

# Colorectal cancer screening participation in First Nations populations worldwide: a systematic review and data synthesis



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## Summary

**Background** First Nations populations have poorer colorectal cancer (CRC) survival compared to non-First Nations populations. Whilst First Nations populations across the world are distinct, shared experiences of discrimination and oppression contribute to persistent health inequities. CRC screening improves survival, however screening rates in First Nations populations are poorly described. This study seeks to define participation rates in CRC screening in First Nations populations worldwide.

**Methods** A systematic literature search was conducted of PubMed, Embase, Cochrane Library, CINAHL, MEDLINE, grey literature, national registries and [ClinicalTrials.gov](https://clinicaltrials.gov). All sources were searched from their inception date to 18 February 2024. Studies were included if they reported CRC screening rates in adult ( $\geq 18$  years) First Nations populations. We aimed to undertake a meta-analysis if there were sufficient data. Quality of papers were assessed using the Joanna Briggs Institute (JBI) appraisal tool. The study was registered with PROSPERO, CRD42020210181.

**Findings** The literature search identified 1723 potentially eligible published studies. After review, 57 studies were included, 50 from the United States (US), with the remaining studies from Australia, Aotearoa New Zealand (NZ), Canada, Dominica and Guatemala. Additionally, eleven non-indexed reports from national programs in Australia and NZ were included. There were insufficient data to undertake meta-analysis, therefore a systematic review and narrative synthesis were conducted. CRC screening definitions varied, and included stool-based screening, sigmoidoscopy and colonoscopy. US First Nations screening rates ranged between 4.0 and 79.2%, Australia reported 10.6–35.2%, NZ 18.4–49%, Canada 22.4–53.4%, Guatemala 2.2% and Dominica 4.2%. Fifty-five studies were assessed as moderate or high quality and two as low quality.

**Interpretation** Our findings suggested that there is wide variation in CRC screening participation rates across First Nations populations. Screening data are lacking in direct comparator groups and longitudinal outcomes. Disaggregation of screening data are required to better understand and address First Nations CRC outcome inequities.

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**Keywords:** Bowel cancer; Colorectal cancer; Screening; Indigenous; First Nations

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### Research in context

#### Evidence before this study

Colorectal cancer (CRC) is a leading cause of mortality around the world. CRC screening has been shown to reduce the mortality rate in the overall population however First Nations people continue to have higher incidence of colorectal cancer and poorer survival compared to the overall population. It is possible that lower screening rates may contribute to the disproportionate burden of disease in First Nations people. In a preliminary search of PubMed, Embase, Cochrane Library, CINAHL, MEDLINE, and Google Scholar, we scoped existing evidence on colorectal cancer screening participation rates in First Nations populations from inception to February 2024, with no restriction by language. Our search terms included “caecal neoplasm OR colorectal neoplasm OR bowel cancer OR colon cancer OR rectal cancer” AND “diagnostic screening OR population screening OR screening” AND “Indigenous OR Aboriginal OR First Nations OR Native”. This search of electronic databases did not yield a published quantitative synthesis of this evidence base.

#### Added value of this study

Drawing on the included 57 published studies and 11 non-indexed colorectal screening program reports, this systematic review found that First Nations CRC screening rates varied widely between population groups and were likely lower

compared to non-First Nations populations. 50 of the 57 studies included were based in the United States (US), and the remaining studies were from Canada, Aotearoa New Zealand, Australia, Guatemala and Dominica. It is important to note that most studies were descriptive and lacked a direct comparator population to better understand discrepancies in screening rates. There were paucity of data examining trends in screening rates over time, with most study designs being cross-sectional. This study highlighted the heterogeneity in available data, including populations groups, screening methods used and definitions of screening status, precluding meta-analytic review.

#### Implications of all the available evidence

Colorectal cancer screening participation rates in First Nations populations vary widely, and data were heterogeneously recorded. There are limited studies outside the US, and longitudinal data were lacking. Data disaggregation and the inclusion of primary data in relation to First Nations populations is required to capture the inequities of First Nations people. Frequent evaluation of colorectal screening interventions in local First Nations populations are required for targeted political advocacy and strategic planning to address global health inequities seen in this population group.

## Introduction

Cancer screening programs save lives by allowing detection of asymptomatic disease, prompting earlier diagnosis and the opportunity to reduce morbidity and mortality.<sup>1</sup> Colorectal cancer is the second most common cause of cancer death worldwide.<sup>2</sup> Colorectal cancer screening has been shown in several randomised controlled trials to improve survival and has been adopted in many countries to improve colorectal cancer outcomes.<sup>3–6</sup> National colorectal cancer screening guidelines vary. In Canada, national guidelines recommend faecal occult blood testing (FOBT) for average risk patients between age 50 and 74 years,<sup>7</sup> with a follow up colonoscopy for positive FOBT results. In 2023, the Australian guidelines recommend immunochemical FOBT (iFOBT) for average risk patients between age 45 and 74.<sup>8</sup> In Aotearoa New Zealand, iFOBT is recommended for average risk individuals aged 60–74.<sup>9</sup> In these countries, endoscopic screening is recommended only for individuals at higher risk based on personal or family history.<sup>7–9</sup> In the United States, approved colorectal cancer screening methods include FOBT, sigmoidoscopy or colonoscopy.<sup>10</sup> While the efficacy of screening is proven,<sup>4</sup> the overall impact on cancer-related outcomes at a population-level is reduced by low participation rates.<sup>11</sup>

First Nations populations across the world generally have a higher incidence of colorectal cancer and poorer survival compared to non-First Nations populations.<sup>12–16</sup>

First Nations populations across the world represent distinct and diverse people groups, however there are likely conserved themes of social determinants that lead to persistent health inequities.<sup>17,18</sup> The examination of all First Nations populations allows insights to be shared across these groups. Addressing health inequities related to First Nations colorectal cancer outcomes is imperative to achieving the United Nations (UN) pledge to “leave no one behind”<sup>19</sup> and achieve its Sustainable Development Goal (SDG) 10—“to reduce inequalities within and among countries”. Lower participation rates in population-based colorectal cancer screening may be one factor contributing to poorer colorectal cancer outcomes in First Nations populations,<sup>6</sup> however First Nations screening participation rates globally remain poorly described.<sup>14,16,20–22</sup>

It is therefore vital to examine First Nations colorectal cancer screening rates, including data gaps and weaknesses, to guide clinical practice, policy and research. In light of this, we undertook a systematic review of colorectal cancer screening participation rates in First Nations populations worldwide with the aim to undertake a meta-analysis if there were sufficient data.

## Methods

This study was conducted and reported in accordance with the Preferred Reporting Items for Systematic

Reviews and Meta-Analyses (PRISMA) statement,<sup>23</sup> and according to the Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines for the meta-analysis of observational studies.<sup>24</sup> The protocol for this systematic review and meta-analysis was registered with the International Prospective Register of Systematic Reviews (PROSPERO; registration number CRD42020210181 on 18 November 2020; available from [https://www.crd.york.ac.uk/prospero/display\\_record.php?ID=CRD42020210181](https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020210181)).

### Search strategy

We conducted a systematic literature search of PubMed, Embase, Cochrane Library, CINAHL, MEDLINE, national registries where available, [ClinicalTrials.gov](https://www.clinicaltrials.gov) and the Australian New Zealand Clinical Trials registry for all studies reporting colorectal cancer screening participation in First Nations people. All sources were searched from their inception date to 18 February 2024.

A detailed search strategy used relevant index terms (Medical Subject Headings and Emtree) as well as free text terms for colorectal cancer. These terms were combined with a set of terms for screening and a set of terms for First Nations populations ([Supplementary Figure S1](#)). The electronic database search was conducted by an experienced information specialist (CD). Searches were confined to human studies without language restriction. Additionally, we reviewed references from relevant papers to identify further eligible studies.

For national and provincial population-based colorectal cancer screening programs identified by the above search strategy, we then used the Google search engine and the program websites to identify any reports that were published by these programs in sources not indexed in the initial search strategy databases. Additionally, we undertook a search of the IARC CanScreen5 website (<https://canscreen5.iarc.fr/>) to identify countries with a documented colon cancer screening policy and available quantitative performance indicator data. For those identified countries, we then used the Google search engine to identify which of these countries had a) First Nations populations and b) colon cancer screening program reports, published in sources not indexed in the initial search strategy databases.

### Selection criteria

Studies were included if they met the following criteria: (1) quantitative study; (2) study population: adult ( $\geq 18$  years) participants, First Nations or Indigenous population; (3) exposure: colorectal cancer screening; (4) outcomes: screening participation rate or sufficient raw data to calculate. Only full text published original data were used for analyses.

Criteria for exclusion were: (1) wrong study design (e.g. qualitative studies, abstracts and posters); (2)

studies not providing usable primary data to calculate screening participation, including when First Nations data has been collected but was unable to be extracted from combined data in the publication; (3) studies conducted in the wrong population (e.g. paediatric ( $<18$  years), non-First Nations population); (4) wrong outcome; and (5) studies reporting duplicated patient cohorts that had already been included.

After removal of duplicates, each title and abstract was reviewed independently by at least two authors using the Rayyan software platform.<sup>25</sup> Discrepancies were resolved by consensus with a further author.

Programs reports identified from the search of the non-indexed literature, were included if they contained useable primary data to calculate program screening participation rates in First Nation populations.

### Data extraction

For articles that met the inclusion criteria, two independent reviewers used standardised data collection forms to extract the following from each study: first author, publication year, journal, country where the study was performed, study design and method of data collection, recruitment period, sampling frame, population and First Nations group, colorectal cancer screening modality, screening participation rate, and if appropriate, reason for exclusion following full-text review. Any data discrepancy between the reviewers was resolved by referring to the original studies.

For non-indexed reports that met the inclusion criteria, two independent reviewers used standardised data collection forms to extract the following from each report where available: author, publication year, reporting country, recruitment period, sampling frame, population and First Nations group, colorectal cancer screening modality, screening participation rate, and if appropriate, reason for exclusion following full-text review. Any data discrepancy between the reviewers was resolved by referring to the original reports.

### Quality assessment

The risk of bias was assessed independently by two authors using the Joanna Briggs Institute appraisal tool for studies reporting prevalence data.<sup>26</sup> Any discrepancy between reviewers was resolved by consensus with a third author. Quality assessment classified papers as low, moderate or high quality based on nine criteria. Studies were rated low quality if they scored 0 to 3 out of 9, moderate quality if they scored 4–6, and high quality if scored 7–9.

### Data synthesis and statistical analysis

We aimed to undertake a meta-analysis if there were sufficient data. However, if this was not possible, the plan was to conduct a narrative synthesis to explore, describe, and interpret the available evidence for screening use among the First Nations populations.

### Ethics and informed consent

Ethical approval was not required for this evidence synthesis. Informed consent was waived for this study design.

### Role of the funding source

There was no funding source for this study. All authors had full access to all the data in the study and accept responsibility for the decision to submit for publication.

## Results

### Search results and study characteristics

The search strategy identified 1723 studies. Following removal of 354 duplicates, 1369 studies underwent title and abstract review. 198 papers were identified for full text evaluation, of which 141 were excluded (Fig. 1). Excluded studies are presented in [Supplementary Figure S2](#). The reasons for exclusion included wrong study design (N = 62), no usable primary data (N = 48), wrong population (N = 25), duplicate study (N = 5), and wrong outcome (N = 1). Therefore, 57 studies were included in the final narrative synthesis (Fig. 1).

Because of wide variations in the populations studied, screening methods used, and definitions of screening status in the included studies, a meta-analysis could not be performed. Therefore, as per the study design, we conducted a narrative synthesis to explore, describe, and interpret the available evidence for colorectal screening participation among First Nations populations.

Screening participation rates were predominantly recorded in these studies as “ever” screened or “up-to-date” screening. Definitions of “ever” screened included ever being screened by sigmoidoscopy or colonoscopy, CT colonoscopy or ever having stool-based screening. While there were a variety of definitions of “up-to-date” screening between populations, study periods and countries, the majority of studies included defined “up-to-date” screening as stool-based screening in the past 1 year, sigmoidoscopy within the past 5 years, or colonoscopy within the past 10 years. Twenty-three studies examined the prevalence of “ever screened” for colorectal cancer among First Nations peoples (Table 1). Of these 23 studies, 19 were from the United States and its Territories, and included American Indians, Alaska Natives, Native Hawaiians, and Chamorro of Guam. The remaining studies were from Australia (and included data in relation to First Nations Australians), Aotearoa New Zealand (and included data in relation to Maori people), Guatemala (and included data in relation to Maya of Southwestern Guatemala), and Dominica (and included data in relation to Kalinago). Ever screening rates in these 19 studies ranged from 2.2% (ever screened for colon cancer among Maya in Guatemala)<sup>29</sup> to 65.6% (ever had a FOBT or colonoscopy among Hopi women).<sup>34</sup> There was wide variability among reported

rates of screening by study design (clinic based-vs. population-based studies), First Nations group and region, as well as the definition used to define ever screened.

Thirty-eight studies examined prevalence of “up-to-date screening” for colorectal cancer among First Nations populations (Table 2). Of these 38 studies, 35 were from the United States and its Territories, and included American Indians, Alaska Natives, Native Hawaiians and Chamorro of Guam. Two studies were from Canada and included First Nations and Metis peoples. One study was from Aotearoa New Zealand and included data in relation to Maori and Pacific people. Data from the United States recorded that up-to-date screening among American Indian and Alaska Native populations was between 4.0% in a 1996–2004 cohort and 79.2% in a 2018–2020 cohort,<sup>53,60</sup> while most studies had a range of 40–50% screening rates. In Canada, approximately 25–40% of First Nations people were up-to-date with colorectal cancer screening.<sup>50,51</sup> One study examining the impact of COVID-19 on colonoscopy screening in the prior 12 months reported a lower rate in 2020 (13.8%) vs. 2014–2019 (17.8%).<sup>61</sup>

Using the Joanna Briggs tool to assess the risk of bias for included studies, 40 were assessed as high quality, 15 as moderate quality and two as low quality ([Supplementary Table S1](#)).

We identified two countries (Australia and Aotearoa New Zealand) whose population-based colorectal cancer screening programs had published, in non-indexed sources, reports that contained data on First Nations population participation rates. The Australian National Bowel Cancer Screening Program began its phased roll-out in 2006. The full program roll-out, with free two-yearly iFOBT testing offered to all those aged 50–74 years, was achieved in 2020. The Australian Institute of Health and Welfare (AIHW), in their 2023 monitoring report of the National Bowel Cancer Screening Program, reported an estimated 31.3% participation rate among Indigenous Australians in the full program for the period 2020–2021 (Table 2).<sup>84</sup> Indigenous participation rates were estimated using 2021 Census proportions.<sup>84</sup> Estimated participation rates among Indigenous Australians in the program reports from the earlier phases of the partially rolled-out program (eight reports in total) ranged from 10.6% in 2008 to 35.2% in 2019–2020 ([Supplementary Table S2](#)).<sup>84,87–94</sup> The phased roll-out of the program may have impacted on participation rates at different periods of the program. In addition, as there is a lack of reliable population identification for Indigenous Australians at the time of invitation, participation rates for Indigenous Australians are estimated based on the latest census proportions for Indigenous Australians. The program monitoring report acknowledges this as a limitation of this data.<sup>84</sup>

In 2016, the New Zealand Ministry of Health published their final evaluation report of the Bowel

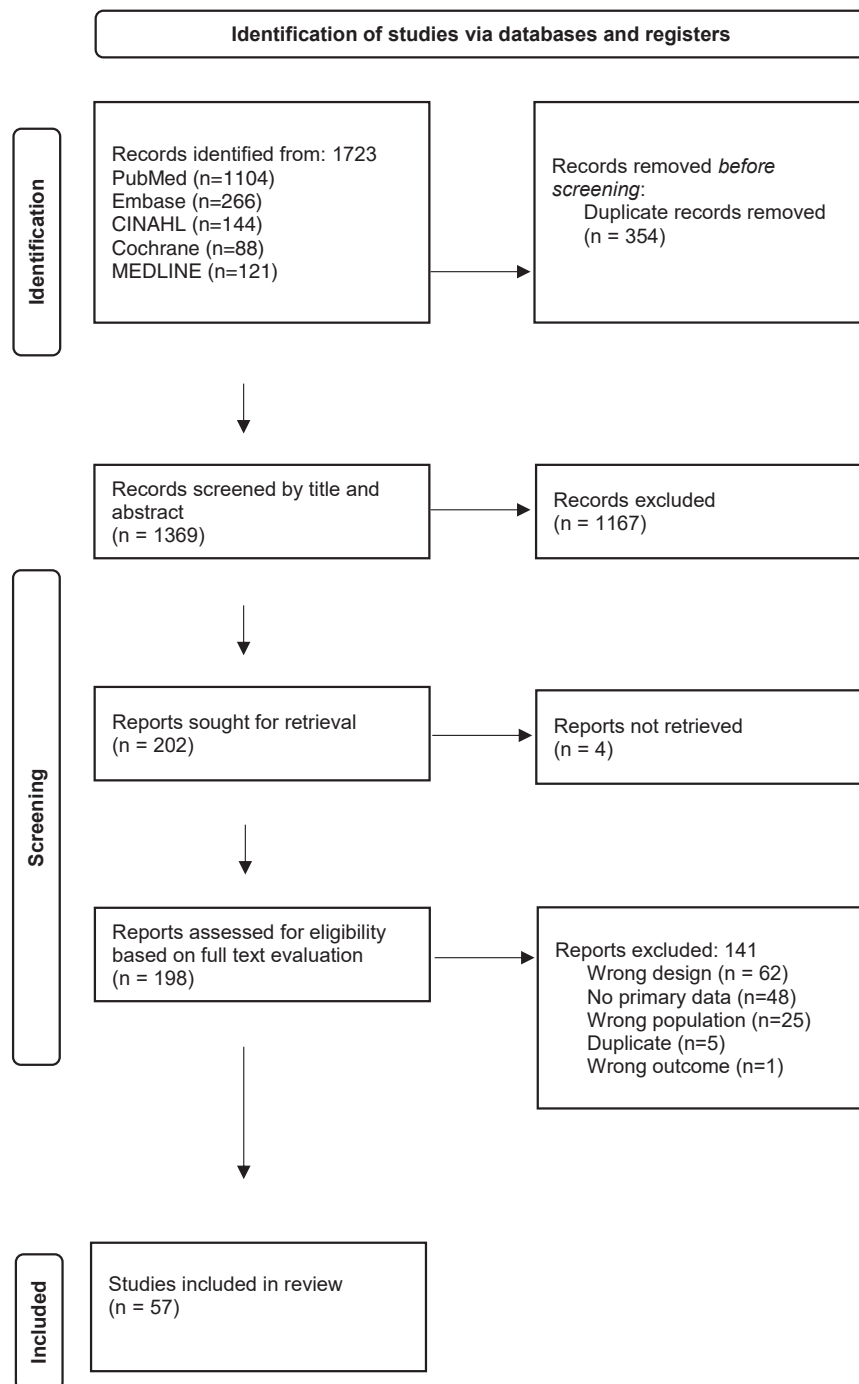


Fig. 1: PRISMA flow diagram.

Screening Pilot conducted in the Waitemata District Health Board Area from 2012 to 2015.<sup>85</sup> The pilot was conducted in two rounds, with a participation rate among Maori of 46.1% in Round 1 and 46.0% in Round 2.<sup>85</sup> The participation rate among Pacific people was 30.6% in Round 1 and 36.7% in Round 2.<sup>85</sup> Among

Maori, participation rate was initially higher in males than females in Round 1 but was similar in males and females in Round 2. Participation rate among Pacific people was similar for males and females in both rounds. Following the pilot, a national colon cancer screening program has begun with the Cancer Society

First author	Country	First nations group	Study period	Study design	Total sample size	M/F	Age range	Modality	Screening rate (95% CI)
Christou (2012) <sup>27</sup>	Australia	Indigenous Australians (Western Australia)	2009–2010	Cross-sectional	91	N/A	≥35	Colonoscopy	15.4% (N/A)
Warner (2023) <sup>28</sup>	Dominica	Kalinago	N/A	Cross-sectional	24	N/A	≥18	FOBT, sigmoidoscopy or colonoscopy	4.2% (N/A)
Arana-Chicas (2020) <sup>29</sup>	Guatemala	Indigenous populations of Southwestern Guatemala (96% Maya)	2019	Cross-sectional	91	8/83	≥50	FOBT, sigmoidoscopy or colonoscopy	2.2% (N/A)
Sandiford (2018) <sup>30</sup>	New Zealand	Maori	2014–2015	Cross-sectional	1388	N/A	50–74	FOBT	43.2% (N/A)
Balajadia (2008) <sup>31</sup>	USA	Chamorro of Guam	2004	Cross-sectional	254	N/A	≥50	FOBT	38.3% (N/A)
Batai (2022) <sup>32</sup>	USA	American Indians (Hopi)	2012	Cross-sectional	102	102/0	≥50	FOBT or colonoscopy	51.0% (N/A)
Batai (2022) <sup>33</sup>	USA	American Indians (Hopi)	2018–2019	Cross-sectional	83	83/0	≥50	FOBT, colonoscopy	71.1% (N/A)
Brown (2015) <sup>34</sup>	USA	American Indians (Hopi)	2012	Cross-sectional	122	0/122	≥50	FOBT, colonoscopy	65.6% (N/A)
Cartwright (2023) <sup>35</sup>	USA	American Indians (Zuni Pueblo)	2020–2021	Cross-sectional	219	N/A	50–75	FOBT, colonoscopy	42.9% (N/A) (FOBT); 36.5% (N/A) (colonoscopy)
Edwardson (2023) <sup>36</sup>	USA	American Indians (Zuni Pueblo)	2020–2021	Cross-sectional	218	109/109	50–75	FOBT or colonoscopy	57.8% (N/A)
Farmer (2005) <sup>37</sup>	USA	Lumbee Indians	N/A	Cross-sectional	N/A	N/A	50–91	FOBT, sigmoidoscopy or colonoscopy	51.8% (N/A)
Gonzales (2012) <sup>38</sup>	USA	American Indians (Hopi)	2007	Cross-sectional	117	43/74	50–87	FOBT, colonoscopy	49.6% (N/A)
Harmon (2014) <sup>39</sup>	USA	Native Hawaiians	1999–2002	Cross-sectional	9912	4347/5565	≥50	Sigmoidoscopy, colonoscopy	31.0% (N/A)
Holm (2010) <sup>40</sup>	USA	American Indian and Alaska Native (Rural, Northern Plains)	2003	Cross-sectional	N/A	N/A	≥50	Sigmoidoscopy, colonoscopy	25.6% (17.0–34.2)
Nguyen (2003) <sup>41</sup>	USA	Chamorro women (San Diego)	2002	Cross-sectional	77	0/77	≥50	FOBT, sigmoidoscopy or colonoscopy	61.0% (N/A)
Pandhi (2010) <sup>42</sup>	USA	American Indians	2004–2006	Cross-sectional	247	96/151	≥51	FOBT, sigmoidoscopy or colonoscopy	17.0% (N/A)
Perdue (2011) <sup>43</sup>	USA	American Indians (Northern Plains and SW Reservation)	N/A	Cross-sectional	751	N/A	≥51	FOBT, sigmoidoscopy or colonoscopy	35.0% (N/A)
Perdue (2013) <sup>44</sup>	USA	American Indian and Alaska Native (women only)	1996–2007	Cross-sectional	286	0/286	50	FOBT, sigmoidoscopy or colonoscopy	13.3% (N/A)
Redwood (2019) <sup>45</sup>	USA	Alaskan Native	2017	Cross-sectional	1616	824/792	40–75	FOBT, sigmoidoscopy or colonoscopy	58.0% (N/A)
Roh (2016) <sup>46</sup>	USA	American Indians (Northern Plains)	2013–2014	Cross-sectional	181	84/97	50–95	Colonoscopy	47.8% (N/A)
Sanderson (2011) <sup>47</sup>	USA	American Indians (Northern Plains)	2006	Cross-sectional	107	27/80	50–79	Sigmoidoscopy, colonoscopy	28.0% (N/A)
Schumacher (2008) <sup>48</sup>	USA	American Indian and Alaska Native (Alaska and Southwest [SW])	2004–2007	Cross-sectional	949 (Alaska); 1830 (SW)	N/A	≥50	FOBT, colonoscopy	51.3% (N/A) (Alaska); 16.6% (N/A) (SW)
Wernli (2014) <sup>49</sup>	USA	American Indians	1996–2010	Prospective	475	N/A	50–55	FOBT, sigmoidoscopy or colonoscopy	34.9% (N/A)

CI, Confidence Interval. FOBT, Faecal occult blood test or stool-based screening test. USA, United States of America. M, male, F, female. N/A, not available.

**Table 1: Colorectal cancer “ever” screening rates in First Nations populations.**

of New Zealand, in their online 2022 position statement, reporting a 49% Māori and 39% Pacific people participation rate in the Aotearoa New Zealand National Bowel Screening Program<sup>86</sup> (Table 2).

## Discussion

This systematic literature review suggests colorectal cancer screening participation rates in First Nations people are widely varied between population groups.

First author	Country	First Nations group	Study period	Study design	Total sample size	M/F	Age range	Up-to-date screening definition	Screening rate (95% CI)
Decker (2015) <sup>50</sup>	Canada	Winnipeg First Nations	2008	Cross-sectional	N/A	N/A	50–74	Sigmoidoscopy, colonoscopy: 5 years. FOBT: 2 years.	25.5% (24.1–27.0)
Withrow (2014) <sup>51</sup>	Canada	Ontario First Nations and Metis	2007–2011	Cross-sectional	N/A	N/A	50–74	Sigmoidoscopy, colonoscopy: 10 years. FOBT: 2 years.	28.5% (15.7–41.3) (First Nations Male FOBT)/ 39.6% (29.8–49.3) (Females). 23.6% (15.7–31.3) (Metis Males FOBT)/22.4% (15.2–29.6) (Females). 52.3% (39.9–64.7) unscreened (First Nations Male FOBT or endoscopy per criteria)/ 38.8% (29.0–48.5) unscreened (Females), 53.4% (40.5–66.2) unscreened (Metis Males FOBT or endoscopy per criteria)/ 46.0% (34.2–57.7) (Females).
Bartholomew (2019) <sup>52</sup>	New Zealand	Maori and Pacific	2013	Cross-sectional	1304 (Maori); 1579 (Pacific)	N/A	≥50	FOBT: 2 years	25.9% (N/A) (Maori), 18.4% (N/A) (Pacific)
Balcerak (2023) <sup>53</sup>	USA	American Indian and Alaska Native	2018–2020	Cross-sectional	N/A	N/A	50–75	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	79.2% (N/A)
Bandi (2021) <sup>54</sup>	USA	American Indian and Alaska Native	2018	Cross-sectional	N/A	N/A	50–75	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	56.0% (45.5–66.1)
Brown (2015) <sup>34</sup>	USA	American Indians (Hopi)	2012	Cross-sectional	122	0/122	≥50	Colonoscopy: 10 years.	39.3% (N/A)
Burnett-Hartman (2016) <sup>55</sup>	USA	American Indian and Alaska Native	2010–2012	Cross-sectional	7824	3571/ 4253	50–75	FOBT, sigmoidoscopy or colonoscopy: 18 months.	47.7% (N/A)
Cassel (2020) <sup>56</sup>	USA	Native Hawaiian (Kane)	2014–2018	Cross-sectional	216	N/A	N/A	FOBT, sigmoidoscopy or colonoscopy: 2 years.	42.0%
Cole (2013) <sup>57</sup>	USA	American Indian and Alaska Native	1998–2005	Cross-sectional	N/A	N/A	≥50	FOBT: 1 year. Sigmoidoscopy, colonoscopy: 5 years.	38.2% (34.6–41.7) (urban); 35.8% (31.8–39.9) (rural)
Coughlin (2004) <sup>58</sup>	USA	American Indian and Alaska Native	1999	Cross-sectional	18,048 (rural); 6538 (Suburban); 34,937 (metro)	N/A	≥50	Sigmoidoscopy, colonoscopy: 5 years.	34.6% (25.1–47.6) (rural), 22.2% (12.2–40.5) (suburban), 36.4% (29.1–45.6) (metro)
Crawley (2008) <sup>59</sup>	USA	American Indian and Alaska Native	2003–2005	Cross-sectional	7752	3194/ 4558	50–75	Sigmoidoscopy, colonoscopy: 5 years. FOBT: 1 year.	33.7% (N/A) (women); 48.2% (N/A) (men)
Day (2011) <sup>60</sup>	USA	American Indian and Alaska Native	1996–2004	Cross-sectional	142,051	57,529/ 84,505 (17 unknown sex)	50–80	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	4.0% (N/A)
Dennis (2021) <sup>61</sup>	USA	American Indian and Alaska Native	2014–2019	Cross-sectional	9459 (2014–2019); 2226 (2020)	N/A	50–75	Sigmoidoscopy, colonoscopy: 1 year.	17.8% (N/A) (2014–2019); 13.8% (N/A) (2020)
Domingo (2018) <sup>62</sup>	USA	Native Hawaiian	2011–2014	Cross-sectional	1456	N/A	50–75	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	62.1% (N/A)
DuBard (2009) <sup>63</sup>	USA	American Indian and Alaska Native	2006	Cross-sectional	776	N/A	50–80	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	32.6% (N/A)
Fedewa (2017) <sup>64</sup>	USA	American Indians	2007–2012	Prospective	489	232/257	≥50	FOBT: 1 year.	78.3% (N/A)

(Table 2 continues on next page)

First author	Country	First Nations group	Study period	Study design	Total sample size	M/F	Age range	Up-to-date screening definition	Screening rate (95% CI)
(Continued from previous page)									
Gutnik (2022) <sup>65</sup>	USA	American Indian and Alaska Native	2016	Cross-sectional	3593	N/A	50–75	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	54.0% (N/A)
Hamman (2015) <sup>66</sup>	USA	American Indians	2002–2008	Cross-sectional	2234	N/A	50–64	Sigmoidoscopy, colonoscopy: 5 years.	45.0% (N/A)
Haverkamp (2020) <sup>67</sup>	USA	American Indian and Alaska Native	2014	Prospective	566	275/291	50–75	FOBT: 1 year. Sigmoidoscopy 5 years AND FOBT 3 years. Colonoscopy: 10 years.	6.4% (N/A)
Henley (2010) <sup>68</sup>	USA	American Indian and Alaska Native	2008	Cross-sectional	2829	1145/1684	50–75	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	53.9% (49.1–58.7) (women); 53.0% (47.0–59.0) (men)
Holm (2010) <sup>40</sup>	USA	American Indians	2003	Cross-sectional	N/A	N/A	≥50	FOBT: 2 years.	9.5% (5.1–16.9)
Johnson–Jennings (2014) <sup>69</sup>	USA	American Indian and Alaska Native	2001–2010	Cross-sectional	4969	2475/2494	≥50	Sigmoidoscopy, colonoscopy: 5 years. FOBT: 1 year.	45.6% (N/A)
Johnston (2021) <sup>70</sup>	USA	American Indians	2015–2018	Cross-sectional	476	N/A	≥45	FOBT, sigmoidoscopy or colonoscopy: 2 years.	62.5% (N/A)
Joseph (2016) <sup>71</sup>	USA	American Indian and Alaska Native	2009–2012	Cross-sectional	N/A	N/A	50–80	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	Alaska: 58.4% (N/A) (vs. Alaska BRFSS 2012 59.8%); Washington: 48.0% (N/A) (2009, 50.9%; 2012, 58.4%)
Kane (2023) <sup>72</sup>	USA	American Indian and Alaska Native	2018	Cross-sectional	N/A	N/A	50–75	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	62.7% (59.2–66.2)
Kelly (2007) <sup>73</sup>	USA	American Indians (Lumbee)	1998–2002	Cross-sectional	57	14/43	≥51	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	21.1% (N/A)
Liss (2014) <sup>74</sup>	USA	American Indian and Alaska Native	2010	Cross-sectional	3171	1719/1452	50–75	FOBT: 1 year. Sigmoidoscopy 5 years AND FOBT 3 years. Colonoscopy: 10 years.	49.5% (N/A)
Maly (2014) <sup>75</sup>	USA	American Indians (Cowlitz tribe)	2009–2010	Cross-sectional	229	N/A	≥50	Sigmoidoscopy, colonoscopy: 5 years. FOBT: 5 years.	61.0% (N/A)
May (2019) <sup>76</sup>	USA	American Indian and Alaska Native	2014	Cross-sectional	867	N/A	50–75	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	75.3% (N/A)
May (2020) <sup>77</sup>	USA	American Indian and Alaska Native	2008–2016	Cross-sectional	2305 (2008); 2731 (2010); 2987 (2012); 2984 (2014); 3226 (2016)	N/A	50–75	FOBT: 1 year. Sigmoidoscopy 5 years AND FOBT 3 years. Colonoscopy: 10 years.	55.2% (50.8–59.6) (2008); 53.9% (49.7–58.1) (2010); 53.2% (49.3–57.0) (2012); 57.2% (53.3–61.1) (2014); 59.4% (55.9–62.9) (2016)
Muller (2017) <sup>78</sup>	USA	American Indian and Alaska Native	2013–2014	Cross-sectional	404	178/226	50–75	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	11.1% (N/A)
Muus (2009) <sup>79</sup>	USA	American Indian and Alaska Native	2004–2005	Cross-sectional	2447	2447/0	≥55	FOBT: 1 year.	23.4% (N/A)

(Table 2 continues on next page)



First author	Country	First Nations group	Study period	Study design	Total sample size	M/F	Age range	Up-to-date screening definition	Screening rate (95% CI)
(Continued from previous page)									
Nguyen (2003) <sup>41</sup>	USA	Chamorro	2002	Cross-sectional	77	0/77	≥50	Sigmoidoscopy, colonoscopy: 5 years. FOBT: 1 year.	54.5% (N/A)
Schumacher (2008) <sup>45</sup>	USA	American Indian and Alaska Native (Alaska and Southwest)	2004–2007	Cross-sectional	2745	950/1795	≥50	Sigmoidoscopy, colonoscopy: 5 years.	22.0% (N/A)
Shah (2022) <sup>80</sup>	USA	American Indian and Alaska Native	2019	Cross-sectional	N/A	N/A	50–75	FOBT: 1 year. Sigmoidoscopy: 5 years. Colonoscopy: 10 years.	36.2% (N/A) (women); 47.3% (N/A) (men)
Simonds (2011) <sup>81</sup>	USA	American Indian and Alaska Native	2001–2005	Cross-sectional	981	N/A	≥50	Proctoscopy, sigmoidoscopy, colonoscopy: 5 years. FOBT: 1 year	47.5% (N/A)
Steele (2008) <sup>82</sup>	USA	American Indian and Alaska Native	2000–2006	Cross-sectional	32,426	N/A	≥50	Sigmoidoscopy, colonoscopy: 5 years. FOBT: 1 year.	44.0% (40.8–47.2)
Watanabe-Galloway (2011) <sup>83</sup>	USA	American Indian and Alaska Native (Northern Plains only)	1997–2006	Cross-sectional	N/A	N/A	≥50	Sigmoidoscopy, colonoscopy: 5 years.	32.0% (25.0–39.9) (1997–2000); 31.5% (24.8–39.1) (2003–2006); (AI/AN other US 2003–2006: 37.1%; 33.8–40.4)
<b>Monitoring reports</b>									
AIHW (2023) <sup>84</sup>	Australia	Indigenous Australians	2020–2021	N/A	N/A	N/A	50–74	FOBT	31.3%
NZ Ministry of Health (2016) <sup>85</sup>	NZ	Maori and Pacific	2012–2015	N/A	N/A	N/A	50–74	FOBT	30.6%–46.1%
Cancer Society of NZ (2022) <sup>86</sup>	NZ	Maori and Pacific	2017–2022	N/A	N/A	N/A	60–74	FOBT	39–49%
CI, Confidence Interval. FOBT, Faecal occult blood test or stool based screening test. USA, United States of America. NZ, New Zealand. M, male, F, female. N/A, not available. AIHW, Australian Institute of Health and Welfare.									
<b>Table 2: Colorectal cancer “up-to-date” screening rates in First Nations populations.</b>									

Participation in colorectal cancer screening has shown to improve survival with, a 40% reduction in death from colorectal cancer compared to patients diagnosed another way.<sup>95</sup> It is therefore plausible that population groups that have lower screening rates have poorer colorectal cancer outcomes.<sup>12–15</sup> This systematic review highlights, that despite First Nations populations being recognised as high-priority, vulnerable population for colorectal cancer, there is limited literature available with sufficient primary data to adequately inform screening interventions to improve colorectal cancer outcomes for First Nations people.

Participation rates for ever screened in US First Nations people ranged between 13.3 and 71.1%, depending on the US First Nations group and time of data collection,<sup>32,44</sup> compared to the US Centres for Disease Control and Prevention reports of 72% in the overall population in 2020.<sup>96</sup> Australian First Nations participation was reported as 15.4% in a study of Indigenous Western Australians in 2012,<sup>27</sup> and 31.3% in

the 2023 monitoring report of the national program.<sup>84</sup> This compares to 40.9% of the overall population who participated in the program in 2020–2021.<sup>84</sup> Aotearoa New Zealand First Nations up-to-date screening was 18.4% for Pacific people and 25.9% for Maori people in a study during a pilot bowel screening programme for a 2013 cohort.<sup>52</sup> More recent data in 2022 found that while Maori and Pacific participation (49% and 39% respectively) have increased, they are still lower than the overall population screening rate of 63%.<sup>86</sup> Canadian First Nations ranged between 22.4 and 53.4%,<sup>51</sup> compared to rates of 20–51% based on jurisdiction in the overall population.<sup>97</sup> This suggests that overall colorectal screening participation rates in First Nations worldwide are likely lower than rates in the overall population. This may partially explain why colorectal cancer incidence and mortality rates remain higher in First Nations people despite the implementation of screening services.<sup>12–16</sup> Interestingly, Canadian First Nations studies and four of the 50 US studies had

comparable First Nations screening rates compared to the overall population, and perhaps there are lessons to learn from these regions.<sup>32,50,51,53,64,76</sup>

This is the first study to systematically investigate quantitative literature on colorectal cancer screening in First Nations populations worldwide, using robust, reproducible methodology following PRISMA guidelines. The methods used in our systematic review were designed to limit bias, using a minimum of two independent reviewers at all stages of the research process from abstract screening, full text review, data extraction to quality assessment. Previous systematic reviews have largely been limited to qualitative studies.<sup>98</sup>

Our study exposes the important absence of high-quality data to allow systematic meta-analysis for this important issue. The reviewed literature allows some inference of consistently observed themes indicating disparities in colorectal cancer screening, with lower utilisation in First Nations relative to non-First Nations people. A weakness of the studies identified for this review is that most were descriptive and lacked a direct comparator population, limiting how to best understand discrepancies in screening rates. Another limitation was the paucity of data examining trends in screening rates over time, with most study designs being cross-sectional.

There were limited data available outside the United States, with 50 of the 57 identified in the US alone. There were two Canadian studies and Aotearoa New Zealand studies one study each from Australia, Guatemala and Dominica highlighting a distinct need for more nation specific data. First Nations populations are heterogeneous, as shown across populations within the United States, and this study acknowledges that extrapolating data across and between national settings for First Nations populations may be hazardous.<sup>18</sup> Similarly, national-level data on First Nations people's cancer outcomes may aggregate data to a level (state-based, region-based) that fails to inform service planning. Another limitation of this study was the variability in screening methods (FOBT, sigmoidoscopy, colonoscopy) and information regarding screening access, such as whether patients received screening through population level interventions versus opportunistic screening via local health providers. This information was not consistently available across studies.

In interpreting the findings of any systematic review, publication bias needs to be considered. Given the paucity of data, we were unable to undertake a meta-analysis and quantitative methods to statistically assess for publication bias. A recent review of evidence-based practice in Indigenous health and social settings, highlighted the issue of publication bias and the factors contributing to it, including institutionalised racism in academia, exclusion from editorial gatekeeping processes and lack of resources to publish.<sup>99</sup> Our inclusion of grey literature, or evidence not published in indexed

sources, has helped to mitigate some publication bias.<sup>100</sup> Grey literature was able to provide a more balanced picture of available evidence, such as the inclusion of result estimates in national reports that may not have otherwise been highlighted.

Limited publications and lower cancer screening participation, where comparison is possible, may indicate the ongoing effects of colonialism that are shared between these First Nations groups. Postcolonial theories draw attention to the sociocultural and historical context in which our health system exists,<sup>101</sup> to allow for critical analysis of the colonial experience of health in First Nations people.<sup>18</sup> It is important to recognise that colorectal cancer screening decisions for First Nations occur in a setting of multiple competing health priorities, intersection between race, politics and power dynamics, which can have synergistic or compounding negative effects on health.<sup>17,18</sup> First Nations people share a disproportionate burden of morbidity and mortality associated with non-communicable diseases like obesity, cardiovascular disease, and diabetes worldwide.<sup>102</sup> Cancer screening participation and outcomes occur amongst a complex, interdependent web of social determinants for health that include, but are not limited to lower socio-economic status, discrepant health literacy, education levels and opportunities, and frequent cultural and geographic isolation from health services.<sup>103</sup>

Adopting a postcolonial perspective allows health systems to more effectively achieve the UN's SDG 10 to reduce health inequities seen within and among countries.<sup>104</sup> The exploration of structural, social and cultural barriers are required to develop of a more culturally responsive health systems approach to achieve health equity in colorectal cancer outcomes.<sup>98,105</sup> Studies in Native Hawaiian populations cite historic dispossession, discrimination, lack of medical insurance and fatalistic attitudes towards colorectal cancer as reasons for screening avoidance.<sup>106</sup> Chamarro people residing in Guam reported a preference for visiting traditional healers rather than seeking Western medical services for cancer detection and management.<sup>31</sup> A study of Maori people identified barriers including lack of cultural competency of health care practitioners and a dearth of First Nations-specific colorectal cancer health promotion.<sup>22</sup>

In Australia, barriers to screening exist at multiple levels. Australian studies highlight the themes of shame, cancer fatalism, low health literacy, and institutional mistrust in returning government distributed stool screening kits.<sup>98,107,108</sup> Cancer-related service delivery is also limited by geography, whereby home FOBT kits are temperature sensitive, necessitating a 'hot zone policy'.<sup>109</sup> The 'hot zone policy' means that kits are not sent to areas that average monthly temperatures above 30 °C during certain times of the year.<sup>109</sup> Areas affected by this policy are usually more remote and have higher Indigenous populations than other areas not deemed to

be hot zones.<sup>109</sup> At the health systems level, competing political agendas, insufficient First Nations input in policy design, implicit bias and funding structures have been identified as barriers.<sup>16,31</sup>

It is important to note, that in response to access and response difficulties, the Australian National Bowel Cancer Screening Program has been implementing alternative access to screening for vulnerable, under-screened populations, with a focus on First Nations health services. The “Alternative Access Model” enables iFOBT screening kits to be administered directly by the local health service to the individual, thus reducing barriers to screening.<sup>110</sup>

Our study has several potential policy and practice implications. On a policy level, this study presents systematically collected health data for analysis and interpretation that may be helpful to inform health planning and policy. This includes the goals of capacity building and the inclusion of First Nations peoples in driving and addressing the issues of access, availability and engagement in colorectal cancer screening for First Nations populations.

Given the low availability of data, ensuring that insights can be shared across different First Nations groups is critical, while appreciating that within the term “First Nations” includes a rich social and cultural diversity. Ongoing frequent evaluation of colorectal cancer screening in local First Nations populations would assist in targeted political advocacy and strategic planning.

It is of note 48 studies were excluded as they contained no primary data for First Nations populations. The AIHW notes that participation rates for First Nation Australians are likely underestimates due to the large proportion of those whose First Nations status is not stated, not available or misclassified.<sup>94</sup> Meanwhile, it is possible some USA studies may overestimate the true First Nations CRC screening rate due to inclusion of diagnostic and surveillance exams due to misclassification errors in medical records.<sup>111</sup> The UN’s SDG target 17.18 calls for the “availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location, and other characteristics relevant in national contexts”.<sup>112</sup> Data disaggregation or the inclusion of primary data in relation to First Nations populations is required to capture the inequities First Nations people face across the UN SDGs and monitor progress for First Nations peoples. It should be a national priority that data disaggregation includes First Nations “identifiers” in official statistics recording to allow for self-identification from a human rights-based approach to data collection. Furthermore, equally partnering with First Nations health researchers is vital to enhance the emerging field of First Nations inquiry to ensure First Nations people are the main beneficiaries and can determine the research agenda at all levels.<sup>113,114</sup>

Poorer survival for First Nations people with colorectal cancer needs to be addressed urgently. Without adequate data, discrepancies cannot be highlighted, and discrepant outcomes may not be apparent. Without addressing the problem of colorectal cancer screening participation rates, this will continue to be a barrier to achieving health equity for First Nations people.

Colorectal cancer screening participation rates for First Nations populations vary widely but are generally below the rates for non-First Nations populations. This may account for some of the discrepant outcomes experienced by First Nations people in poorer morbidity and mortality from colorectal cancer. Significant heterogeneity in the populations studied, method of screening, and definitions of screening status precluded meta-analytic review. Disaggregation of data are required to better understand First Nations colorectal cancer outcome inequities. Data and research that is informed by First Nations peoples and informs public policy and community action is needed to address gaps in colorectal cancer screening, and in turn overcome the intolerable discrepancy in poorer survival outcome for First Nations people with colorectal cancer.

#### Contributors

LP, BK and AT conceptualised the study. LP wrote the protocol and the initial draft of the manuscript. CD did the literature search. LP, PC, GM, JT, AF, AT and BK collected and interpreted the data. AT did the statistical analysis. All authors had full access to the data and provided critical revision and final approval of the manuscript. All authors accept responsibility for the decision to submit for publication. LP, BK and AT have access to and verify the underlying study data.

#### Data sharing statement

Data are presented in the manuscript and appendices. Further data he findings of this study are available from the corresponding author, LP, on reasonable request.

#### Declaration of interests

AF sits on the Clinical Advisory Board for the Australian National Bowel Cancer Screening Program. This organisation had no input into study design, data analysis or interpretation.

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#### Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.eclinm.2024.102666>.

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