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Brief communication

Self-reported receipt of colonoscopy in national surveys: is it over- or under-reported?

Self-reported health behaviors and procedures from national surveys are used to track progress toward public health goals, including the Healthy People 2020 objectives [1]. One goal is to increase the proportion of adults up to date with colorectal cancer screening to 70.5%, although 2015 National Health Interview Survey (NHIS) indicates only 62% are up to date [2]. There is a perception in the scientific literature that self-reported colonoscopy, the most commonly used colorectal cancer screening test, is overestimated in national surveys [3,4]. Indeed, a meta-analysis conducted by Raucher et al computed sensitivities and specificities of self-reported endoscopy relative to medical records and applied them to 1998 and 2000 NHIS data; they found that bias-corrected prevalence were greater than observed prevalence [5]. However, it is unknown if this finding holds with more recent survey data. In the present study, we apply reported sensitivities and specificities [5] to estimate corrected colonoscopy prevalence with 2000–2015 NHIS data.

The NHIS is a nationally representative in-person household survey among noninstitutionalized adults conducted annually, although cancer screening histories are collected every two to three years [6]. Using 2000, 2003, 2005, 2008, 2010, 2013, and 2015 data, self-reported (hereafter referred to as observed) prevalence of colonoscopy in the past 10 years for any reason was estimated accounting for complex survey design. We then applied sensitivities (0.79, 95% CI: 0.73–0.84) and specificities (0.90, 95% CI: 85–93) for lower endoscopic procedures (sigmoidoscopy and colonoscopy) from Rauscher et al's meta-analyses [5] to estimate corrected prevalence using an established equation, shown in the following [7]. Ninety-five percent confidence intervals (CIs) of observed CIs were approximated with Taylor Series and corrected CIs were computed with bootstrap sampling with 1000 replicates accounting for variability of observed prevalence, sensitivities, and specificities. Because Rauscher et al's meta-analysis used data from studies conducted in the 1990s, we applied a range of sensitivities (0.79–1.00) and specificities (0.70–1.00) to gauge the impact of potentially changing accuracy over time in supplementary analyses.

Equation:

$$P_{corrected} = \frac{(P_{observed} - FP)}{(Se + Sp - 1)} = \frac{(P_{observed} - 1 + Sp)}{(Se + Sp - 1)},$$

where $P_{corrected}$ = corrected prevalence; $P_{observed}$ = observed prevalence; FP = false positives, Se = sensitivity, Sp = specificity, Se = 0.79, FP = 0.10, and Sp = 0.90. In supplementary analyses, different combinations of Se and Sp were considered and ranged from 0.79 to 1.00 and 0.70 to 1.00, respectively.

Between 2000 and 2015, observed colonoscopy prevalence increased from 20.1% (95% CI: 19.0, 21.2) to 61.1% (95% CI: 59.6, 62.6) among females and from 20.5% (95% CI: 19.2, 21.9) to 60.4% (95% CI: 58.7, 62.0) among males (Fig. 1). At the beginning of the study period, observed estimates exceeded corrected values, however, starting in 2005, observed point prevalence were lower than corrected values. By 2010, corrected colonoscopy prevalence was not only higher than observed prevalence, but corresponding CIs did not overlap (Fig. 1).

In supplementary analyses, with specificity held at 90%, the sensitivity of self-reports would need to increase from 79% to 96% for corrected colonoscopy prevalence to be lower than observed values throughout the study period. When sensitivity was held at 79%, the specificity would have to drop from 90% to 67% for this to occur. For 2015 data, we varied both sensitivity and specificity to determine ranges that would produce lower corrected than observed colonoscopy prevalence (Supplemental Table 1). For example, this would occur if specificity declined to 85% and sensitivity improved to 90%.

In this study, observed colonoscopy prevalence was higher than corrected values at the beginning of the study period, but as colonoscopy became more common, corrected estimates exceeded the observed estimates, such that the number of false negatives surpassed false positives in the latter part of the study period. Our finding that self-reports are over-reported for one set of values but not for another could apply to other rapidly increasing behaviors or procedures if the accuracy of reporting is constant. It is also plausible that as a procedure or behavior becomes more (or less) common or socially acceptable, the accuracy of self-reports may also change as respondents may be more familiar with its terminology and/or be less embarrassed to report it. For example, self-reports of marijuana use may vary over time [8]. Whether the sensitivity of self-reported colonoscopy improved over time paralleling its increasing use and media coverage is unknown, but could impact our findings if sensitivity greatly improved [9]. Supplementary analyses showed that corrected prevalence would be lower than observed values throughout the study if sensitivity increased from 79% to 96%, holding specificity at 90%. It's also plausible that as

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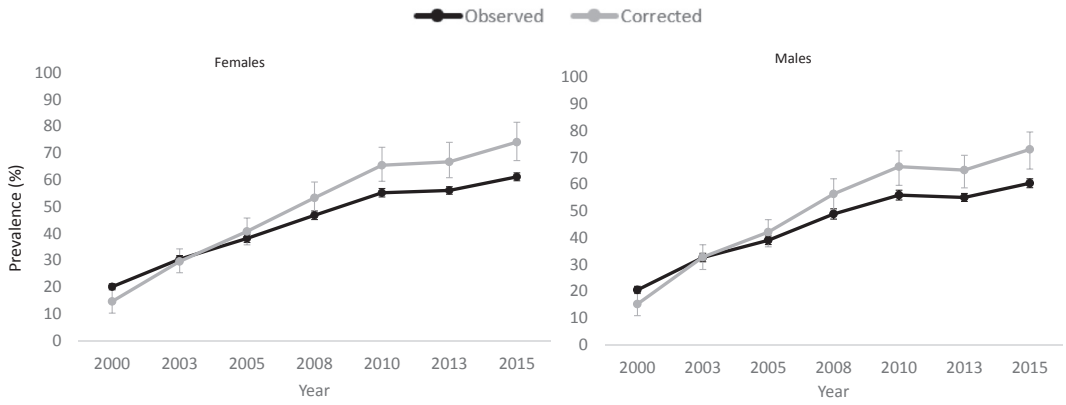

Fig. 1. Observed and corrected prevalence of colonoscopy in the past 10 y among females and males, ages ≥50 years.[a] a. Observed prevalence was calculated from self-reported 2000, 2003, 2005, 2008, 2010, 2013, and 2015 National Health Interview Survey data. Corrected prevalence was calculated by applying sensitivities (0.79, 95% CI: 0.73, 0.88) and specificities (0.90, 95% CI: 0.83, 0.93) reported in Rauscher et al's meta-analyses [5].

colonoscopy becomes more socially desirable or popular, people may be more likely to report a test when they did not have one, leading to a lower specificity. Although specificity would have to drop from 90% to 75% with sensitivity remaining at 79% for bias-corrected colonoscopy prevalence to be lower than observed values during the study period. Even when we simulated sensitivity and specificity moving in opposite directions, the corrected colonoscopy was lower than observed prevalence only with substantial changes to specificity and sensitivity. For example, the aforesaid phenomenon would occur if specificity declines to 85% and sensitivity improves to 90%. If accuracy (specificity and/or specificity) has not markedly changed, the present study challenges the notion that colonoscopy is over-reported in national surveys.

Limitation of the present study is that it did not account for other biases, such as nonresponse bias in surveys. The analyses relied on the most recent meta-analysis of accuracy of self-reported lower endoscopy (colonoscopy and sigmoidoscopy), but underlying data date back to the 1990s [5]. However, supplementary analyses showed that sensitivity would have to drastically improve, or the specificity would have to drop to alter key findings. In addition, we examined colonoscopy for any reason, consistent with Healthy People 2020s definition [1].

In conclusion, our study provides an example of how prevalence may be under-reported for one set of observed value, but not for another if accuracy has not changed over time. Future research on whether the sensitivity of a self-reported colonoscopy has improved over time is needed to track progress toward nationwide goals.

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Appendix

Supplementary Table 1
Corrected colonoscopy prevalence when varying sensitivities and specificities were applied to 2015 observed prevalence of colonoscopy in the past 10 y (observed prevalence = 61.1%)

Specificity	Sensitivity																					
	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.89	0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99	1.00
0.70	63.5	62.2	*61.0*	*59.8*	*58.7*	*57.6*	*56.5*	*55.5*	*54.6*	*53.6*	*52.7*	*51.8*	*51.0*	*50.2*	*49.4*	*48.6*	*47.8*	*47.1*	*46.4*	*45.7*	*45.1*	*44.4*
0.71	64.2	62.9	61.7	*60.6*	*59.4*	*58.4*	*57.3*	*56.3*	*55.3*	*54.4*	*53.5*	*52.6*	*51.8*	*51.0*	*50.2*	*49.4*	*48.6*	*47.9*	*47.2*	*46.5*	*45.9*	*45.2*
0.72	64.9	63.7	62.5	61.3	*60.2*	*59.1*	*58.1*	*57.1*	*56.1*	*55.2*	*54.3*	*53.4*	*52.5*	*51.7*	*50.9*	*50.2*	*49.4*	*48.7*	*48.0*	*47.3*	*46.6*	*46.0*
0.73	65.6	64.3	63.1	62.0	*60.9*	*59.8*	*58.8*	*57.8*	*56.8*	*55.9*	*55.0*	*54.1*	*53.3*	*52.5*	*51.7*	*50.9*	*50.1*	*49.4*	*48.7*	*48.0*	*47.4*	*46.7*
0.74	66.2	65.0	63.8	62.7	61.6	*60.5*	*59.5*	*58.5*	*57.5*	*56.6*	*55.7*	*54.8*	*54.0*	*53.2*	*52.4*	*51.6*	*50.9*	*50.1*	*49.4*	*48.8*	*48.1*	*47.4*
0.75	66.9	65.6	64.5	63.3	62.2	61.2	*60.2*	*59.2*	*58.2*	*57.3*	*56.4*	*55.5*	*54.7*	*53.9*	*53.1*	*52.3*	*51.6*	*50.8*	*50.1*	*49.5*	*48.8*	*48.1*
0.76	67.5	66.3	65.1	64.0	62.9	61.8	*60.8*	*59.8*	*58.9*	*58.0*	*57.1*	*56.2*	*55.4*	*54.6*	*53.8*	*53.0*	*52.3*	*51.5*	*50.8*	*50.1*	*49.5*	*48.8*
0.77	68.0	66.8	65.7	64.6	63.5	62.5	61.5	*60.5*	*59.5*	*58.6*	*57.7*	*56.9*	*56.0*	*55.2*	*54.4*	*53.7*	*52.9*	*52.2*	*51.5*	*50.8*	*50.1*	*49.5*
0.78	68.6	67.4	66.3	65.2	64.1	63.1	62.1	61.1	*60.2*	*59.2*	*58.4*	*57.5*	*56.7*	*55.9*	*55.1*	*54.3*	*53.6*	*52.8*	*52.1*	*51.4*	*50.8*	*50.1*
0.79	69.1	68.0	66.8	65.7	64.7	63.7	62.7	61.7	*60.8*	*59.9*	*59.0*	*58.1*	*57.3*	*56.5*	*55.7*	*54.9*	*54.2*	*53.5*	*52.8*	*52.1*	*51.4*	*50.8*
0.80	69.7	68.5	67.4	66.3	65.2	64.2	63.2	62.3	61.3	*60.4*	*59.6*	*58.7*	*57.9*	*57.1*	*56.3*	*55.5*	*54.8*	*54.1*	*53.4*	*52.7*	*52.0*	*51.4*
0.81	70.2	69.0	67.9	66.8	65.8	64.8	63.8	62.8	61.9	*61.0*	*60.1*	*59.3*	*58.5*	*57.7*	*56.9*	*56.1*	*55.4*	*54.7*	*54.0*	*53.3*	*52.6*	*52.0*
0.82	70.7	69.5	68.4	67.3	66.3	65.3	64.3	63.4	62.5	61.6	*60.7*	*59.9*	*59.0*	*58.2*	*57.5*	*56.7*	*56.0*	*55.3*	*54.6*	*53.9*	*53.2*	*52.6*
0.83	71.1	70.0	68.9	67.8	66.8	65.8	64.9	63.9	63.0	62.1	61.3	*60.4*	*59.6*	*58.8*	*58.0*	*57.3*	*56.5*	*55.8*	*55.1*	*54.4*	*53.8*	*53.1*
0.84	71.6	70.5	69.4	68.3	67.3	66.3	65.4	64.4	63.5	62.6	61.8	*60.9*	*60.1*	*59.3*	*58.6*	*57.8*	*57.1*	*56.4*	*55.7*	*55.0*	*54.3*	*53.7*
0.85	72.0	70.9	69.8	68.8	67.8	66.8	65.9	64.9	64.0	63.2	62.3	61.5	*60.7*	*59.9*	*59.1*	*58.4*	*57.6*	*56.9*	*56.2*	*55.5*	*54.9*	*54.2*
0.86	72.5	71.4	70.3	69.3	68.3	67.3	66.3	65.4	64.5	63.6	62.8	62.0	61.2	*60.4*	*59.6*	*58.9*	*58.1*	*57.4*	*56.7*	*56.1*	*55.4*	*54.8*
0.87	72.9	71.8	70.7	69.7	68.7	67.7	66.8	65.9	65.0	64.1	63.3	62.5	61.7	*60.9*	*60.1*	*59.4*	*58.7*	*58.0*	*57.3*	*56.6*	*55.9*	*55.3*
0.88	73.3	72.2	71.2	70.1	69.2	68.2	67.3	66.4	65.5	64.6	63.8	62.9	62.2	61.4	*60.6*	*59.9*	*59.2*	*58.5*	*57.8*	*57.1*	*56.4*	*55.8*
0.89	73.7	72.6	71.6	70.6	69.6	68.6	67.7	66.8	65.9	65.1	64.2	63.4	62.6	61.9	61.1	*60.4*	*59.6*	*58.9*	*58.3*	*57.6*	*56.9*	*56.3*
0.90	**74.1**	73.0	72.0	71.0	70.0	69.1	68.1	67.2	66.4	65.5	64.7	63.9	63.1	62.3	61.6	*60.8*	*60.1*	*59.4*	*58.7*	*58.1*	*57.4*	*56.8*
0.91	74.4	73.4	72.4	71.4	70.4	69.5	68.6	67.7	66.8	65.9	65.1	64.3	63.5	62.8	62.0	61.3	*60.6*	*59.9*	*59.2*	*58.5*	*57.9*	*57.3*
0.92	74.8	73.8	72.7	71.8	70.8	69.9	69.0	68.1	67.2	66.4	65.6	64.8	64.0	63.2	62.5	61.7	*61.0*	*60.3*	*59.7*	*59.0*	*58.4*	*57.7*
0.93	75.1	74.1	73.1	72.1	71.2	70.3	69.4	68.5	67.6	66.8	66.0	65.2	64.4	63.6	62.9	62.2	61.5	*60.8*	*60.1*	*59.5*	*58.8*	*58.2*
0.94	75.5	74.5	73.5	72.5	71.6	70.6	69.7	68.9	68.0	67.2	66.4	65.6	64.8	64.1	63.3	62.6	61.9	61.2	*60.5*	*59.9*	*59.2*	*58.6*
0.95	75.8	74.8	73.8	72.9	71.9	71.0	70.1	69.3	68.4	67.6	66.8	66.0	65.2	64.5	63.8	63.0	62.3	61.6	*61.0*	*60.3*	*59.7*	*59.1*
0.96	76.1	75.1	74.2	73.2	72.3	71.4	70.5	69.6	68.8	68.0	67.2	66.4	65.6	64.9	64.2	63.4	62.7	62.1	61.4	*60.7*	*60.1*	*59.5*
0.97	76.4	75.5	74.5	73.5	72.6	71.7	70.9	70.0	69.2	68.4	67.6	66.8	66.0	65.3	64.6	63.8	63.2	62.5	61.8	61.2	*60.5*	*59.9*
0.98	76.8	75.8	74.8	73.9	73.0	72.1	71.2	70.4	69.5	68.7	67.9	67.2	66.4	65.7	64.9	64.2	63.5	62.9	62.2	61.6	*60.9*	*60.3*
0.99	77.1	76.1	75.1	74.2	73.3	72.4	71.5	70.7	69.9	69.1	68.3	67.5	66.8	66.0	65.3	64.6	63.9	63.3	62.6	62.0	61.3	*60.7*
1.00	77.3	76.4	75.4	74.5	73.6	72.7	71.9	71.0	70.2	69.4	68.7	67.9	67.1	66.4	65.7	65.0	64.3	63.6	63.0	62.3	61.7	61.1

Observed colonoscopy prevalence = 61.1%. Sensitivity = 0.79 and specificity = 0.90 in the main analyses, resultant corrected prevalence = 74.1% as shown in bold value and outlined cell. Italicized represent instances where corrected estimates were lower than observed estimate of 61.1%. Data for women are presented. Results for males are similar (data not shown).