age at the time diabetes was diagnosed was 42 years (interquartile range: 37–47) of age. The overall age-adjusted prevalence did not differ substantially between men (3.3%, 95% CI 2.3–4.5) and women (2.6%, 95% CI 1.9–3.6).

Table 2 shows an inverse and graded association between educational attainment and self-reported diabetes in both genders, being stronger among women. In a model combining males and females, however, the product term between sex and educational level was not statistically significant (p for interaction = 0.55 and 0.44, respectively, for high school and college education or higher).

Compared to participants with college education or higher, the age-adjusted odds ratio (OR) for self-reported diabetes for those with less than high school was 2.5 (95% CI 1.0–6.4) among men; among women, the OR was 5.0 (95% CI 2.0–11.7) (Table 3, model 1). Only among men we did observe an increment in

Table 1 – Risk factors for diabetes and markers of health care access and utilization by gender and educational attainment.

Characteristic	Men (N = 1033)[a]			Women (N = 1033)[b]		
	Less than high school (N = 254)	High school (N = 389)	College or higher (N = 390)	Less than high school higher (N = 216)	High school (N = 462)	College or higher school (N = 686)
Age years—median (interquartile range)	45 (41–52)	41 (36–45)	38 (34–43)	48 (44–55)	42 (37–47)	40 (36–45)
Body mass index at age 20 (%)						
Underweight (<18.5)	16.5	10.3	9.2	20.8	21.2	17.4
Normal (18.5–24.9)	71.7	77.6	75.9	68.5	70.6	77.8
Overweight/obesity (>25)	11.8	12.1	14.9	10.7	8.2	4.8
Body mass index (%)						
Underweight/normal (<24.9)	38.2	36.2	44.6	34.3	45.2	61.1
Overweight (25.0–29.9)	46.0	43.2	40.3	32.9	32.5	28.9
Obesity (class 1) (30.0–34.9)	14.2	16.2	11.5	19.9	13.4	7.1
Obesity (class 2 or 3) (≥35)	1.6	4.4	3.6	12.9	8.9	2.9
Waist circumference (cm) (%)						
<80 (W)/<94 (M)	42.9	45.5	50.5	15.3	22.7	35.1
80–87.9 (W)/94–101.9 (M)	33.5	27.0	27.7	23.6	29.0	32.7
≥88 (W)/≥102 (M)	23.6	27.5	21.8	61.1	48.3	32.2
Leisure-time physical inactivity at age 20 (%)	16.5	7.7	10.0	67.1	52.2	34.4
Leisure-time physical inactivity (%)	59.1	52.7	47.7	71.3	70.1	53.8
Covered by health insurance (%)	34.7	44.5	69.5	27.8	53.9	79.7
Never having had serum cholesterol tested (%)	26.4	17.0	11.8	9.7	10.2	8.6

Pró-Saúde Study, Rio de Janeiro, Brazil, 1999–2001.

[a] chi-square trend across educational levels—$p = 0.23$ for overweight/obesity at age 20; $p = 0.63$ for current obesity; $p = 0.45$ for waist circumference ≥ 102; $p = 0.024$ for current leisure-time physical inactivity (LTPI); $p = 0.005$ for LTPI at age 20; $p < 0.001$ for covered by health insurance and never having had cholesterol tested.

[b] chi-square trend across educational levels—$p < 0.001$ for overweight/obesity age 20, current obesity, waist circumference ≥ 88, current LTPI, LTPI at age 20 and covered by health insurance; $p = 0.46$ for never having had cholesterol tested.

Table 2 – Prevalence (%) of self-reported history of physician-diagnosed diabetes according to gender and educational attainment.

	N	Cases	Prevalence (%)	
			Unadjusted (95% CI)	Age-adjusted (95% CI)
Men				
Less than high school	254	22	8.6 (5.8–12.1)	4.5 (2.6–7.9)
High school	389	15	3.8 (1.9–5.8)	3.5 (2.1–5.8)
College or higher	390	7	1.8 (0.5–3.1)	1.8 (0.8–3.8)
Women				
Less than high school	216	23	10.6 (6.5–14.8)	6.1 (3.5–10.4)
High school	462	19	4.1 (2.3–5.9)	3.6 (2.3–5.7)
College or higher	686	9	1.3 (0.5–2.1)	1.3 (0.7–2.5)

Pró-Saúde Study, Rio de Janeiro, Brazil, 1999–2001.

Table 3 – Association between education attainment and self-reported history of physician-diagnosed diabetes according to gender.

	College or higher	High school OR (95% CI)	Less than High school OR (95% CI)
Men (N = 1033)			
Model 1—age	(reference)	1.9 (0.8–4.9)	2.5 (1.0–6.4)
Model 2—age + health insurance coverage + never having had serum cholesterol tested		2.3 (0.9–6.5)	3.5 (1.3–9.1)
Women (N = 1364)			
Model 1—age	(reference)	2.9 (1.3–6.5)	5.0 (2.1–11.7)
Model 2—age + health insurance coverage + never having had serum cholesterol tested		2.9 (1.3–6.5)	4.9 (1.9–12.1)

Pró-Saúde Study, Rio de Janeiro, Brazil, 1999–2001.

these ORs after an additional adjustment for markers of potential and actual access to care (OR = 3.5, 95% CI 1.3–9.1) (Table 3, model 2).

4. Discussion

In our study, we observed a stronger inverse association in women than in men between education and self-reported history of physician-diagnosed diabetes, in line with previous studies using the same case definition [4,7,8]. A steeper socioeconomic gradient for woman compared to men was also described for coronary heart disease [18], obesity [19] and metabolic syndrome [20]. However, gender differences in social inequalities in health vary according to life stage and health outcome [21], as well as the choice of socioeconomic indicator [19] and inequality measure [22].

The gender difference was somewhat reduced when we adjusted for markers of health care access. This finding suggests that gender differences in the association between SEP and self-reported diabetes in studies based on already diagnosed cases are at least partially due to a detection bias.

Such results were to some extent expected. First, a direct association between female gender and outpatient visit rates has been consistently shown both in Brazil [11,12] and in more industrialized countries [14,15]. Pregnancy and childbirth events and a larger number of chronic conditions are pointed out as reasons for the higher utilization of health services by women [14]. Moreover, it has been suggested that women value health more than men and believe more strongly that medical care is effective [14]. Second, although the Brazilian health system is supposed to provide universal care, the existence of a multi-tiered system yields access barriers to lower SEP population. Indeed, studies carried out in Brazil showed a direct association between SEP and the likelihood of consulting a physician [11,12]. Similar results were reported in other countries [13].

In our study, the likelihood of being covered by health insurance increased with educational attainment. Women were more likely than men to be insured in all educational levels. Brazilian national data also shows a higher proportion of women insured when compared to men [23]. Similar results were observed in the USA [24,25], where income was reported to be associated with health insurance coverage for both men and women, whereas being employed full time was reported as a predictor of insurance coverage only among women [25]. We did not study the reasons for not being insured in our study population. However, a higher proportion of coverage obtained under a spouse's or parent's plan among women than in men might explain part of the gender differences in insurance coverage observed in our study.

Although a detection bias can lead to the overestimation of the gender difference in the SEP–diabetes association, this might be a real phenomenon. In fact, studies based on cases identified by means of blood tests [1,3,6] also showed the gender difference detected in this study. Possible explanations may include gender differences in the pathways connecting SEP and diabetes. For example, in agreement with previous studies [6,26] we observed that educational attainment was inversely associated with major risk factors for diabetes [body

composition and physical inactivity] among women, whereas among men the gradient was less pronounced or absent.

The importance of incorporating gender issues in health planning has been increasingly recognized [26]. Moreover, gender analysis has been shifted from a focus in women's health to analysis that seek to better understand factors which affect both women and men's health [27]. Our findings support the hypothesis that among low SEP men, but not women, a less frequent use of medical care would result in lower diabetes detection and awareness. Lack of recent physician visits predicted a longer delay time to physician diagnosis of diabetes in the ARIC study [28]. The American Diabetes Association recommends testing for type 2 diabetes in asymptomatic adults within the health care setting, where both discussion of abnormal results and follow up can be carried out. Tests should be repeated at 3-year intervals, beginning at any age for individuals who are overweight and present additional risk factors (e.g. hypertension, first-degree relative with diabetes), and after 45 years of age for those without risk factors [29]. Improving use of health care is, therefore, a fundamental requirement for the success of this opportunistic screening strategy. Regarding men, this is especially true since their less frequent use of health care services is recognized [11,12,14,15,25]. A more thorough understanding of the reasons that explain gender differences in socioeconomic gradient in access and use of health care might be obtained trough qualitative research.

Some limitations of this study should be mentioned. First, because of its cross-sectional nature, it can be argued that belonging to a low SEP group could be a result of the impact of diabetes on SEP. However, this is unlikely to be an important problem in the present analysis, because the study population comprised only public employees with stable jobs. In addition, we used educational attainment as a marker of SEP, which is usually defined early in life [30], and thus before the onset of the diabetes (in the present analysis, diabetes was diagnosed at a median age of 42 years). Since low SEP is also associated with a worse diabetes prognosis [30], a selective survival bias might have occurred. However, if those low SEP individuals with severe disabling disease were already retired or dead at the time of the study, the association between SEP and diabetes would be attenuated. Because health insurance coverage and access to health care present reciprocal effects on health, the cross-section nature of our study also precludes us from identifying which health care access characteristic had a larger effect on the analysis. Finally, due to sample size limitations in specific socio-demographic strata, we had limited power in formal tests for statistical interaction between gender and education with a product term in the multivariate regression.

Although a previous study [1] has shown that detection bias may explain the heterogeneity by gender in the SEP–diabetes association, to our knowledge this is the first report of empirical evidence suggesting a different impact of health service access on the magnitude of such association in women and men. In addition, work on gender differences in the SEP–diabetes association originated mainly from developed countries. In this respect, Macintyre et al. [31] pointed out that gender differences in health may vary between societies at different stages of economic and industrial development, as well as with cultural differences regarding gender roles.

In conclusion, our data suggest that a detection bias may play a role in explaining gender differences in the socioeconomic gradient in self-reported physician-diagnosed diabetes. More importantly that a methodological artifact, this should be considered evidence of important barriers that may preclude low SEP men to have diabetes diagnosed at an early stage.

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Conflict of interest

There are no conflicts of interest.

REFERENCES

[1] P. Goldenberg, Schenkman Simone, L.J. Franco, Prevalência de diabetes mellitus: diferenças de gêneros e igualdade entre os sexos, Cad Saúde Pública 12 (1996) 37–45.
[2] V. Connolly, N. Unwin, P. Sherriff, R. Bilous, W. Kelly, Diabetes prevalence and socioeconomic status: a population based study showing increased prevalence of type 2 diabetes mellitus in deprived areas, J. Epidemiol. Community Health 54 (2000) 173–177.
[3] J.M. Robbins, V. Vaccarino, H. Zhang, S.V. Kasl, Socioeconomic status and type 2 diabetes in African American and non-Hispanic white women and men: evidence from the third national health and nutrition examination survey, Am. J. Public Health 91 (2001) 76–83.
[4] M. Tang, Y. Chen, D. Krewski, Gender-related differences in the association between socioeconomic status and self-reported diabetes, Int. J. Epidemiol. 32 (2003) 381–385.
[5] E.E. Agardh, A. Ahlbom, T. Andersson, S. Efendic, V. Grill, J. Hallqvist, et al., Explanations of socioeconomic differences in excess risk of type 2 diabetes in Swedish men and women, Diabetes Care 27 (2004) 716–721.
[6] W. Rathmann, B. Haastert, A. Icks, G. Giani, R. Holle, C. Meisinger, et al., Sex differences in the associations of socioeconomic status with undiagnosed diabetes mellitus and impaired glucose tolerance in the elderly population: the KORA Survey 2000, Eur. J. Public Health 15 (2005) 627–633.
[7] I. Larranaga, J.M. Arteagoitia, J.L. Rodriguez, F. Gonzalez, S. Esnaola, J.A. Pinies, The Sentinel Practice Network of the Basque Country Socio-economic inequalities in the prevalence of Type 2 diabetes, cardiovascular risk factors and chronic diabetic complications in the Basque Country, Spain Diabet. Med. 22 (2005) 1047–1053.
[8] J.M. Robbins, V. Vaccarino, H. Zhang, S.V. Kasl, Socioeconomic status and diagnosed diabetes incidence, Diabetes Res. Clin. Pract. 68 (2005) 230–236.
[9] S.C. Maty, S.A. Everson-Rose, M.N. Haan, T.E. Raghunathan, G.A. Kaplan, Education, income, occupation, and the 34-year

incidence (1965–1999) of Type 2 diabetes in the Alameda County Study, Int. J. Epidemiol. 34 (2005) 1274–1281.
[10] R.M. Andersen, Revisiting the behavioral model and access to medical care: does it matter? J. Health Soc. Behav. 36 (1995) 1–10.
[11] M.F. Capilheira, I. da Silva dos Santos, Individual factors associated with medical consultation by adults, Rev. Saúde Pública 40 (2006) 436–443.
[12] R. Mendonza-Sassi, J.U. Béria, A.J.D. Barros, Outpatient health service utilization and associated factors: a population-based study, Rev. Saúde Pública 37 (2003) 372–378.
[13] R. Mendonza-Sassi, J.U. Béria, Utilización de los servicios de salud: uma revisión sistemática sobre los factores relacionados, Cad Saúde Pública 17 (2001) 819–832.
[14] L.M. Verbrugge, The twain meet: empirical explanations of sex differences in health and mortality, J. Health Soc. Behav. 30 (1989) 282–304.
[15] J. Keene, X. Li, Age and gender differences in health service utilization, J. Public Health 27 (2005) 74–79.
[16] C.E. Cashin, M. Borowitz, O. Zuess, The gender gap in primary health care resource utilization in Central Asia, Health Policy Plan. 17 (2002) 264–272.
[17] StataCorp, Stata Statistical Software: Release 8.0, Stata Corporation, College Station, TX, 2003.
[18] R.C. Thurston, L.D. Kubzansky, I. Kawachi, L.F. Berkman, Is the association between socioeconomic position and coronary heart disease stronger in women than in men? Am. J. Epidemiol. 162 (2005) 57–65.
[19] J. Wardle, J. Waller, M.J. Jarvis, Sex differences in the association of socioeconomic status with obesity, Am. J. Public Health 9 (2002) 1299–1304.
[20] E.B. Loucks, D.H. Rehkopf, R.C. Thurston, I. Kawachi, Socioeconomic disparities in metabolic syndrome differ by gender: evidence from NHANES III, Ann. Epidemiol. 17 (2007) 19–26.
[21] S. Matthews, O. Manor, C. Power, Social inequalities in health: are there gender differences? Soc. Sci. Med. 49 (1999) 133–142.
[22] C.A. Mustard, J. Etches, Gender differences in socioeconomic inequality in mortality, J. Epidemiol. Community Health 57 (2003) 974–980.
[23] Agência de Saúde Suplementar, Cadernos de Informação de Saúde Suplementar, ANS, Rio de Janeiro, 2006.
[24] C. DeNavas-Walt, B.D. Proctor, J. Smith, U.S. Census Bureau, current population reports, P60-233. Income, poverty, and health insurance coverage in the United States: 2006, U.S Government Printing Office, Washington, DC, 2007.
[25] C. Merzel, Gender differences in health care access indicators in an urban, low-income community, Am. J. Public Health 90 (2000) 909–916.
[26] C. Vlassoff, C. Garcia Moreno, Placing gender at the centre of health programming: challenges and limitations, Soc. Sci. Med. 54 (2002) 1713–1723.
[27] K. Hunt, E. Annandale, Relocating gender and morbidity: examining men's and women's health in contemporary Western societies. Introduction to Special Issue on Gender and Health, Soc. Sci. Med. 48 (1999) 33–48.
[28] T.A. Samuels, D. Cohen, F.L. Brancati, J. Coresh, W.H. Kao, Delayed diagnosis of incident type 2 diabetes mellitus in the ARIC study, Am. J. Manage. Care 12 (2006) 717–724.
[29] American Diabetes Association, Standards of medical care in diabetes—2009, Diabetes Care 32 (Suppl. 1) (2009) S13–61.
[30] A.F. Brown, S.L. Ettner, J. Piette, M. Weinberger, E. Gregg, M.F. Shapiro, et al., Socioeconomic position and health among persons with diabetes mellitus: a conceptual framework and review of the literature, Epidemiol. Rev. 26 (2004) 63–77.
[31] S. Macintyre, K. Hunt, H. Sweeting, Gender differences in health: are things really as simple as they seem? Soc. Sci. Med. 42 (1996) 617–624.