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Prostate cancer screening in Switzerland: 20-year trends and socioeconomic disparities

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ABSTRACT

Background. Despite important controversy in its efficacy, prostate cancer (PCa) screening has become widespread. Important socioeconomic screening disparities have been reported. However, trends in PCa screening and social disparities have not been investigated in Switzerland, a high risk country for PCa. We used data from five waves (from 1992-2012) of the population-based Swiss Health Interview Survey to evaluate trends in PCa screening and its association with socioeconomic indicators.

Methods. We used multivariable Poisson regression to estimate prevalence ratios (PR) and 95% Confidence Intervals (CI) adjusting for demographics, health status, and use of healthcare.

Results. The study included 12,034 men aged ≥50 years (mean age: 63.9). Between 1992 and 2012, ever use of PCa screening increased from 55.3% to 70.0% and its use within the last two years from 32.6% to 42.4% (p-value < 0.05). Income, education, and occupational class were independently associated with PCa screening. PCa screening within the last two years was greater in men with the highest (> $6,000/month) vs. lowest income (≤$2,000) (46.5% vs. 38.7% in 2012, PR for overall period = 1.29, 95%CI: 1.13-1.48). These socioeconomic disparities did not significantly change over time.

Conclusions. This study shows that about half of Swiss men had performed at least one PCa screening. Men belonging to high socioeconomic status are clearly more frequently screened than those less favored. Given the uncertainty of the usefulness of PCa screening, men, including those with high socioeconomic status, should be clearly informed about benefits and harms of PCa screening, in particular, the adverse effect of over-diagnosis and of associated over-treatment.

Introduction

Worldwide, more than 1.1 million cases of prostate cancer (PCa) and 307,000 PCa-related deaths were recorded in 2012, accounting for around 8% of all new cancer cases and 15% in men (Ferlay et al., 2015). In order to reduce PCa mortality, periodic PCa screening by prostate-specific antigen (PSA) has been proposed in the mid 1990's. However, because of conflicting evidence that the potential benefits of screening in reducing mortality may not outweigh the harm of over-diagnosis and the over-treatment of such diagnosis (Ilic et al., 2013; Kim and Andriole, 2015), most organizations including the U.S. Preventive Services Task Force currently recommend against PSA-based screening for prostate cancer. Recent guidelines from the European Association of Urology (2013), the American Urological Association (2013) and the American Cancer Society (2010) emphasize informed-decision making for PCa screening (Heidenreich et al., 2014; Ilic et al., 2013; Wolf et al., 2010). Informed-decision making involves patients considering the pros and cons of screening considering the options together with personal values, and making a decision (Bowen et al., 2011). Several studies including studies from the United States and European countries have shown that men or their physicians/urologists

Abbreviations: BMI, Body mass index; CI, Confidence interval; PCa, Prostate cancer; PSA, Prostate specific antigen; PR, Prevalence ratio; RCT, Randomized clinical trial; SES, Socioeconomic status; SRH, Self-rated health; SHIS, Swiss Health Interview Survey.

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Table 1
Characteristics of the 12,034 men aged 50 years old and older according to the Swiss Health Interview Survey (SHIS) waves (1992 to 2012).

	1992 N = 1371	1997 N = 1353	2002 N = 2846	2007 N = 2764	2012 N = 3700	
Survey participation rates	70.8	68.8	63.9	66.3	53.1	
	N (%)[1]	N (%)[1]	N (%)[1]	N (%)[1]	N (%)[1]	p-Value[2]
Characteristics						
Age (in years)						<0.001
50–59	627(44.5)	532(42.9)	1019(42.8)	950(39.6)	1389(39.6)	
60–69	527(38.7)	452(30.5)	977(30.5)	970(34.1)	1262(32.7)	
70 and older	217(16.9)	369(26.5)	850(26.5)	844(26.4)	1049(27.7)	
Marital status						<0.001
Single	94(3.7)	88(4.2)	250(5.9)	237(5.9)	306(8.5)	
Married and registered partnership	1044(85.6)	1012(83.7)	2037(81.4)	1901(78.2)	2809(72.8)	
Widowed	98(4.7)	123(5.8)	247(5.0)	253(5.4)	188(5.9)	
Divorced, separated, registered partnership dissolved	135(6.0)	130(6.2)	312(7.8)	373(10.4)	397(12.8)	
Education						<0.001
Primary	210(15.0)	194(14.1)	316(11.5)	239(7.6)	397(10.6)	
Secondary	722(52.9)	774(56.6)	1792(63.0)	1526(54.4)	1912(49.9)	
Tertiary	439(32.1)	385(29.3)	738(25.5)	999(38.0)	1391(39.6)	
Household income in $ USD[3]						<0.001
≤2000	382(30.2)	176(12.3)	256(9.7)	225(7.1)	240(6.7)	
2001–4000	531(40.6)	602(46.7)	1224(45.7)	1111(41.1)	1511(40.3)	
4001–6000	284(18.5)	384(28.2)	883(28.5)	802(29.8)	1149(31.5)	
≥6001	174(10.6)	191(12.8)	483(16.0)	626(22.1)	800(21.5)	
Employment status						<0.001
Out of the labor force	573(43.8)	663(46.1)	1516(47.9)	1396(44.6)	1661(43.1)	
Employed/workers	798(56.2)	690(53.9)	1330(52.1)	1368(55.4)	2039(56.9)	
Occupational class (employed/workers only, N = 6225)						0.001
Superior and intermediate professions	349(45.4)	299(43.4)	553(40.7)	623(46.1)	871(43.7)	
Employee, non-manual professions	100(11.2)	73(10.2)	131(9.8)	138(9.9)	193(9.4)	
Independent, artisan	122(14.5)	116(18.0)	285(21.0)	288(19.6)	439(19.8)	
Overseer, qualified worker, skilled worker	227(28.9)	202(28.5)	361(28.6)	319(24.4)	536(27.1)	
Citizenship						<0.001
Swiss	1233(88.1)	1211(87.3)	2598(86.9)	2556(89.5)	3267(86.5)	
Not Swiss	138(11.9)	142(12.7)	248(13.1)	208(10.5)	433(13.5)	
Linguistic area						<0.001
German	964(73.3)	922(75.8)	1985(74.3)	1723(73.7)	2521(73.9)	
French	327(21.3)	331(20.2)	649(21.4)	826(22.1)	900(21.4)	
Italian	80(5.4)	100(4.0)	212(4.3)	215(4.2)	279(4.7)	
Type of urban area of residence						<0.001
Metropolitan	475(35.5)	427(36.1)	793(33.7)	1162(53.2)	1771(52.8)	
Medium size urban	380(26.2)	390(25.0)	838(26.2)	703(22.2)	859(23.4)	
Small size urban	277(22.0)	339(24.1)	667(23.2)	446(11.8)	613(11.7)	
Rural	239(16.3)	197(14.8)	548(17.0)	453(12.8)	457(12.0)	
Health status						
Self-rated health						<0.001
Very bad	10(0.6)	11(1.0)	25(0.9)	16(0.5)	27(0.7)	
Bad	55(3.6)	36(2.3)	96(3.4)	89(2.9)	148(4.0)	
So-so	181(12.6)	168(12.1)	350(12.0)	380(12.2)	673(17.1)	
Good	794(59.0)	807(59.8)	1801(64.5)	1793(66.6)	1774(49.0)	
Very good	331(24.1)	331(24.9)	574(19.1)	486(17.7)	1078(29.2)	
Body mass index						<0.001
Underweight	29(1.9)	30(2.0)	71(2.3)	11(0.5)	20(0.5)	
Normal weight	618(44.7)	558(39.9)	1113(38.4)	1192(43.7)	1399(38.7)	
Overweight	596(44.0)	647(49.8)	1323(47.9)	1251(45.4)	1733(46.4)	
Obesity	128(9.4)	118(8.3)	339(11.4)	310(10.5)	548(14.5)	
Physical symptoms						<0.001
No, a few	640(47.7)	613(47.0)	1413(50.2)	1319(48.3)	2100(56.8)	
Some	431(31.6)	461(33.6)	934(32.3)	919(34.1)	1072(29.1)	
Important	300(20.7)	279(19.3)	499(17.4)	526(17.6)	528(14.2)	
Currently smoking						<0.001
Yes	413(29.5)	373(26.9)	777(28.0)	686(24.4)	826(22.3)	
No	958(70.5)	980(73.1)	2069(72.0)	2078(75.6)	2874(77.7)	
Health services uses						
General practitioner or family doctor visit in the last 12 months						0.004
No	318(24.3)	263(21.1)	556(21.1)	499(19.0)	718(20.0)	
Yes	1053(75.7)	1090(78.9)	2290(78.9)	2265(81.0)	2982(80.0)	
Prostate screening						
Ever screening						<0.001
No	631(44.7)	550(39.9)	1045(37.9)	847(31.2)	1091(30.0)	
Yes	740(55.3)	803(60.1)	1801(62.1)	1917(68.8)	2609(70.0)	
Screening in the last two years						<0.001
No	933(67.4)	886(65.1)	1796(64.0)	1571(57.6)	2080(57.6)	
Yes	438(32.6)	467(34.9)	1050(36.0)	1193(42.4)	1620(42.4)	

Notes to Table 1:
[1] Proportions are weighted.
[2] Pearson chi-square test.
[3] In 1992, 1997 and 2002, 1 CHF = 0.7 USD; in 2007, 1 CHF = 0.8 USD; 2012, 1 CHF = 1.1 USD (source: www.oanda.com).

continue to use PSA testing (Carrasco-Garrido et al., 2014; Dimitrakaki et al., 2009; Drazer et al., 2015; So et al., 2014). In fact, PSA testing increased in the United States between 1992 and 2005, but it then leveled off between 2005–2010 and dropped in 2013 (Drazer et al., 2015). Factors such as age, higher socioeconomic status (SES), being married, and having a usual source of care have been associated with PSA test use (Dimitrakaki et al., 2009; Drazer et al., 2015; Ross et al., 2005). The introduction of PSA screening has resulted in more than 1 million additional men being diagnosed and treated for PCa in the United States, most of this excess incidence being attributable to overdiagnosis (Welch and Albertsen, 2009).

Switzerland presents one of the highest incidence rate of PCa in the world and this cancer is the most frequent cancer among men (Swiss Federal Statistical Office, 2011). There is no national organized PCa screening program but opportunistic PCa is frequent. In particular, a population-based study in Geneva reported that about 60% of physicians and all urologists systematically recommended such screening to their patients aged 50 years and more (Bouchardy et al., 2004). PSA for PCa screening is generally not subsidized by the national health insurance. Similarly to other international organizations, the 2011 Swiss Medical Board recommends against PSA screening for PCa in men without symptoms or without family predisposition for PCa (Swiss Medical Board, 2011). Moreover, in 2014, the Swiss Society of Internal Medicine included PSA-based PCa screening among the top 5 lists of procedures to avoid (smartermedicine.ch) and prior to these formal statements, PCa screening was generally not promoted by Swiss public health organizations.

Temporal patterns of PCa screening by SES in Switzerland have not been investigated, which is of particular interest given that the use of PCa screening has been shown to vary by SES in other developed countries (Carrasco-Garrido et al., 2014; Dimitrakaki et al., 2009; Ross et al., 2007; So et al., 2014; Tabuchi et al., 2015; Weber et al., 2013). In general cancer screening is most frequent among individuals belonging to high SES because of better knowledge and higher access to medical care. Thus, with regards to PCa, we could expect that the use of PCa screening characterized by unclear benefits and potential harms is more frequent in higher socioeconomic group than lower socioeconomic group. This study aims to examine the trends in PCa screening, associations and changes over time of the associations between SES and PCa screening between 1992 and 2012 by analyzing Swiss national population health surveys.

Methods

Survey design

The Swiss Health Interview Survey (SHIS) is a cross-sectional population-based survey repeated every 5 years since 1992 and conducted by the Swiss Federal Statistical Office. It is designed to be representative of all residents' aged 15 years and older living in Switzerland, which are selected at random following a two-stage stratified sampling strategy. The present study included data from 1992 to 2012 waves (overall participation rate: 64.6%; participation rate by waves, see Table 1) and was restricted to respondents aged 50 years and over (N = 16,910). Respondents with missing data on PCa exam use (N = 1123), SES (N = 1322), sociodemographic characteristics (N = 24), specific health statuses (N = 191) and health service use (N = 194) were excluded (online Supplementary Figure S1). The final analytic study population included 12,034 individuals.

Dependent variables

There were two main outcomes: PCa screening in the past two years, and ever receiving PCa screening. For all five waves, men were asked: "Have you ever had a prostate preventive exam?" (yes, no). If a respondent answered yes, additional information was collected about the date of the most recent test. For the last two waves (2007, 2012), respondents had to specify the type of examination (digital rectal exam, PSA, or both) and the reason of the examination (diagnosis, screening, or other).

Independent variables

Four indicators of socioeconomic position were used: income per month (≤$2000, $2001–4000, $4001–$6000, >$6000), education level (primary, secondary, and tertiary), employment (employed *vs.* out of the labor force) and, among employed, the current occupational class (liberal, intermediate, non-manual professions, independent/artisans, overseer/qualified worker, skilled worker) was assessed. Household income was weighted with the number of persons living in the household and the number of children less than 14 years old (to account for the potential expenditures on children by families). In June 2015, 1 US dollar (USD) corresponded to approximately 1 Swiss Franc (CHF). Educational levels codification was close to that of the International Standard Classification of Education 1997 (SaCO., U.N.E, 2014): primary corresponded to compulsory education and lower secondary education (approximately 9 years of education starting at age 4 or 5), secondary education includes additional specialized or vocational training (approximately 1–3 years of additional education), and tertiary included more theory-based and specialized degrees which correspond to bachelors, masters and doctoral degrees (approximately an extra 1–8 years of education). Occupational class was based on the Erikson, Goldthorpe and Portocarero social class scheme (Erikson et al., 1979) which classified occupation based on job duties, setting/environment and management responsibilities.

A full description of the following independent variables is presented in the online Supplementary material. Briefly, sociodemographic characteristics considered were age, marital status, citizenship, and area of residence. We categorized respondents by Swiss speaking-regions (German, French, Italian) as health behaviors may differ across those regions (Ogna et al., 2014). Health status characteristic covariates included self-rated health (SRH), physical symptoms, health service use, smoking and body mass index (BMI).

Statistical analysis

Descriptive statistics of respondents' characteristics were reported using weighted proportions. Weights were used to correct for the complex survey design and non-participation bias. Differences between waves were tested using unweighted chi-square test. Variations in PCa screening were examined using weighted prevalence ratios (PR) and 95% confidence intervals (CI) estimated with unadjusted and adjusted Poisson regression with robust variance estimators. For the main analysis, the models were stratified by year. Adjusted models included the following variables: education, household income, employment status, age, marital status, citizenship, urban/rural status, linguistic areas, self-rated health, BMI, physical symptoms, smoking, and use of health services. For each socioeconomic indicator different coding schemes were examined (education using three to five levels, income as a continuous versus nominal variable, employment in three versus two levels, occupational class in four versus six levels) to check robustness of results and results were similar (data not shown). A test for temporal trend was assessed by adding a survey wave and predictor product terms in the models. Trends were examined for the two PCa screening definitions described above (i.e., ever had prostate exam, prostate exam in the last two years). p Value <0.05 defined statistical significance. Because most tests for temporal trends were not statistically significant, multivariate associations between PCa examination and respondent factors were tested after combining the five survey waves. A model restricted to those employed was conducted to examine the association between occupational class and PCa screening. All analyses were conducted with SPSS 22 and STATA 12. We conducted several additional analyses (including analyses limited to the last two waves, which collected information on the type of examination (digital rectal exam, PSA, or both) and the reason of the examination (diagnosis, screening, or other)) described in the online Supplementary material.

Results

Table 1 presents the characteristics of the respondents according to the waves of the survey. Among the 12,034 respondents included in the analyses, mean age was 63.9 (standard deviation 9.3) years, most were Swiss (weighted proportions, 87.6%), married (79.4%), and had a secondary level of education (55.1%). Respondents' characteristics varied by survey waves.

Overall, the prevalence of ever PCa screening increased from 55.3% in 1992 to 70.0% in 2012 (Table 1) and screening within the last two

years increased from 32.6% to 42.4% during the same time (adjusted p-values < 0.05).

Fig. 1 presents the weighted proportions of men who had a PCa screening within the last 2 years according to the waves of the survey and household income (left side of Fig. 1) or education (right side of Fig. 1). PCa screening in the two last years increased both with time and increasing levels of income or education. The proportion of screened (in the two last years) men was 46.5% in the last wave of 2012 among male population with highest levels of income and 39% among population of highest level of education.

Table 2 presents the weighted proportion of men who had PCa examination within the two years according to the men characteristics and survey waves. The proportion of men with such examination increased with age and survey waves. Lowest rates of examination were generally found among residents in the rural area, or having very bad health, being underweight, and smokers. Corresponding weighted proportion for ever conducting a PCa exam (online Table S1) were similar.

Table 3 presents the adjusted prevalence ratios of PCa examination (last two years and ever) according to men characteristics. In adjusted analyses, the prevalence of a PCa exam in the past two years and ever PCa exam increased by 6% and 5%, respectively.

Household income remained positively associated with PCa exam within the last two years after adjusting for other socioeconomic factors and sociodemographic factors, health status, and health services use. In the overall 1992–2012 period, PCa exam within the last two years was 29% significantly higher for respondents in the highest income category (>$6000) compared to those belonging to the lowest category (≤$2000) (PR: 1.29, 95%CI: 1.13–1.48). Similar results were found for ever PCa exam.

Education but not employment was independently associated with PCa exam within the last two years. Rates of PCa exam within the last two years were higher among respondents with secondary and tertiary levels than primary level. Similar results were found for ever conducting a PCa exam. Of note, in analyses restricted to respondents in the labor force (N = 6225, 52.7% of the sample), independent (PR = 1.13, 95%CI 1.03–1.24), non-manual employee (PR = 1.14, 95%CI 1.03–1.27), and superior professions (PR = 1.16, 95%CI 1.07–1.26) had significantly higher prevalence of ever PCa exam compared to manual professions (online Table S2). These associations were not apparent for PCa within the last two years.

In addition, several demographic characteristics, health status, and health utilization factors were independently associated with PCa exam. In particular, PCa exam prevalence varied by linguistic region and urban area. Compared to their German counterparts, respondents from the Italian-speaking region were more likely to report PCa exam within the last two years, but not PCa exam ever. Rural residence was associated with decreased rates of PCa exam compared to metropolitan residence, for screening within the last two years (PR = 0.80, 95%CI 0.72–0.88) and ever (PR = 0.90, 95%CI 0.85–0.95) (Table 3). Married or in couple respondents had higher prevalence of PCa examination in the past two years and ever PCa testing compared to their single/divorced/widowed counterparts.

Overweight and smoking status were associated with PCa exam (within the last two years and ever), whereas no consistent association was found for self-rated health and physical symptoms with PCa exam except for important physical symptoms, which remained associated with ever PCa exam.

Health services use as measured by visiting a general practitioner in the past 12 months was strongly associated with higher prevalence of PCa exam whether within the last two years (PR = 3.55, 95%CI 3.07–4.10) or ever (PR = 1.49, 95%CI 1.40–1.60).

Associations and trends were similar in analyses restricted to screening reason only and to PSA with or without digital rectal examination (DRE) using waves 2007 and 2012 (Tables 4 and online S3).

Sensitivity analyses

Results were similar in sensitivity analyses restricted to respondents who were never treated for cancer and in models using multiple imputation (data not shown).

Discussion

This study is the first to examine nationwide trends over 20 years of PCa screening in Switzerland. PCa screening prevalence in Switzerland is high compared to other cancer screening (Fedewa et al., 2015) and increased from 1992 to 2012.

Between 1992 and 2012, ever use of PCa screening increased from 55% to 70% and its use within the last 2 years from 33% to 42%. Strong socio-economic disparities exist with men with higher incomes, education, or professional level having higher use of PCa exam. These socioeconomic disparities did not significantly change over time. Prevalence and trends are similar to other developed countries such as Australia and the United States (Drazer et al., 2015; Swan et al., 2003, 2010; Weber et al., 2013). One out of 2 men aged 60 years or more had had a PCa exam within the past two years. This contrasts with the very low prevalence of colorectal cancer screening – which efficacy has been clearly demonstrated – recently reported using the same source population (Fedewa et al., 2015). The rise is striking given the serious debate regarding recommendations and could be, at least in part, attributed to the rapid uptake of PSA (Finney Rutten et al., 2005; Potosky et al., 1995; Scales et al., 2008). Similar high prevalence was found among men who reported having a general practitioner visit in

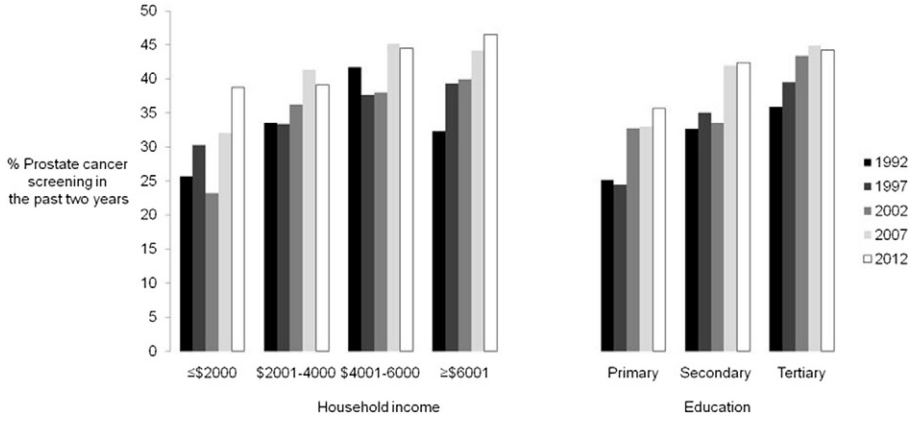

Fig. 1. Weighted proportions of men who had a PCa screening within the last 2 years according to survey waves and household income (left side) or education (right side).

Table 2
Weighted proportions of prostate cancer examination in the past two years among the 12,034 men aged 50 years old and older according to men characteristics and the Swiss Health Interview Survey (SHIS) waves (1992 to 2012).

	1992 N = 1371	1997 N = 1353	2002 N = 2846	2007 N = 2764	2012 N = 3700	p-Value[1]
Characteristics						
Age (in years)						<0.001
50–59	26.0	28.1	30.0	31.4	30.5	
60–69	37.7	39.5	45.6	49.3	51.5	
70 and older	38.2	40.8	34.7	50.0	48.7	
Marital status						<0.001
Single	28.0	20.6	30.5	37.2	32.5	
Married and registered partnership	32.7	35.4	37.0	43.7	44.1	
Widowed	36.3	36.8	34.0	39.2	40.1	
Divorced, separated, registered partnership dissolved	31.0	36.9	31.4	36.9	40.0	
Education						<0.001
Primary	25.2	24.5	32.8	33.0	35.6	
Secondary	32.7	35.1	33.6	42.0	42.4	
Tertiary	35.9	39.5	43.4	44.9	44.2	
Household income in $ USD[2]						<0.001
≤2000	25.7	30.3	23.2	32.1	38.7	
2001–4000	33.6	33.4	36.2	41.3	39.1	
4001–6000	41.7	37.6	38.0	45.1	44.5	
≥6001	32.3	39.3	39.9	44.2	46.5	
Employment status						<0.001
Out of the labor force	37.8	38.3	39.5	50.3	49.2	
Employed/workers	28.6	32.0	32.8	36.1	37.2	
Occupational class (employed/workers only, N = 6225)						0.004
Superior and intermediate professions	32.0	34.7	37.6	36.6	37.7	
Employee, non-manual professions	36.1	27.8	36.7	37.6	40.6	
Independent, artisan	26.5	27.5	29.9	34.8	36.3	
Overseer, qualified worker, skilled worker	21.2	32.4	26.7	35.4	35.9	
Citizenship						0.128
Swiss	33.0	35.1	36.5	42.8	43.6	
Not Swiss	29.3	33.6	32.9	39.2	34.8	
Linguistic area						0.018
German	34.4	36.1	36.0	41.1	40.7	
French	27.9	32.0	36.3	45.9	46.9	
Italian	26.6	27.5	34.4	46.6	48.5	
Type of urban area of residence						<0.001
Metropolitan	34.7	37.3	37.6	43.0	44.5	
Medium size urban	32.6	36.9	34.4	42.1	42.0	
Small size urban	32.6	32.9	34.3	46.0	41.3	
Rural	28.0	28.9	37.7	37.2	35.0	
Health status						
Self-rated health						0.006
Very bad	28.4	18.4	41.9	33.8	32.0	
Bad	31.5	48.0	33.6	38.4	44.1	
So-so	36.3	39.7	30.3	45.9	44.2	
Good	32.4	34.2	36.7	43.2	44.6	
Very good	31.3	33.9	37.4	37.7	37.6	
Body mass index						<0.001
Underweight	8.0	37.4	31.7	58.8	21.4	
Normal weight	34.0	34.7	34.1	41.0	38.8	
Overweight	32.5	34.9	37.9	43.0	45.5	
Obesity	31.6	35.2	35.3	44.6	42.6	
Physical symptoms						0.006
No, a few	29.4	31.1	36.9	40.2	41.1	
Some	34.6	39.1	32.8	42.2	44.4	
Important	37.0	37.1	39.3	48.9	43.2	
Currently smoking						<0.001
Yes	26.9	29.2	31.6	38.7	40.8	
No	35.0	37.0	37.7	43.6	42.8	
Health services uses						
General practitioner or family doctor visit in the last 12 months						<0.001
No	11.9	9.2	10.5	13.7	13.4	
Yes	39.2	41.8	42.9	49.1	49.6	

[1] Pearson chi-square test.
[2] In 1992, 1997 and 2002, 1 CHF = 0.7 USD; in 2007, 1 CHF = 0.8 USD; 2012, 1 CHF = 1.1 USD (source: www.oanda.com).

the last 12 months, suggesting that general practitioners were major facilitators of PCa exam despite the lack of robust evidence on PCa screening efficacy.

In 2009, two major large randomized controlled trials (RCTs) with conflicting results were published (Andriole et al., 2009; Schroder et al., 2009). The efficacy of PCa screening is very controversial and most guidelines around the world, including those from Switzerland, recommend against systematic PSA screening. Similarly to what has been observed in the United States and in Europe (Eisinger et al., 2015), PCa screening in Switzerland seems to have increased

Table 3
Adjusted prevalence ratios for prostate cancer examination among the 12,034 men aged 50 years old and older according to men characteristics and type of examination, the Swiss Health Interview Survey (SHIS) (1992 to 2012).

	1992–2012					
	Prostate cancer examination in the past 2 years			Ever prostate cancer examination		
	PR	95%CI	p-Value for trend[1]	PR	95%CI	p-Value for trend[1]
Characteristics						
Age in years (reference: 50–59)			0.648			0.039
60–69	1.41	1.29–1.53		1.33	1.26–1.39	
70 and older	1.34	1.21–1.48		1.40	1.32–1.49	
Married or in couple (reference: single, divorced, widow)	1.13	1.06–1.21	0.731	1.11	1.06–1.16	0.826
Education (ref. primary)			0.138			0.317
Secondary	1.13	1.02–1.26		1.07	1.00–1.14	
Tertiary	1.14	1.02–1.28		1.08	1.01–1.16	
Household income in $USD[2] (reference: ≤2000)			0.477			0.851
2001–4000	1.08	0.96–1.21		1.11	1.02–1.20	
4001–6000	1.26	1.12–1.43		1.22	1.13–1.33	
≥6001	1.29	1.13–1.48		1.26	1.16–1.38	
Employed (reference: out of labor force)	0.99	0.92–1.07	0.786	0.97	0.92–1.01	0.012
Linguistic area (reference: German)			<0.001			0.005
French	1.09	1.02–1.16		0.96	0.92–1.01	
Italian	1.23	1.12–1.35		0.98	0.92–1.04	
Not Swiss	1.07	0.98–1.17	0.435	1.05	0.99–1.10	0.299
Type of area of residence (reference: Metropolitan)			0.731			0.754
Medium size urban	0.88	0.83–0.95		0.95	0.91–0.99	
Small size urban	0.98	0.91–1.05		1.00	0.96–1.04	
Rural	0.80	0.72–0.88		0.90	0.85–0.95	
Self-rated health (1 very bad to 5 very good)	1.01	0.97–1.06	0.866	1.01	0.98–1.04	0.114
BMI (reference: normal weight)			0.930			0.677
Underweight	0.64	0.46–0.89		0.85	0.70–1.04	
Overweight	1.09	1.02–1.16		1.04	1.01–1.08	
Obesity	1.04	0.95–1.14		1.00	0.94–1.06	
Physical symptoms (reference: No and few)			0.578			0.046
Some	1.01	0.95–1.08		1.02	0.98–1.07	
Important	1.04	0.95–1.13		1.08	1.03–1.14	
Smoking (reference: no)	0.91	0.85–0.98	0.168	0.91	0.87–0.96	0.913
General practitioner or family doctor visits last 12 m (reference: no)	3.55	3.07–4.10	0.962	1.49	1.40–1.60	0.527
Survey waves	1.06	1.03–1.08	–	1.05	1.04–1.06	–

[1] p-Value for time-trend was estimated as follows: for each predictor (age, education, income, etc.), we estimated separately one multivariate model including all predictors plus the interaction term between the predictor and the wave. We reported only the p-value.
[2] In 1992, 1997 and 2002, 1 CHF = 0.7 USD; in 2007, 1 CHF = 0.8 USD; 2012, 1 CHF = 1.1 USD (source: www.oanda.com).

between 1992 until 2007, then leveled off. The impact of the two large RCTs published in 2012 and of the updated PCa screening guidelines needs to be determined in further waves. Of note and contrary to the United States, the impact of Swiss national updated guidelines on PSA test use in Switzerland already appeared to be low (SaCO., U.N.E, 2014).

1992–2012 determinants of PCa screening

In addition and in line with previous reports (Drazer et al., 2011, 2015; Finney Rutten et al., 2005; Fitzpatrick et al., 1998; Hiatt et al., 2002; Ross et al., 2005; Swan et al., 2003, 2010; Weber et al., 2013), practitioner visit in the last 12 months, age, being married or in couple, overweight, and smoking were consistently and independently associated with PCa exam.

Education and income were positively associated with PCa exam. This is in line with previous studies performed in developed countries including Sweden, which also has free health care and no organized PCa screening program (Cullati et al., 2009; Drazer et al., 2011, 2015; Finney Rutten et al., 2005; Hiatt et al., 2002; Karlsen et al., 2013; Morgan et al., 2013; Rapiti et al., 2009; Robinson et al., 1996; Ross et al., 2005; Rundle et al., 2013), although it contrasts with studies conducted in Australia (Weber et al., 2013; Weller et al., 1998). The importance of considering SES when interpreting time trends in PCa exam has been previously emphasized (Liu et al., 2001). Employment status was not associated with PCa screening, which is consistent with other findings (Coughlin et al., 2004; Zapka et al., 2002). Among those employed, we observed greater PCa screening prevalence for respondents with professional jobs relative to those with manual positions. Several mechanisms have been proposed to explain the association of SES and PCa screening. These include greater access to health care facilities, health literacy and health-oriented behavior, fewer transportation barriers, social environment, and cognitive and psychological explanations (Bryere et al., 2014; Fitzpatrick et al., 1998; Rundle et al., 2013; Tobias-Machado et al., 2013; Wardle et al., 2004; Weller et al., 1998). In fact, PSA test seems to play a major role since the relationship of SES and PCa generally observed (Nijs et al., 2000; Scales et al., 2008) was not observed before PSA test was widely available (1990s) (Liu et al., 2001). Switzerland has universal health-insurance coverage, permitting access to a broad range of services. However, individual PCa screening is not officially covered in case of routine examination by a doctor and services may be partially or fully covered depending on whether or not an individual's annual deductible and out of pocket cost is met. Individuals are responsible for a 10% co-payment after their annual deductible, which ranges from 300–2500 CHF, is met. A recent study reports that despite universal health care, 13% of Swiss forgo healthcare for economic reasons and that the proportion of healthcare forgone due to economic reasons among those with lower income (30%) was significantly greater compared to those with the highest income (4%) (Guessous et al., 2012). Thus, in addition to mechanisms listed above, respondents with higher SES could be less likely to forgo PCa screening than respondents with lower SES.

While data on social inequality in screening usually suggests that low SES is a barrier to effective cancer screening (Fedewa et al., 2015;

Table 4
Adjusted prevalence ratios for prostate cancer exam for screening reason only among the 6404 men aged 50 years old and older according to men characteristics and type of screening, the Swiss Health Interview Survey (SHIS) (1992 to 2012).

	2007–2012 N = 6404					
	Screening in the past 2 years			Ever screening		
	PR	95%CI	p-Value for trend[1]	PR	95%CI	p-Value for trend[1]
Characteristics						
Age in years (reference: 50–59)			0.127			0.962
60–69	1.25	1.10–1.42		1.20	1.10–1.31	
70 and older	1.13	0.97–1.32		1.14	1.02–1.27	
Married or in couple (reference: single, divorced, widow)	1.18	1.06–1.32	0.426	1.13	1.05–1.23	0.452
Education (ref. primary)			0.366			0.954
Secondary	1.26	1.05–1.50		1.12	0.98–1.27	
Tertiary	1.13	0.93–1.37		1.07	0.93–1.23	
Household income in $USD[2] (reference: ≤2000)			0.134			0.690
2001–4000	1.20	0.96–1.48		1.15	0.98–1.36	
4001–6000	1.42	1.14–1.78		1.29	1.08–1.53	
≥6001	1.42	1.12–1.80		1.34	1.12–1.60	
Employed (reference: out of labor force)	0.97	0.86–1.09	0.313	0.97	0.89–1.06	0.670
Linguistic area (reference: German)			0.627			0.606
French	1.19	1.07–1.32		1.03	0.95–1.11	
Italian	1.36	1.17–1.59		1.04	0.92–1.16	
Not Swiss	1.13	0.98–1.30	0.723	1.07	0.97–1.19	0.536
Type of area of residence (reference: Metropolitan)			0.963			0.896
Medium size urban	0.82	0.74–0.92		0.92	0.85–0.99	
Small size urban	1.00	0.89–1.13		1.01	0.93–1.09	
Rural	0.77	0.65–0.91		0.84	0.75–0.94	
Self-rated health (1 very bad to 5 very good)	1.12	1.03–1.22	0.357	1.08	1.02–1.15	0.196
BMI (reference: normal weight)			0.286			0.896
Underweight	0.35	0.14–0.87		0.82	0.47–1.42	
Overweight	1.10	0.99–1.21		1.04	0.97–1.12	
Obesity	1.05	0.90–1.21		1.01	0.91–1.13	
Physical symptoms (reference: no and few)			0.953			0.836
Some	0.93	0.83–1.03		0.94	0.87–1.01	
Important	0.89	0.77–1.04		0.94	0.84–1.05	
Smoking (reference: no)	1.01	0.90–1.13	0.968	0.93	0.86–1.01	0.244
General practitioner or family doctor visits last 12 m (reference: no)	3.54	2.90–4.34	0.341	1.41	1.27–1.57	0.875
Survey waves	1.08	0.98–1.19	–	1.09	1.03–1.17	–

[1] The p-value for univariate time-trend was estimated by the interaction between wave (2007 = 0, 2012 = 1) and the predictor, using Poisson regression (dependent variable: uptake of prostate screening, independent variables: the predictor, wave and predictor * wave interaction).
[2] In 1992, 1997 and 2002, 1 CHF = 0.7 USD; in 2007, 1 CHF = 0.8 USD; 2012, 1 CHF = 1.1 USD (source: www.oanda.com).

Guessous et al., 2010; Perneger et al., 2013; Wardle et al., 2004), our results showed that high SES might be a risk factor of potentially harmful cancer screening. Indeed, because PCa screening has not been demonstrated to be beneficial and has, in fact, been demonstrated to be harmful to some, what typically is thought of as protective factor (high SES) is better conceptualized here as a risk factor. PSA testing is more common among high SES men (Nijs et al., 2000; Scales et al., 2008) and this contributes to the evidence that men who have higher SES have higher incidence of PCa but are also more likely to have localized and/or low grade at diagnosis and lower mortality (Rundle et al., 2013). Thus, higher SES may lead to higher medical surveillance and screening, including cancer screening with unclear benefits and clear harms. This should be of particular interest given the increasing trends among those with high SES observed in our study and in others (Aarts et al., 2010). Of note, while a previous analysis showed rapidly increasing rates of PCa screening in men aged 50–74 in France between 2005 and 2008, a more recent analysis of 2011 rates suggest that wealthier populations are currently showing the most noteworthy step backwards (Eisinger et al., 2015). We did not find such trends in 2012 in Switzerland.

Lack of time can be a barrier to cancer screening but contrary to a previous report (Weber et al., 2013), respondents who were out of labor force were not more likely to be screened than their counterparts. Analysis restricted to respondents in labor force showed greater use of PCa exam among respondents with occupation class higher than an overseer, qualified, skilled worker. This further suggests the SES inequality that we observed in the overall study sample.

After adjusting for SES status and other potential confounders, we also found greater PCa exam in urban versus rural areas. This has been found in some (Baade et al., 2011; Coory and Baade, 2005) but not all (Sharp et al., 2014; Weber et al., 2013) previous studies. Geographical differences in PCa exams could potentially be explained by area-level variations in access to health services; urban area being really dense in health services in Switzerland (Berlin et al., 2014). Also, differences in cancer beliefs, attitudes and help-seeking behavior between urban and rural residents have been reported (Sharp et al., 2014).

Limitations and strengths

There are several limitations of our study worth noting. We did not have information on family history of PCa, which may influence PCa screening. Despite efforts to ask respondents in lay language about PCa exam, there may have been misclassification due to respondents not understanding the question or having inaccurate recall. Validation studies of self-reported cancer screening indicate that respondents may overestimate screening, though the degree of PCa screening misclassification is moderate (Rauscher et al., 2008). Additionally, except for the 2007 and 2012 surveys, we were unable to clearly differentiate between digital rectal exam and PSA tests and between screening and disease investigation. Yet, analyses restricted to PSA tests for screening

purpose showed similar results. Income data from the SHIS has not been validated and respondents may have overestimated their income; however, income was weighted by the composition of the household (including living with children less than 14 years). We considered citizenship but lacked information on ethnicity/race which has been associated with PCa exam in more heterogeneous populations such as the United States (Reynolds, 2008). Furthermore, we excluded 2382 respondents due to missing information on screening, sociodemographic, health status, and health service use, which may introduce selection bias though the proportion of respondents excluded due to missing information (8.6%) which is small, and limiting the magnitude of bias. Yet, sensitivity analyzed by imputing missing information yielded similar results. Finally, while we adjusted for multiple potential confounders, we cannot exclude residual confounding.

Clinical and public health impact

Despite the fact that PCa screening is controversial, we found that a large proportion of Swiss men are being tested. In addition to the adverse effects of PCa treatment, harms associated with PCa screening are well established and included anxiety/distress, bleeding and infection related to biopsy, and overdiagnosis that ranged from 23% to 42% of screen-detected cancers (Draisma et al., 2009). Given the potential negative impact of PCa screening at both population and individual-level, the Swiss Society of Internal Medicine included PSA-based PCa screening among the top 5 lists of procedures to avoid (smartermedicine.ch). Furthermore, due to the uncertainty regarding the usefulness of PCa screening, men – including men from high SES – should be clearly informed about the harms and benefits of PCa screening (Wolf et al., 2010). When the evidence that the benefits of screening outweigh the risks is unclear, an individual's values and preferences must be factored into the screening decision. To facilitate informed-decision making, decision aids for PC screening have been developed in other countries. There is a paucity of data on the practice of informed-decision making in Switzerland (Briel et al., 2007; Perneger et al., 2010). Further, no specific decision aids have been developed or piloted in Switzerland, which would be helpful in promoting and facilitating informed-decision making in Switzerland.

Conclusion

This study is the first to examine nationwide trends over time of PCa screening in Switzerland. Socioeconomic disparities, generally characterized by higher SES status being associated with better position to avoid risks and to take advantage of protective factors, are one of the most challenging public health issues (Wardle et al., 2004). While we found that men belonging to high SES status are more frequently exposed to PSA controversial screening, we reported that in 2012 approximately 4 of every 10 lowest income men were screened for PCa in the past two years, while approximately 5 of every 10 highest income men were so screened and therefore exposed to over-diagnosis and over-treatment (Welch and Albertsen, 2009). Therefore and given the uncertainty of the usefulness of PCa screening, all men should be clearly informed about the harms and benefits of PCa screening (Wolf et al., 2010).

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Author contributions

IG, SF, SC, CB, CBJ, OM, DSC were involved in the study design. SC conducted statistical analyses, IG, SF, SC, CB, CBJ, OM, DSC reviewed and were involved in writing the manuscript.

Conflicts of interest

The authors declare that there are no conflicts of interest.

Transparency document

The Transparency document associated with this article can be found, in the online version.

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