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Ten-year changes in colorectal cancer screening in Switzerland: The Swiss Health Interview Survey 2007, 2012 and 2017

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ABSTRACT

Recent recommendations for colorectal cancer (CRC) screening suggest fecal occult blood test (FOBT) or colonoscopy. Since 2013, mandatory health insurance in Switzerland reimburse CRC screening. We set out to determine if CRC testing rate and type of CRC screening changed in Switzerland from 2007 to 2017 and between the three main language regions. We extracted data on 50–75-year-olds from the Swiss Health Interview Survey (SHIS) 2007, 2012 and 2017 to determine rates of self-reported testing with FOBT within last 2 years and colonoscopy within last 10 years. We estimated prevalence ratio (PR) in multivariate-adjusted logistic regression models and compared rates in German-, French- and Italian-speaking regions, adjusting for sociodemographic, self-rated health and insurance variables. Overall testing rates (FOBT or colonoscopy) increased in all regions from 2007 to 2017 (German-speaking 33.6% to 48.3%; French-speaking 30.8% to 48.8%; Italian-speaking 37.9% to 46.8%), mainly because of an increase in colonoscopy rate for screening reasons ($p < 0.001$ in all regions). Rates of FOBT testing fell significantly in the German-speaking region (11.9% to 4.4%, $p < 0.001$), but not in the Italian- (13.9% to 8.5%, $p = 0.052$) and French-speaking regions (7.6% to 7.4%, $p = 0.138$). Overall CRC testing rate rose from 33.2% in 2007 to 48.4% in 2017, mainly because of an increase of colonoscopy rate for screening reasons. Coverage remains below the 65% target of European guidelines. Organized screening programs encouraging FOBT screening could contribute to further increasing the CRC testing rate.

1. Introduction

In Switzerland, colorectal cancer (CRC) is the third highest cause of cancer-related deaths, killing almost 1,700 people per year (Arndt et al., 2016). CRC screening based on either a colonoscopy every ten years or fecal occult blood test (FOBT) every two years can cut mortality in half (Arditi et al., 2009; Bibbins-Domingo et al., 2016; Brenner et al., 2014; Council, 2003; Helsingen et al., 2019; Lauby-Secretan et al., 2018; Meester et al., 2015). CRC screening guidelines issued by the European Commission (EC) in 2012 define an uptake rate of 45% as acceptable, but recommend 65% as a desirable target (von Karsa et al., 2012). CRC mortality is effectively reduced about equally by colonoscopy (Bibbins-Domingo et al., 2016; Brenner et al., 2014) and the less burdensome immunological FOBT (FIT), though FOBT is not as sensitive in detecting adenomas or CRC (Helsingen et al., 2019; Quintero et al., 2012). CRC screening in countries like the US and Switzerland is still mostly based on colonoscopy (Fedewa et al., 2015; McQueen et al., 2009).

"CRC testing" is a general term that includes both screening and diagnostic tests since, in the determination of overall testing rate, it does not matter why a person was tested. CRC testing is underused in Switzerland. Studies using different data sources have shown that the proportion of Swiss people up to date with CRC testing with either colonoscopy or FOBT was 33.6% in 2005, rising to 39.5% in 2012 (Braun et al., 2020; Braun et al., 2019; Fischer et al., 2013; Ulyte et al., 2020). In 2013, health insurance law change and insurances began to reimburse CRC screening by either colonoscopy or FOBT for those in the age group of 50–69 years. Since then, analyses from claims data suggest a steady increase in CRC testing rate in Switzerland, especially for colonoscopy

Abbreviations: FOBT, Fecal occult blood test; CRC, Colorectal Cancer; HDHP, High deductible health plan; LDHP, Low deductible health plan; SHIS, Swiss Health Interview Survey; SFSO, Swiss Federal Statistics Office; CHF, Swiss franc; FIT, fecal immunochemical Test; HMO, Health Maintenance Organisation.

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(Braun et al., 2020). Recent studies based on health insurance claims data showed an increase in the proportions of the population tested for CRC within a 12 month period from 8.1% in 2012 to 9.9% in 2018 (Schneider et al., 2021). Several factors were associated with lower CRC testing: higher deductible health plans (HDHP), younger age (under 60), and basic insurance without private insurance. In Switzerland, people assume the full costs of medical care up to their annual deductible; for HDHP, that is between CHF 1500 and CHF 2500 (approximately same amount in USD). But claims data tends to underestimate the CRC testing rate, particularly FOBT, in the general population (Schneider et al., 2021).

Claims data can be compared to or supplemented with data from survey, though population surveys tend to overestimate the CRC rate (Schneider et al., 2008). Thus, adding survey data to those from claims data helps to capture an overview of the probable true CRC testing rate in the general population. It also enables to monitor changes in CRC testing since 2013 and adapt testing policies. In order to get a better sense of the true CRC testing rate in Switzerland and across language regions and factors associated with it, we need to update the 2007 and 2012 analyses of the Swiss Health Interview Survey (SHIS) with the data collected in 2017 (Braun et al., 2020; Spaeth and Zwahlen, 2013).

We aimed at describing the changes in proportion of the Swiss population up-to-date with CRC testing and methods of testing performed from 2007 to 2017. We further aimed at describing variations in testing rate across language regions and socio-demographics factors associated with CRC testing.

2. Methods

2.1. Data source

Every five years, since 1992, the Swiss Federal Statistics Office (SFSO) conducts a cross-sectional, nationwide, population-based Swiss Health Interview Survey (SHIS). The most recent SHIS was in 2017. The SHIS includes randomly selected participants $\geq$ 15 years old, who live in private households in Switzerland, and first interviews them by telephone and then via questionnaire. The SFSO stratifies the sample by canton and weights the results by region, age, gender, nationality, and household size to represent the whole population of the Switzerland across all linguistic regions. Because the SFSO adheres to the Swiss Federal Statistics Act and collects and anonymizes the data before sharing, we did not require ethical approval for our study under the Swiss Human Research Act.

2.2. Study variables

We analyzed SHIS data from 2007, 2012 and 2017. Our primary outcomes of interest were testing rate for CRC in 2017, change in rates from 2007 to 2017, and differences between linguistic regions. We calculated the FOBT rate within the previous 2 years and the colonoscopy rate (with or without FOBT) within the past 10 years.

We followed the methods described by Braun and al. for extracting the testing rate and covariates in SHIS 2007 and 2012 (Braun et al., 2020). Questions were added to SHIS 2017 to precise the time period between the test and the survey and we included them as described hereafter. The questions "Have you ever had an FOBT?" and "Have you ever had a lower gastrointestinal endoscopy?" were followed by, "What was the date of your last examination (month/year)?" If respondents did not know the exact date of their test, they could select from four time intervals: for FOBT, within 12 months, 1–2 years, 2–5 years, and 5 + years; for lower gastrointestinal endoscopy, within 12 months, 1–5 years, 5–10 years and 10 + years. If respondents gave only a test year, they were asked if they were tested within the same intervals (e.g. within 12 months if they said they were tested in 2016). Based on their answers to these questions, we included in the FOBT group those who had an FOBT within the last 24 months (determined by counting backwards in months from the interview date to the test date), those who said they had been tested within the last 2 years, and those who were tested in 2015 but did not answer the other questions. We included in the colonoscopy group those who reported a lower gastrointestinal endoscopy within the last 120 months, said they had been tested within the last 10 years, or were tested in 2007. For the analysis, the colonoscopy group also included respondents who reported having both tests within the recommended time.

SHIS questions are designed for laypersons and thus do not differentiate between types of lower gastrointestinal endoscopy. We use colonoscopy as a blanket term for lower gastrointestinal endoscopy because colonoscopy is far and away the most common endoscopic CRC screening test in Switzerland. SHIS also does not distinguish guaiac-based FOBT from fecal immunochemical Test (FIT), so we use FOBT for both. SHIS asks respondents if their test was for screening or diagnostic purposes. We combine these self-reports under the blanket term "CRC testing rate" to describe the overall testing rate.

We included respondents to the SHIS aged 50–75 years who completed both the telephone and written part of the SHIS 2007, 2012 and 2017 to avoid missing characteristics of the participants (some of them are only collected during a part of the survey). We excluded participants with missing values for CRC testing from the main analysis.

2.3. Covariates

To adjust our analysis for factors that might influence CRC testing and stratify the results, we extracted data on several sociodemographic, insurance, and health factors, choosing covariates like those of Braun et al. (Braun et al., 2020). The sociodemographic factors we stratified and adjusted for included age, gender, nationality, education, income, canton of residence, and linguistic region. We based level of education on the SFSO categories of primary, secondary, and tertiary. To determine variable income, we divided individual income into four categories: <3000; 3000–4500; 4500–6000; >6000 Swiss Francs (CHF). We adjusted for age (50–69; 60–69; 70–75), gender, nationality (Swiss or foreign), canton of residence, and linguistic region (German, French, Italian). We extracted data about participation in a managed care model and classed family doctor, HMO, and telemedicine under the blanket term HMO). We also adjusted for level of deductible (300; 500, 1000 or 1500; 2000 or 2500 CHF). To assess health conditions, we extracted self-rated health status from the question, "What is your general health status?" (very good; good; moderate; bad; very bad).

2.4. Statistical analyses

We used descriptive statistics to establish baseline characteristics of the study population in each year, then we extracted the weighted percentages of respondents who said they had had a colonoscopy (with or without FOBT) within the past ten years or an FOBT within the past two years. For each SHIS, we determined the testing rate for each strata of covariates: age, gender, nationality, education, income, type of insurance, deductible, and self-reported health status. We used Pearson's Chi-square test to determine the association between categorical variables and then compared the weighted testing rate between linguistic regions and measured the change between each SHIS (2007, 2012 and 2017).

For SHIS 2017, we fitted multivariate-adjusted logistic regression models to estimate the prevalence ratio (PR) of overall CRC testing rate for each covariate (95% CI). We fitted multivariate-adjusted logistic regression models for type of CRC testing (FOBT and colonoscopy) and adjusted the model for all covariates. The baseline category in our models was "no testing".

For our sensitivity analysis, we calculated the testing rate for self-reported "screening" or "diagnostic" test to estimate how much screening methods had changed over time, then fitted a multivariate-adjusted logistic regression model for each type of test for each SHIS.

Since Vaud and Uri cantons introduced an organized program in 2015 and 2013 respectively, we repeated our analysis after excluding the inhabitants of these cantons (data not shown).

The threshold for statistical significance for all analyses was $p < 0.05$. We used STATA 15.1 for all statistical analyses (Stata Corp, College Station, Texas, US).

3. Results

SHIS 2017 included 22,314 respondents: 18,832 completed both parts of the survey (84.4%), and we analyzed data from 8,044 people aged 50–75 years (36.0%). From them, 6 (<0.1%) were excluded and 6,974 (86.7%) were included in the multivariate-adjusted logistic regression. SHIS 2012 included 21,597 respondents: 18,357 completed both parts of the survey (85.0%), and we analyzed data from 7,342 people aged 50–75 years (34.0%). From them, 7 (<0.1%) were excluded and 6,052 (82.4%) were included to the multivariate-adjusted logistic regression. SHIS 2007 included 18,760 respondents: 14,393 completed both parts of the survey (76.7%) and we analyzed data from 5,859 people aged 50–75 years (31.2%). From them, 11 (<0.1%) were excluded and 4,566 (77.9%) were included in the multivariate-adjusted logistic regression. In 2017, 72.9% of those whose data we analyzed lived in the German-speaking regions of Switzerland, 22.5% in the French-speaking regions, and 4.6% in the Italian-speaking region. Most respondents had a low deductible health plan (LDHP; 45.7%). Baseline characteristics of the participants are summarized in Table 1. More detailed description of participants in SHIS 2007 and 2012 were previously described (Braun et al., 2020; Spaeth and Zwahlen, 2013).

Proportion of testing with fecal occult blood test (FOBT) in the past 2 years, colonoscopy in the past 10 years, both test and overall testing rate.

The Fig. 1 describes the change in testing rate from 2007 to 2017, showing an overall CRC testing rate increased, FOBT rate decreased and colonoscopy rate increased. In 2017, the weighted proportions of participants tested for CRC within recommended intervals was 48.4%. Of these, 43.1% had been tested with colonoscopy and 5.2% with only an FOBT; 7.7% had both tests and were included in the colonoscopy group (Supplementary File 1). Weighted adjusted FOBT testing rate in 2017 varied between linguistic regions and colonoscopy rate varied by age and deductible (Supplementary File 1). Between 2007 and 2017, overall and colonoscopy testing rates increased steadily in every region of the Switzerland ($p < 0.001$ for each). FOBT rate first dropped in the French-speaking region from 7.6% (95%CI 6.0% to 9.5%) in 2007 to 5.7% (95% CI 4.6% to 7.1%) in 2012. In 2017 it increased to 7.4% (95%CI 6.2% to 8.8%), but the difference was not statistically significant ($p = 0.073$). FOBT rate decreased between 2007 and 2017 in German- ($p < 0.001$) and Italian-speaking regions ($p = 0.052$) (Fig. 2).

Change in overall (solid line), colonoscopy (dashed line) and FOBT (dotted line) testing rate in the recommended time between German- (purple square) French- (turquoise round) and Italian-speaking (gold triangle) part of the Switzerland.

Our multinomial multivariate-adjusted regression analysis included 6,974 participants who provided information on all covariates in 2017 (Supplementary File 2, Table). We found that living in the French- (PR 1.76, 95%CI 1.35 to 2.30) and Italian-speaking regions of the Switzerland (PR 1.86, 95%CI 1.27 to 2.72) were associated with higher FOBT rate than living in the German-speaking part. The likelihood of having been tested with a colonoscopy did not differ between linguistic regions. Testing rate and type of test were associated with age, self-rated health, insurance type, and deductible levels. Those aged 50–59 had a lower prevalence of all types of CRC testing (overall, screening and diagnostic) and HDHP and basic insurance coverage.

The Table Supplementary File 3 describes the weighted proportions of screening and diagnostic CRC testing in 2007, 2012 and 2017. Diagnostic FOBT rate decreased from 2.2% in 2007 to 1.4%, in 2017 ($p = 0.299$). FOBT screening rate dropped from 9.3% in 2007 to 4.4% in

Table 1
Characteristics of 50–75 years-old respondents, from the Swiss Health Interview Survey 2007, 2012 and 2017.

	2007 N = 5,848 % (95%CI)	2012 N = 7,335 % (95%CI)	2017 N = 8,038 % (95%CI)
Age (years)			
50–59	45.6 (43.9–47.3)	45.5 (44.1–47.0)	46.7 (45.4–48.0)
60–69	38.6 (36.9–40.2)	38.3 (36.9–39.7)	35.5 (34.2–36.7)
70–75	15.9 (14.7–17.0)	16.2 (15.2–17.2)	17.8 (16.9–18.8)
Gender			
Male	48.8 (47.1–50.6)	49.2 (47.8–50.7)	49.5 (48.2–50.8)
Female	51.2 (49.4–52.9)	50.8 (49.3–52.3)	50.5 (49.2–51.8)
Nationality			
Swiss	86.0 (84.3–87.5)	84.2 (82.8–85.4)	82.4 (81.3–83.5)
Non-Swiss	14.0 (12.5–15.7)	15.8 (14.6–17.2)	17.6 (16.5–18.7)
Education			
Primary	19.2 (17.9–20.6)	19.1 (17.8–20.4)	14.7 (13.8–15.7)
Secondary	56.6 (54.9–58.3)	51.7 (50.2–53.1)	52.1 (50.8–53.4)
Tertiary	24.2 (22.7–25.7)	29.3 (28.0–30.6)	33.1 (31.9–34.4)
Income [1]			
<3000 CHF [2]	34.4 (32.8–36.2)	32.7 (31.3–34.1)	32.4 (31.2–33.7)
3000–<4500 CHF [2]	17.6 (16.3–19.0)	19.6 (18.3–20.8)	19.4 (18.4–20.5)
4500–<6000 CHF [2]	15.6 (14.3–17.0)	14.3 (13.3–15.5)	15.8 (14.8–16.8)
> 6000 CHF [2]	32.3 (30.6–34.1)	33.4 (32.0–34.9)	32.4 (31.1–33.6)
Self-rated health			
Very good	17.1 (15.8–18.4)	30.3 (29.0–31.7)	33.1 (31.8–34.3)
Good	65.3 (63.6–66.9)	46.3 (44.9–47.8)	47.2 (45.9–48.5)
Moderate	13.2 (12.1–14.4)	18.4 (17.2–19.6)	14.7 (13.8–15.6)
Bad	3.7 (3.0–4.5)	4.1 (3.5–4.7)	4.1 (3.6–4.6)
Very bad	0.7 (0.5–1.2)	0.9 (0.6–1.2)	1.0 (0.7–1.3)
Deductible			
300 CHF	45.2 (43.4–47.0)	48.2 (46.7–49.7)	45.7 (44.4–47.1)
500/1000/1500 CHF	44.0 (42.3–45.9)	37.5 (36.1–39.0)	32.2 (31.1–33.6)
2000/2500 CHF	10.8 (9.6–12.0)	14.3 (13.2–15.4)	22.0 (20.8–23.1)
Insurance			
Basic	57.8 (56.1–59.5)	65.5 (64.2–66.9)	66.1 (64.9–67.4)
Semi-private	27.8 (26.3–29.4)	24.4 (23.2–25.7)	25.0 (23.8–26.1)
Private	14.4 (13.3–15.6)	10.0 (9.3–10.9)	8.9 (8.2–9.7)
Participation in HMO			
Non-HMO	n/a	58.6 (57.2–60.0)	49.9 (48.6–51.2)

(continued on next page)

Table 1 (*continued*)

	2007 N = 5,848 % (95%CI)	2012 N = 7,335 % (95%CI)	2017 N = 8,038 % (95%CI)
HMO	n/a	41.4 (40.0–42.8)	50.1 (48.8–51.4)
Linguistic region			
German-speaking	72.9 (71.6–74.2)	71.7 (70.7–72.8)	72.9 (72.0–73.8)
French-speaking	22.2 (21.1–23.4)	23.3 (22.3–24.4)	22.5 (21.7–23.4)
Italian-speaking	4.9 (4.4–5.4)	4.9 (4.5–5.4)	4.6 (4.2–4.9)

Note: the percentage are adjusted for all variables in the table. Missing values: **2017**: age = 0, Gender = 0, nationality = 0, education = 16, income = 402, self-rated health status = 5, deductible = 379, insurance = 308, participation HMO = 158, language = 0; **2012**: age = 0, Gender = 0, nationality = 0, education = 24, income = 657, self-rated health status = 10, deductible = 447, insurance = 229, participation HMO = 154, language = 0; **2007**: age = 0, Gender = 0, nationality = 2, education = 7, income = 559, self-rated health status = 3, deductible = 705, insurance = 201, language = 0.
[1] monthly personal income; [2] In October 2017, 1 CHF = 0.97 US Dollar = 0.86 EUR

2017 ($p < 0.001$). Diagnostic colonoscopy rate increased from 13.7% in 2007 to 17.9% in 2017 ($p < 0.001$). Proportion of screening colonoscopy strongly increased from 8.2% in 2007 to 24.9% in 2017 ($p < 0.001$ for entire country and for each region).

The weighted adjusted prevalence ratios of CRC testing rate comparing those tested for screening or diagnostic purpose for all covariates are summarized in the Fig. 3 for 2017 and Figure Supplementary File 4 for 2007 and 2012. In 2017, women were less likely to have screening tests (PR 0.81, 95%CI 0.70 to 0.94) and more likely to have diagnostic tests (PR 1.23, 95%CI 1.03 to 1.45). Those with lower income were less likely to be screened (<3000 CHF: PR 0.77, 95%CI 0.63 to 0.93). Insurance type was strongly associated with purpose of test: those with basic insurance were less likely to be screened (PR 0.44, 95%CI 0.34 to 0.55) than those with semi-private insurance coverage (PR 0.70, 95%CI 0.54 to 0.90) or a medium- (PR 0.74, 95%CI 0.63 to 0.86) or high-deductible health plan (PR 0.66, 95%CI 0.55 to 0.79). Participants who rated their health as very good were less likely to be screened, as were those who did not have an HMO insurance model. Proportion of screening and diagnostic tests did not differ significantly across linguistic regions. In 2007 and 2012, age 50–59, female gender and basic insurance coverage were associated with lower screening test; in 2012, those with medium- or high-deductible health plan were also less prone to have been screened.

Supplementary File 5 shows variations of diagnostic and screening testing rates between German- and French-speaking regions. The increase in colonoscopy rate is mainly due to an increase of screening colonoscopy, as the proportion of diagnostic tests changed in a much smaller magnitude. A small increase in FOBT screening in the French-speaking region in 2017 did not reach statistical significance ($p = 0.065$). Results did not change after we excluded participants from cantons Vaud and Uri.

4. Discussion

Colorectal cancer testing rate increased steadily in Switzerland between 2007 (33.2%) and 2017 (48.4%). Participants in the Swiss Health Survey were almost twice as likely to have had a colonoscopy within recommended intervals (10 years) in 2017 (43.1%) than in 2007 (22.1%). FOBT tests within recommended intervals (2 years) decreased across Switzerland between 2007 (11.0%) and 2017 (5.2%). The increase in overall CRC testing was driven by a threefold increase in colonoscopy screening tests between 2007 (8.2%) and 2017 (24.9%). While overall screening coverage has improved, important disparities persisted between groups (particularly deductible groups, insurance type or age categories) and across regions.

Across the linguistic regions (German, French, Italian) of Switzerland, we found variation in change of rate over time. In 2017, testing and colonoscopy rates were similar across regions, but persons in French and Italian-speaking regions were more likely to have FOBT tests than those in German-speaking regions. Spaeth et al. looked at the 2007 SHIS data and found no difference in FOBT rate, though colonoscopy

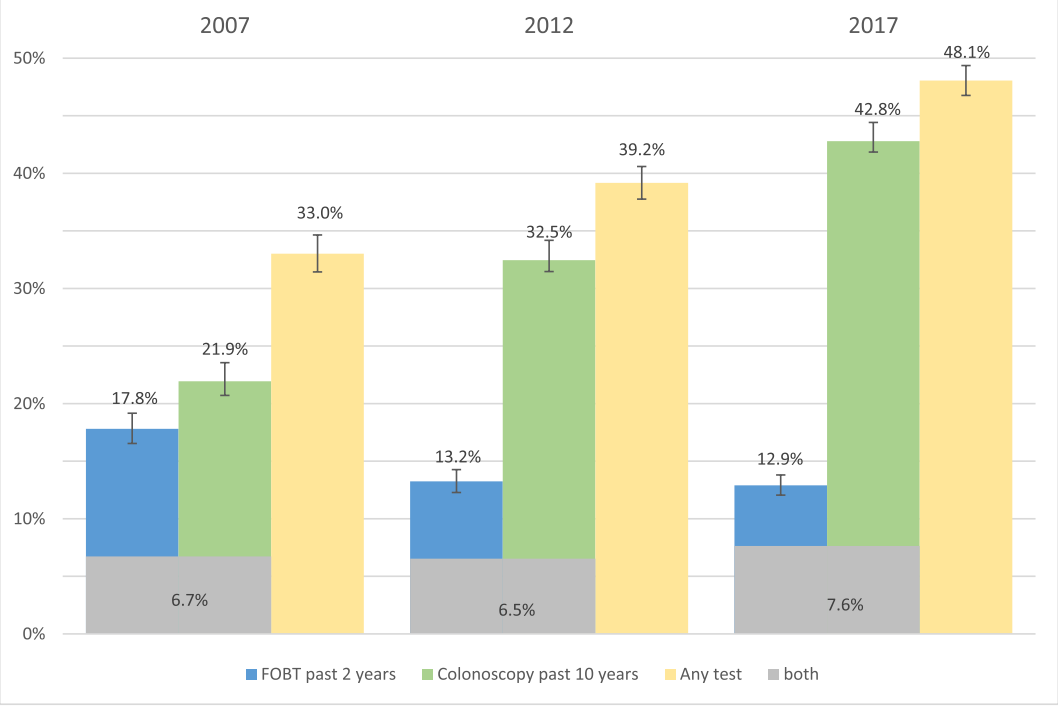

Fig. 1. Weighted proportions of 50–75-year-old respondents tested for colorectal cancer in the Swiss Health Interview Survey 2007, 2012 and 2017.

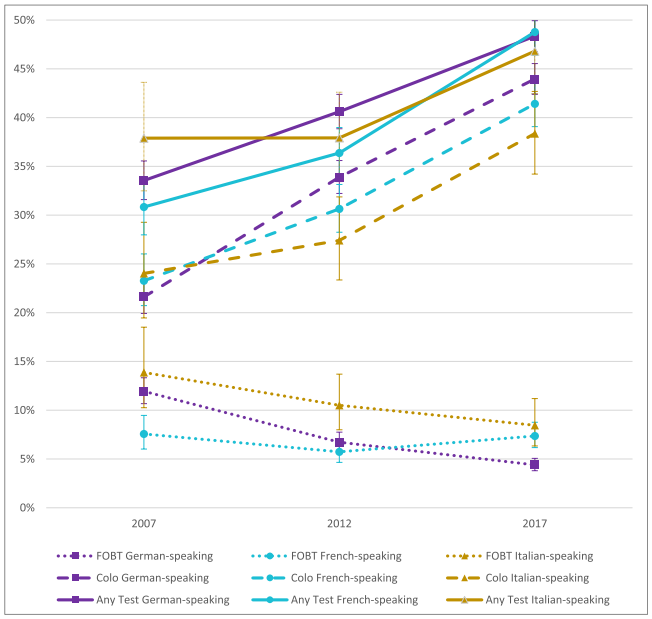

Fig. 2. Evolution of the CRC testing rate between linguistic regions from 2007 to 2017 for the population of 50–75-year-olds, from the Swiss Health Interview Survey 2007, 2012 and 2017.

was more common in French-speaking regions (Spaeth and Zwahlen, 2013). Based on health insurance claims data, Bähler et al found CRC testing rate was higher overall in Italian-speaking regions between 2014 and 2018 (Bahler et al., 2021). Our results suggest that the decrease of FOBT rate was much less pronounced in French-speaking regions, as we found a small increase in the FOBT testing rate between 2012 and 2017. The overall CRC testing rate in 2017 was similar across the three regions. The SHIS only surveyed small numbers from each canton and we could not detect more local changes.

The European Commission's (EC) recommend a minimum screening rate of 45% by the 50–74 years-old, with a goal for screening rate of 65% (Moss et al., 2012). Organized screening programs could enable Switzerland to meet this goal of 65% screening in the eligible population (Bahler et al., 2021). Data about the efficacity of such programs on CRC testing in Switzerland are emerging (Bissig et al, Hempel-Bruder et al. manuscripts in preparation, 2021) (2021a). Furthermore, promoting FOBT might increase screening rates by reaching those less willing to undergo screening colonoscopy (Inadomi et al., 2012; Martin et al., 2019; Ponti et al., 2017; Vart et al., 2012). A growing number of Cantons in Switzerland have implemented or are planning organized screening programs (SwissCancerScreening, 2022). The set-up of these programs varies with some enabling invited population to choose between screening by colonoscopy or FOBT and others mailing FOBT (Auer et al., 2015). In the context of relatively high prevalent opportunistic screening by colonoscopy, mailed FOBT programs, with costs in the range of 20 USD per returned FOBT (Kemper et al., 2018) might be an alternative with similar cost-effectiveness (Ran et al., 2019) but resource-sparing and with lower cost for participants.

Our results, in combination with those of previous studies (Braun et al., 2020; Spaeth and Zwahlen, 2013), should help screening programs target the population most likely to be underserved. Those aged 50–59 who have medium to HDHP and basic or semi-private insurance coverage are less likely to be tested overall, and much less likely to be screened. Those who earn the least are also the least likely to be tested overall, have colonoscopies, or be screened.

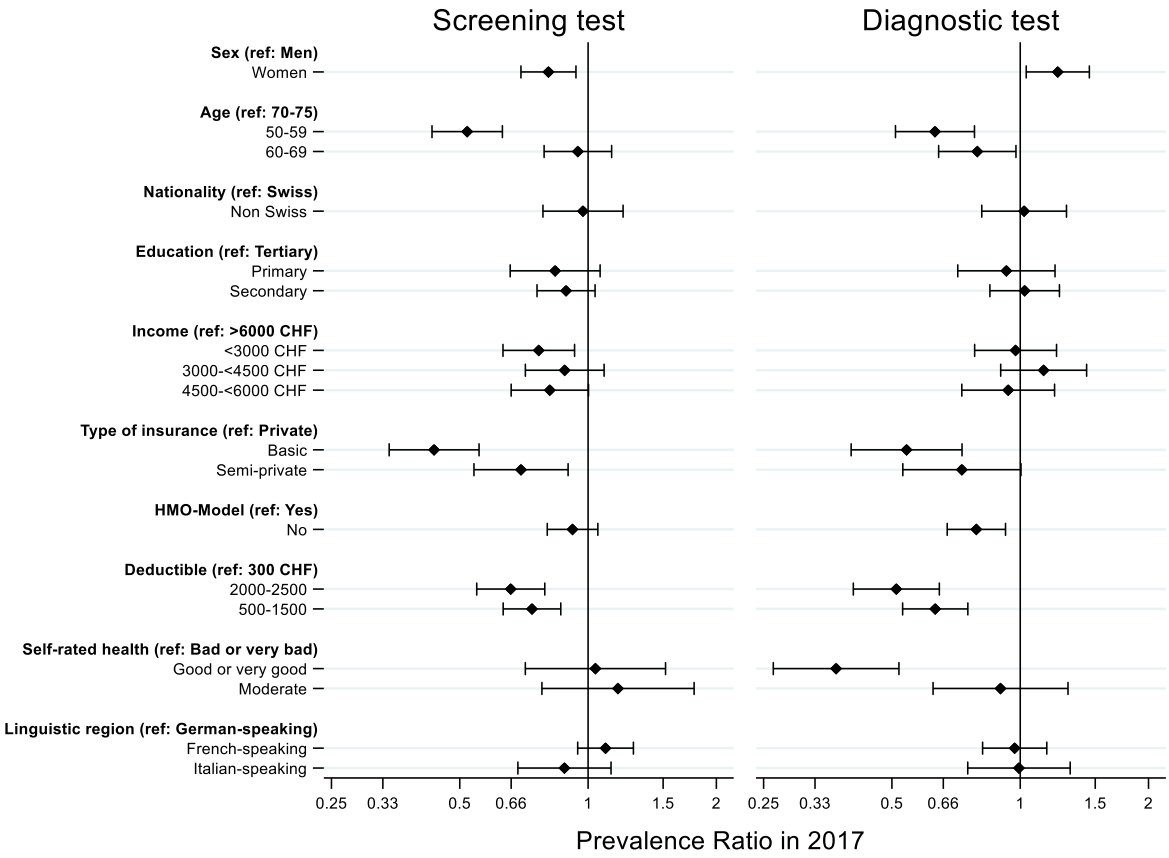

Fig. 3. Weighted adjusted prevalence ratios of colorectal cancer screening or diagnostic rate for the population of 50–75-year-olds, from the Swiss Health Interview Survey 2017.

Our study has limitations. SHIS participants are recruited and interviewed via landline, but an increasing number of people have only mobile phones or use internet telephony services, which might impair the representativeness of the participants with the swiss population. Bias of overreporting exist with every self-reported survey (misunderstanding, pleasing interviewers) and might be also present in the SHIS, leading to higher testing rate. Although the data are weighted by the SFSO, the analysis are based on a subsample of population; confidence intervals are large for stratified analyses and should be interpreted carefully. We urge for careful interpretation of the proportions of participants reporting both FOBT and colonoscopy testing to infer positivity rate of FOBT. We believe this would lead to an overestimation of the positivity rate because these participants are a mixed bag of persons who: a) reported they underwent FOBT testing for screening or diagnostic reasons; b) persons who have had a positive FOBT followed by a colonoscopy; c) persons with a negative FOBT followed by colonoscopy because they changed their preferred method of screening or d) because they experienced symptoms of CRC over time. Our study has strengths. The definition of screening and diagnostic test based on self-reported data might rise question of the validity of such definition, but our study shows a stability and consistence of results over time.

5. Conclusion

Our results confirmed that the CRC testing rate has increased in Switzerland, mostly due to an increase in colonoscopy screening. The Swiss CRC testing rate barely reached EC recommended levels in 2017, but the CRC testing rate is encouragingly increasing over the years. It is not clear if the colonoscopy rate will continue to increase in the next years or reach a plateau. Our study provides potentially useful data to better identify those less likely to be tested. Our data does not provide information on why the swiss population apparently mainly opts for colonoscopies and not for the cheap, non-invasive and similarly effective FOBT. The reasons might be personal preferences, beliefs and information received from health professionals. Developing or extending organized screening programs across Switzerland and encouraging interventions that target underserved populations could help Switzerland meet and maintain higher levels of CRC screening and ultimately save more lives.

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CRediT authorship contribution statement

Rémi Schneider: Conceptualization, Formal analysis, Visualization, Writing – original draft. **Lamprini Syrogiannouli:** Formal analysis, Methodology. **Sarah Bissig:** Writing – review & editing. **Tamara Scharf:** Writing – review & editing. **Jean-Luc Bulliard:** Methodology, Writing – review & editing. **Cyril Ducros:** Methodology, Writing – review & editing. **Cinzia Del Giovane:** Methodology, Writing – review & editing. **Kali Tal:** Methodology, Writing – review & editing. **Marcel Zwahlen:** Methodology, Writing – review & editing. **Kevin Selby:** Methodology, Writing – review & editing. **Reto Auer:** Conceptualization, Funding acquisition, Supervision, Project administration, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2022.101815.

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