

# Squatting and Risk of Colorectal Cancer: A Case-Control Study

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## ABSTRACT

### BACKGROUND

The sitting position, rather than squatting, during defecation has been hypothesized to be a risk factor for colorectal cancer (CRC).

### METHODS

We conducted a case-control study to test this hypothesis. A total of 100 CRC cases from two hospitals in Iran and 100 control subjects, selected from the coronary care unit (CCU) of those same hospitals were selected for this study. We administered a detailed questionnaire to the study subjects asking about history of toilet use and other relevant confounders.

### RESULTS

In logistic regression analysis, the crude and adjusted ORs (95% CIs) for using sitting toilets in any decade were 1.20 (0.89 – 1.61) and 1.07 (0.72 – 1.59), respectively. Also, the crude and adjusted ORs (95% CIs) for using 10 more years of sitting toilets were as 1.16 (0.92 – 1.47) and 1.02 (0.74 – 1.40), neither of which indicated a statistically significant increase in risk.

### CONCLUSION

Our study did not support an appreciable role for using sitting toilets as risk factors for CRC.

### KEYWORDS:

Colon; Rectal; Colorectal; Cancer; Case-control; Risk factor; Iran

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## INTRODUCTION

Colorectal cancer (CRC) is the third most common cause of cancer death in the world.<sup>1</sup> CRC incidence rates show considerable variation around the world; incidence rates per 105 person years, age-adjusted to the world's population, are approximately 40 and 10 in the more developed and less developed countries, respectively.<sup>1</sup> Iran has a CRC age-adjusted incidence rate of approximately 8/105 person-years,<sup>2</sup> making it a low-risk country for this disease but there may be a difference in rates by birth cohorts. Recent evidence suggests that CRC incidence rates are low in older generations, but they are as high in young Iranians as in young Americans.<sup>3</sup> It is unclear whether the high rates in the younger Iranian population is a harbinger of future high rates, possibly due to socioeconomic and lifestyle changes.

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Several hypotheses have been suggested to explain the differences in CRC rates between developed and developing countries.

Burkitt and other scientists, by comparing developed (especially Western) versus other countries, suggested a role for diet, especially high fat and low fiber in the etiology of CRC.<sup>4,5</sup> Possible mechanisms suggested for the association between high fat and low fiber in the etiology of CRC included increased levels of cytotoxic free acids or secondary bile acids in the lumen of the colon, a change in the composition and number of bacteria in the colon, slower passage of stool and hence providing time for bacterial to proliferate among others.<sup>4,6</sup> Despite the results of international comparisons and the presence of such intriguing hypotheses, case-control and cohort studies have not shown an appreciable role for high fat or low fiber in causing CRC.<sup>6,7</sup> Another hypothesis, recently promoted by Isbit,<sup>8</sup> suggests that bowel emptying habits may contribute to CRC risk.

The traditional way of bowel emptying in most developing countries has been to squat before defecating, which is different from sitting on a toilet, the common habit in Western countries. There is evidence that squatting results in much quicker and more complete emptying of the fecal content<sup>9</sup> and hence may result in reduced exposure of the colon and rectum to potentially carcinogenic material. Therefore, it has been suggested that squatting may be associated with reduced risk of CRC.<sup>8</sup>

Iran is a perfect place to study this hypothesis. Iranian people have traditionally used a toilet on which they had to squat, but in the past few decades they have increasingly been using Western toilets on which they sit. Therefore, we conducted this case-control study in Tehran, Iran, to examine the association between using squatting versus sitting toilets and CRC risk.

## MATERIALS AND METHODS

### Subjects and methods

A total of 100 consecutive patients with pathologically confirmed colorectal adenocarcinoma admitted to two hospitals in Tehran (Shariati Hospital and Mehr Hospital) between October 2007 and May 2009 were enrolled in the study. Excluded from the study were patients with familial adenomatous polyposis, hereditary non-polyposis CRC and known history of inflammatory bowel disease. Controls consisted of a sex- and age-matched sample of patients admitted to the coronary care unit (CCU) of the same hospitals with diagnoses of myocardial infarction or unstable angina.

A single researcher administered the questionnaire to each study participant. Study participants were asked about the type of toilet they mostly used during each 10-year period of their life (0-10, 10-20, 20-30, etc). The questionnaire also included questions on demographic information, socioeconomic markers (education, number of people living in the house), history of smoking and aspirin intake, and history of constipation.

The study protocol was approved by the Ethics Committee of the Digestive Disease Research Center, Tehran University of Medical Sciences. All individuals signed informed consent forms.

### Statistical analysis

Proportions of categorical and ordinal variables were tabulated by case group and compared using Fisher's exact and Mann-Whitney U tests, respectively. The means and standard deviations of continuous variables were shown by case status and compared using Mann-Whitney U tests. The total years of using squatting and sitting toilets were calculated for case and control groups, and compared using unadjusted and adjusted logistic regression models. The covariates in the adjusted models were age, sex, education, and history of smoking, aspirin use and constipation.

**RESULTS**

Table 1 compares the demographic characteristics, hospital of admission, smoking history and relevant medical history by case status. Case and control subjects were group-matched for hospital of admission, age and sex. Mean age was close to 60 years in both groups and approximately two-thirds of cases were males. The cases were more educated than controls ( $p < 0.001$ ) and the population density of their houses was smaller ( $p = 0.03$ ) both indicating a higher socioeconomic status of CRC cases than patients with myocardial infarction or unstable angina. History of smoking ( $p = 0.007$ ) and aspirin use ( $p = 0.003$ ) were less common in CRC patients than patients with myocardial infarction or unstable angina. In contrast, CRC patients were more likely to have a history of constipation ( $p = 0.002$ ). When we compared cases and controls for duration of smoking (in years), pack-years of smoking, years of aspirin use, years of constipation, and recent and old history of constipation, the patterns remained the same; i.e., cases were less likely to smoke or use aspirin and were more likely to have constipation (data not shown).

Table 2 shows the history of sitting versus squatting toilet use in cases and controls. As seen in the table, sitting toilet use was more common in older life decades, which reflects a cohort effect. Cases were slightly more likely to use sitting toilets at almost any decade of life but none of these differences were statistically significant. Nor did we observe a statistically significant difference when we compared the use of sitting toilets (at any decade of life; ( $p = 0.29$ ) or overall years of sitting toilet use ( $p = 0.24$ ) between cases and controls.

In the logistic regression analysis, the crude and adjusted ORs (95% CIs) for using sitting toilets in any decade were 1.20 (0.89 – 1.61) and 1.07 (0.72 – 1.59), respectively. The crude and adjusted ORs (95% CIs) for every 10 years of sitting toilets were 1.16 (0.92 – 1.47) and

**Table 1: Hospital of admission, socio-demographic characteristics and relevant medical history by case status.**

Variables	Controls* (N=100)	Cases (N=100)	p-value**
<b>Hospital of admission, n (%)</b>			
Mehr	80(80)	80(80)	-----
Shariati	20(20)	20(20)	
<b>Sex, n (%)</b>			
Female	38(38)	35(35)	-----
Male	62(62)	65(65)	
<b>Age, mean (SD) of years</b>			
	60.6	60.3	-----
<b>Education, n (%)</b>			
None	19(19)	14(14)	<0.001
Elementary	33(33)	18(18)	
Middle school	12 (12)	5 (5)	
High school	24 (24)	34 (34)	
College or higher	12 (12)	29 (29)	
<b>Household density,</b>			
mean (SD) of number of people living per 100 m <sup>2</sup> in the household ***	3.4 (0.29)	2.5 (0.19)	0.03
<b>Smoking history, n (%)</b>			
No	57 (57)	76 (76)	0.007
Yes	43 (46)	24 (25)	
<b>History of aspirin use, n (%)</b>			
No	54 (54)	75 (75)	0.003
Yes	46 (46)	25 (25)	
<b>History of constipation, n (%)</b>			
No	73 (73)	51 (51)	0.002
Yes	27 (27)	49 (49)	

\*Controls were patients with myocardial infarction.

\*\*p-values were not calculated for hospital, sex and age because cases and controls were matched for these variables. p-values for continuous and ordinal variables (education and household density) come from Mann-Whitney U- tests. p-values for dichotomous variables (smoking history, history of aspirin use and history of constipation) come from Fisher's exact tests.

\*\*\*Household density data were available for only 59 control and 55 case subjects.

1.02 (0.74 – 1.40), neither of which indicated a statistically significant increase in risk.

**Table 2:** History of sitting versus squatting toilet use.

Age	Controls* (N=100)	Cases* (N=100)	p-value**
<b>0 to 10</b>			
Squatting	100 (100)	99 (99)	1.00
Sitting	0 (0)	1 (1)	
<b>10 to 20</b>			
Squatting	100 (100)	99 (99)	1.00
Sitting	0 (0)	1 (1)	
<b>20 to 30</b>			
Squatting	95 (98)	95 (95)	0.45
Sitting	2 (2)	5 (5)	
<b>30 to 40</b>			
Squatting	95 (95)	90 (91)	0.28
Sitting	5 (5)	9 (9)	
<b>40 to 50</b>			
Squatting	86 (88)	79 (85)	0.67
Sitting	12 (12)	14 (15)	
<b>50 to 60</b>			
Squatting	72 (84)	65 (83)	1.00
Sitting	14 (16)	13 (17)	
<b>60 to 70</b>			
Squatting	35 (69)	31 (60)	0.41
Sitting	16 (31)	21 (40)	
<b>70 to 80</b>			
Squatting	7 (58)	11 (52)	1.00
Sitting	5 (42)	10 (48)	
<b>80 to 90</b>			
Squatting	1 (50)	2 (40)	1.00
Sitting	1 (50)	3 (60)	
<b>Use of sitting toilets at any decade of life</b>			
No	71 (71)	63 (63)	0.29
Yes	29 (29)	37 (37)	
<b>Duration of use of sitting toilets (years)</b>	5.5 (1.0)	7.7 (1.5)	0.24

\* All numbers in these columns show number (percent) except for duration of use, which shows mean (SD).

\*\* All p-values come from Fisher’s exact tests except for duration of use, which comes from Mann-Whitney U test.

**DISCUSSION**

In this study, we have tested the hypothesis that using sitting toilets increases the risk of CRC, therefore contributing to a higher risk of CRC in Western countries. The results of this study do not support such association.

The biologic mechanism proposed for a po-

tential association between sitting toilet use and CRC is that squatting accelerates defecation and results in more complete emptying of the bowel. In one of his books, Denis Burkitt, who suggested the fiber theory for CRC, writes<sup>10</sup> “There is another factor that may hinder the efficiency with which we empty our bowels.

The usual way to pass a stool, even in Western countries until a century ago and still today in position, the thighs are pressed against the abdominal wall and this is believed to assist stool evacuation.” There is indeed scientific evidence that squatting results is faster and more complete defecation.<sup>9</sup> However, in our study, squatting was not associated with a lower risk of CRC.

Validating our questionnaire was not feasible but there is strong evidence to believe validity of the responses. Cases and controls were both patients admitted to the hospital and were not aware of the study hypothesis, so biased answers and recall bias were unlikely.

History of aspirin use and smoking was higher in CCU patients whereas history of constipation was higher in CRC patients, all of which were consistent with the medical literature.<sup>11-14</sup>

Aspirin use is recommended for patients with cardiovascular diseases (higher in controls) and may protect against CRC (lower in cases).<sup>11,12</sup> Smoking is higher in patients with cardiovascular disease than the general population.<sup>13</sup> History of constipation is more common in patients with CRC.<sup>14</sup> Also, the history of using sitting toilets increased by age which was consistent with common knowledge of this issue in Iran.

This study has some strengths. To our knowledge, this is the first study that has investigated the association between sitting versus squatting and CRC risk. Cases and controls were matched for hospital of admission, which made the referral base of these two groups

relatively similar. The questionnaire included data on some important potential confounders and the results were adjusted for them. All questionnaires were administered to the patients by a single researcher which minimized inter-observer differences. The study also has limitations. The design of the study was retrospective and the controls were not population-based. Sample size was modest but it has more than 90% power to detect an odds ratios of 2 or larger.

In conclusion, our study did not support an appreciable role for using sitting toilets as risk factors for CRC. Further larger prospective studies are needed to confirm this finding.

#### CONFLICT OF INTEREST

The authors declare no conflict of interest related to this work.

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