

## RESEARCH ARTICLE

# Knowledge of Evidence-Based Cancer Risk Factors Remains Low Among New Zealand Adults: Findings from Two Cross-Sectional Studies, 2001 and 2015

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### Abstract

**Objective:** Cancer risk reduction messages are a part of cancer control efforts around the world. The complex reality is that risk factors differ for different types of cancer, making clear communication of desired behavioural changes more difficult. This study aims to describe awareness of risk factors for breast, bowel, cervical, prostate and lung cancer and cutaneous melanoma among New Zealanders in 2014/15 and identify changes in awareness since 2001. **Methods:** Two national telephone surveys, the first (CAANZ01) conducted in 2001, included 438 adults (231 females and 207 males, 64% response rate). The second, conducted in 2014/15 (CAANZ15), included 1064 adults (588 females and 476 males, 64% response rate). **Results:** In 2014/5, most participants could identify evidence-based risk factors for lung cancer and melanoma. In contrast, many participants were unable to name any risk factors (evidence-based or otherwise) for bowel (34.8%), breast (48.8%), cervical (53.9%) and prostate cancer (60.9%). Between 2001 and 2014/5 there were increases in the proportion of individuals identifying sunbeds as increasing melanoma risk, and alcohol consumption and family history as increasing risk for bowel and breast cancer. **Conclusions:** Effective communication of risk information for specific cancers remains a challenge for cancer control. Although some positive changes in awareness over the 14 year period were observed, there remains substantial room for progressing awareness of evidence-based risk factors.

**Keywords:** Cancer- awareness- knowledge- population survey

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### Introduction

Cancer is a leading cause of mortality in many countries around the world, placing a significant burden on national health services and the communities they serve (Stewart and Wild, 2014). With epidemiological evidence suggesting a substantial proportion of this burden is potentially preventable through modification of lifestyle or environmental factors (Harvard Report on Cancer Prevention, 1997; Parkin et al., 2011), cancer risk reduction messages such as being smokefree, sunsmart, maintaining a healthy weight and eating a diet high in fruit and vegetables are common to cancer control programmes around the world.

While these messages are important for reducing the cancer burden, overall, the more complex reality is that risk factors differ across different cancer types. This creates challenges for communication of cancer risk information, with providers needing to balance the provision of accurate and accessible information for all

cancer types, with concerns about ‘cancer information overload’ and the resulting disempowering public perceptions that ‘everything seems to cause cancer’ (Niederdeppe and Levy, 2007; Jensen et al., 2014).

Awareness of evidence-based risk factors is considered an important part of cancer literacy (Diviani and Schulz, 2011). Cancer literacy is akin to overall health literacy but specific to cancer control. It is defined as “all the knowledge a layperson needs to possess to understand the information and advice the health system has to offer with regard to preventing, diagnosing and treating cancer” (Diviani and Schulz, 2011). Though an emerging concept, cancer literacy appears to be associated with cancer information seeking and screening intentions and participation (Diviani and Schulz, 2014), suggesting its potential utility within broader behaviour modification strategies.

While this link between cancer literacy, intentions and behaviour is promising, studies suggest there is often a divergence between perceptions of cancer risk factors

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among the general public and those of expert reviews or consensus statements from the scientific community (Wardle et al., 2001; Waller et al., 2004). Interestingly, the degree of divergence between these views differs between cancer types, reflecting varying public profiles for different cancer types. For instance, there is high public recognition of a link between smoking and lung cancer (Simon et al., 2012; Crane et al., 2016) and excessive sun exposure with cutaneous melanoma (Miles et al., 2005; Keeney et al., 2009) which is aligned with epidemiological evidence for these cancer types (Armstrong et al., 2004; Alberg et al., 2007).

In contrast to lung cancer and melanoma, studies suggest more limited awareness of risk factors for cervical, breast and bowel cancer. For cervical cancer, there is low awareness of human papillomavirus (HPV) as a key risk factor, though higher awareness is observed for cofactors related to the transmission of HPV (e.g. number of sexual partners) (Marlow et al., 2007; Low et al., 2012). Risk factors for breast cancer include inactivity, overweight and alcohol consumption (Barnes et al., 2011), however, studies suggest awareness of these influences is relatively low (Dumalaon-Canaria et al., 2014; Thomson et al., 2014). Similarly with bowel cancer, modifiable behavioural factors that can increase risk include alcohol consumption, diet, being overweight and inactivity (Bosman, 2014; Bhat and East, 2015), but studies suggest recall is relatively low for all except for factors related to diet (McCaffery et al., 2003; Christou and Thompson, 2012).

Prostate cancer provides another contrast, with current evidence suggesting there is relatively little in the way of modifiable risk factors (Bostwick et al., 2004), yet several lifestyle factors are commonly identified by the public as reducing risk (Schulman et al., 2003; Fitzpatrick et al., 2009). In this example, a potential concern for cancer control efforts is when individuals may have unfounded expectations of reduced risk, which may be associated with shifting of resources away from appropriate early detection behaviours.

Despite the inclusion of cancer risk awareness as part of cancer control efforts around the world there is currently little international literature exploring how this has changed over time. This is critical information for cancer control agencies, given the rapid changes in the information and media environment over the past decade. In New Zealand (NZ), the government has set a goal to raise, between 2015 and 2018, the proportion of the population who are aware of cancer risk behaviours (Ministry of Health, 2014). The Cancer Awareness in Aotearoa Study (CAANZ15) provides a baseline for assessing success in this goal as well as allowing comparison to be made with 2001 data (CAANZ01) (Richards, 2016a). Initial findings for awareness of overall cancer risk suggest that, while some gains have been made, substantial gaps in population awareness remain (Richards, In press).

The current study, drawing on data from CAANZ01 and CAANZ15, aims to describe awareness of risk factors for specific types of cancer that are common in NZ (breast, bowel, cervical, cutaneous melanoma, prostate and lung

cancer (Ministry of Health, 2015)) among adult New Zealanders in 2014/5, and identify changes in patterns of awareness since 2001.

## Materials and Methods

This study uses data from two study cohorts, with specific detail about sample selection and measurement published elsewhere (Reeder and Trevena, 2003; Trevena and Reeder, 2007; Richards, 2016a). A summary of methods is provided below.

### Participants

The first cohort consists of 438 adults (231 females and 207 males, 64% response rate), sampled between August and September 2001, and described hereafter as CAANZ01 (Reeder and Trevena, 2003; Trevena and Reeder, 2007). This sample was selected using random digit telephone dialling, using public directories and sample quotas set to reflect the age, sex and ethnicity of the general population. A booster sample of Māori (the indigenous population of New Zealand) was also drawn from the electoral rolls in an effort to obtain adequate representation. For the second cohort (CAANZ15), 1064 individuals (588 females and 476 males, 64% response rate), were sampled between November 2014 and March 2015 (Richards, 2016a). This sample was randomly selected entirely from the electoral rolls, and telephone numbers traced from this information. As with the previous study, a booster sample of Māori respondents was also drawn from electoral rolls.

As described in detail elsewhere, (Reeder and Trevena, 2003; Trevena and Reeder, 2007; Richards, 2016a), compared to the general adult population of NZ these cohorts had higher socioeconomic status (as reflected by occupation (CAANZ15) and education (CAANZ01)) and were under-representative of individuals of Pacific and Asian ethnicity, and, to a lesser degree, those of Māori ethnicity. The CAANZ15 sample also had a larger proportion of older participants than both the general NZ population and the CAANZ01. To help address sampling issues and facilitate comparison between cohorts weighting and standardisation of the cohorts were carried out, described further in the analysis section.

### Procedures

Data were collected via telephone administered questionnaires conducted by trained interviewers. In the case of CAANZ01, interviewers made direct contact with participants over the telephone, for CAANZ15, participants received an introduction letter and information sheet about the study prior to a phone call. Ethical approval for CAANZ01 and CAANZ15 was obtained from the University of Otago Ethics Committee (Reference number 00/03/10) and the Department of Preventive and Social Medicine Ethics Committee (Reference number: D14/369) respectively. Informed consent was obtained from all individual participants included in the study.

### Measures

Both cohorts were asked an identical series of questions about cancer awareness, beginning with open-ended

questions to ascertain unprompted knowledge of cancer risk factors; ‘Do you know of anything that increases the risk of getting melanoma’, ‘Do you know of anything that increases the risk of getting bowel cancer’, ‘Do you know of anything that increases the risk of getting lung cancer’. In CAANZ01, only women were asked ‘Do you know of anything that increases the risk of getting breast cancer’ and ‘Do you know of anything that increases the risk of getting cervical cancer’, while only men were asked ‘Do you know of anything that increases the risk of getting prostate cancer’. In the 2014/5 survey both men and women were asked all questions. Responses were recorded by interviewers and multiple responses were prompted.

*Analyses*

Answers to open-ended questions were coded into categories, with the most common responses (>4%) reported here. All categorisation was checked by a second member of the research team and any discrepancies

resolved through discussion. The survey data were weighted to adjust for poststratification of the sample population relative to the age group (18-29 (20-29 in CAANZ01), 30-49, 50-69, and 70+ years) nested within Māori/non-Māori ethnicity distribution of the NZ population (according to 2013 NZ census data) (Statistics New Zealand, 2015). Statistical analysis was performed in Stata using the survey commands to accommodate the survey design (Stata Corp, 2013). As the survey data were weighted, maximum pseudolikelihood was used to obtain the proportion estimates and Taylor linearization to compute the appropriate standard errors. The test for a difference in proportions was used to assess both intra-year sex differences and differences between cohorts. The two-sided significance level  $\alpha=0.05$  was specified for all statistical tests.

**Results**

In 2014/5, only 1.6% of participants could not identify

Table 1. Perceptions of Risk Factors for Lung Cancer, Bowel Cancer and Melanoma in 2001 and 2014/5

	2001*				2014/5				Overall year Difference	
	male	female	total	Sex Difference	male	female	total	Sex Difference	Difference	p
<b>Lung</b>										
None/don't know	0	1.8	1	<b>1.8 (0.2, 3.4)</b>	1.5	1.8	1.6	0.3 (-1.2, 1.8)	0.7 (-0.5, 1.8)	0.24
Smoking tobacco/cigarettes	98.6	96.9	97.7	-1.7 (-5.0, 1.6)	97.8	97.4	97.6	-0.4 (-2.4, 1.5)	-0.1 (-2.1, 1.9)	0.898
Occupational exposure	14	13.5	13.7	-0.5 (-7.0, 6.0)	35.4	24.2	29.1	<b>-11.2 (-17.6, -4.8)</b>	<b>15.4 (10.9, 19.9)</b>	<b>&lt;0.001</b>
Contact with asbestos	20.7	11.5	15.8	<b>-9.2 (-16.1, -2.3)</b>	25.9	18.9	22	<b>-7.0 (-12.5, -1.5)</b>	<b>6.2 (1.9, 10.6)</b>	<b>0.005</b>
Air pollution	16	9.5	12.5	-6.5 (-13.1, 0.1)	21.7	12.7	16.7	<b>-8.9 (-14.3, -3.5)</b>	4.1 (-0.1, 8.3)	0.055
Other industrial pollution	10.8	5.3	7.9	<b>-5.5 (-10.6, -0.4)</b>	19.7	13.6	16.3	<b>-6.0 (-11.3, -0.8)</b>	<b>8.4 (4.8, 12.0)</b>	<b>&lt;0.001</b>
Second hand tobacco smoke	12.5	11.2	11.8	-1.3 (-7.6, 5.0)	9.9	14.4	12.4	<b>4.5 (0.1, 9.0)</b>	0.6 (-3.3, 4.4)	0.763
Exposure to chemicals	4.3	5.6	5	1.3 (-2.8, 5.3)	1.7	1.9	1.8	0.2 (-1.9, 2.2)	<b>-3.2 (-5.5, -0.9)</b>	<b>0.005</b>
Exposure to fumes	5.8	2.7	4.1	-3.1 (-6.9, 0.7)	1.1	0.2	0.6	-0.9 (-2.3, 0.6)	<b>-3.5 (-5.4, -1.5)</b>	<b>&lt;0.001</b>
<b>Bowel</b>										
None/don't know	53.5	52.2	52.8	-1.3 (-10.9, 8.3)	36.8	33.3	34.8	-3.4 (-10.5, 3.7)	<b>-18.0 (-23.9, -12.0)</b>	<b>&lt;0.001</b>
Diet (not further specified)	34	29.2	31.5	-4.8 (-13.7, 4.1)	44.9	43.2	43.9	-1.7 (-8.7, 5.2)	<b>12.5 (6.8, 18.1)</b>	<b>&lt;0.001</b>
Eating too little fibre	15	18.2	16.7	3.2 (-3.7, 10.2)	11.9	17.6	15.1	<b>5.7 (1.1, 10.3)</b>	-1.6 (-5.8, 2.6)	0.462
Family history of bowel cancer	2.1	11.2	7	<b>9.1 (4.6, 13.6)</b>	11.7	16.4	14.3	<b>4.7 (0.1, 9.3)</b>	<b>7.3 (4.0, 10.7)</b>	<b>&lt;0.001</b>
Eating too much fat	11.4	5	8	<b>-6.3 (-11.5, -1.1)</b>	8.8	7.1	7.8	-1.7 (-5.2, 1.8)	-0.2 (-3.2, 2.9)	0.917
Eating meat	4.7	4.7	4.7	-0.0 (-3.9, 3.9)	9.4	6.8	7.9	-2.6 (-6.0, 0.8)	<b>3.2 (0.6, 5.8)</b>	<b>0.015</b>
Alcohol consumption	6.1	1.9	3.8	<b>-4.2 (-7.9, -0.4)</b>	7.5	6.5	6.9	-1.1 (-4.8, 2.7)	<b>3.1 (0.5, 5.7)</b>	<b>0.019</b>
<b>Melanoma</b>										
None/don't know	2.4	1.9	2.2	-0.5 (-3.2, 2.2)	3.1	3.5	3.3	0.3 (-2.6, 3.2)	1.1 (-0.8, 3.1)	0.253
Excessive sun exposure	86.1	86.5	86.3	0.4 (-6.2, 7.0)	88.2	88.7	88.5	0.5 (-4.0, 4.9)	2.2 (-1.8, 6.2)	0.275
Unprotected sun exposure (age 15+ or unspecified)	15	18.7	17	3.6 (-3.6, 10.9)	33.3	34.5	34	1.2 (-5.4, 7.9)	<b>17.0 (12.1, 21.9)</b>	<b>&lt;0.001</b>
Using sunlamp, tanning bed or solarium	2.1	5.1	3.7	3.0 (-0.6, 6.7)	10.3	13.2	11.9	2.9 (-1.8, 7.6)	<b>8.2 (5.2, 11.2)</b>	<b>&lt;0.001</b>
Fair skin/skin that burns easily	11.3	6.8	8.9	-4.5 (-10.0, 1.0)	13.3	10.2	11.6	-3.1 (-7.6, 1.4)	2.6 (-0.9, 6.1)	0.14
Family history	1.6	2.1	1.9	0.5 (-1.9, 2.9)	5.2	8.4	7	<b>3.3 (0.1, 6.5)</b>	<b>5.1 (3.1, 7.2)</b>	<b>&lt;0.001</b>
Unprotected exposure early age (age <15)	1.8	6.4	4.3	<b>4.6 (0.7, 8.4)</b>	6.1	5.6	5.8	-0.5 (-3.6, 2.5)	1.5 (-1.0, 4.0)	0.228
Having lots of moles	5.1	4.1	4.5	-1.0 (-5.0, 3.0)	3.1	5.7	4.6	2.6 (-0.1, 5.3)	0.0 (2.4, -2.4)	0.992
Not using recommended sun protection	3.2	7.2	5.3	4.0 (-0.1, 8.1)	3.2	5.2	4.3	2.0 (-0.9, 4.9)	-1.0 (-3.6, 1.5)	0.435

Differences presented in bold are statistically significant (p < 0.05)

Table 2. Perceptions of Risk Factors for Breast, Cervical and Prostate Cancer in 2001 and 2014/5

	2001*			2014/5			Sex Difference	Overall Year Sex Difference	
	male	female	total	male	female	total		Difference	p
<b>Breast</b>									
None/don't know	-	53.7	-	59.4	40.5	48.8	<b>-18.9 (-25.9, -11.9)</b>	<b>-13.2 (-21.3, -5.1)</b>	<b>0.001</b>
Family history	-	19.9	-	19	28.8	24.5	<b>9.7 (3.8, 15.7)</b>	<b>8.9 (2.2, 15.6)</b>	<b>0.01</b>
Tobacco smoking	-	8.8	-	9.2	10.9	10.1	1.8 (-2.2, 5.7)	2.2 (-2.5, 6.8)	0.364
Alcohol consumption	-	1.7	-	4.6	8.7	6.9	<b>4.2 (1.0, 7.3)</b>	<b>7.0 (4.0, 10.0)</b>	<b>&lt;0.001</b>
A blow to the breast	-	1.8	-	5.2	4.4	4.7	-0.7 (-3.9, 2.4)	<b>2.6 (0.0, 5.2)</b>	<b>0.046</b>
Not breastfeeding	-	8.5	-	2.7	4.9	4	2.3 (-0.1, 4.7)	-3.5 (-7.6, 0.6)	0.093
Hormone replacement therapy (HRT)	-	4.4	-	1.2	4.8	3.2	<b>3.6 (1.4, 5.8)</b>	0.4 (-2.9, 3.6)	0.831
<b>Cervical</b>									
None/don't know	-	47.2	-	67.8	43	53.9	<b>-24.8 (-31.5, -18.0)</b>	-4.2 (-12.3, 4.0)	0.314
Many different sexual partners	-	22.9	-	10.8	21.1	16.6	<b>10.3 (5.8, 14.9)</b>	-1.8 (-8.4, 4.7)	0.584
History of sexually transmitted infection(s)	-	5.4	-	10.5	17	14.2	<b>6.5 (1.5, 11.5)</b>	<b>11.6 (6.9, 16.3)</b>	<b>&lt;0.001</b>
Having had genital warts	-	3.1	-	5.2	14.8	10.6	<b>9.6 (5.5, 13.8)</b>	<b>11.7 (7.6, 15.8)</b>	<b>&lt;0.001</b>
Unprotected sex	-	3.3	-	3.1	8	5.9	<b>4.9 (1.5, 8.4)</b>	<b>4.7 (0.9, 8.6)</b>	<b>0.016</b>
Family history/genetics	-	3.6	-	3.1	6.8	5.1	<b>3.6 (0.6, 6.7)</b>	3.2 (-0.3, 6.7)	0.073
Tobacco smoking	-	4.1	-	1.5	4.7	3.3	<b>3.2 (0.9, 5.5)</b>	0.7 (-2.5, 3.9)	0.676
<b>Prostate</b>									
None/don't know	81.3	-	-	61.3	60.6	60.9	-0.7 (-7.6, 6.2)	<b>-20.0 (-27.3, -12.7)</b>	<b>&lt;0.001</b>
Family history of prostate cancer	1.9	-	-	12.9	12.3	12.6	-0.6 (-5.3, 4.2)	<b>11.0 (7.0, 14.9)</b>	<b>&lt;0.001</b>
Diet	5.6	-	-	9.9	6	7.7	<b>-3.9 (-7.7, -0.1)</b>	<b>4.4 (0.2, 8.6)</b>	<b>0.042</b>
Not getting regular check ups	3.2	-	-	5.2	11.3	8.6	<b>6.1 (2.6, 9.7)</b>	2.0 (-1.1, 5.1)	0.209
Increasing age	3.4	-	-	5.5	6.8	6.2	1.3 (-1.8, 4.4)	2.1 (-1.3, 5.4)	0.222

\* Differences between 2001 and 2015 were sex-specific comparisons; Note: Differences presented in bold are statistically significant ( $p < 0.05$ )

any risk factors for lung cancer (Table 1), with almost all aware of tobacco smoking as a risk factor. Since 2001, there had been an increase in the proportions identifying occupational exposures, contact with asbestos and industrial pollution as increasing risk, but a drop in those mentioning general exposure to chemicals or fumes. In 2014/5, males were more likely than females to identify occupational exposure, contact with asbestos, air pollution or other industrial pollution as increasing risk of lung cancer, while the reverse was true for second-hand smoke.

For bowel cancer there was a significant drop between 2001 and 2014/5 in the proportions unable to identify any risk factors (from 52.8% to 34.8%), and increases in awareness of diet, eating meat, drinking alcohol and family history as risk factors for bowel cancer. In 2014/5, females were more likely than males to identify eating too little fibre and family history of bowel cancer. In 2001 males were more likely than females to identify alcohol consumption as increasing risk of bowel cancer, however, this sex difference was no longer significant in 2014/5.

In 2014/5, few (3.3%) were unable to identify risk factors for melanoma and there was a high degree of awareness that excessive or unprotected sun exposure as a risk factor. Over time, there were increases in the proportions that identified having a family history of melanoma and using a sunlamp, tanning bed or solarium as increasing risk.

Table 2 shows perceptions of risk for (primarily) sex specific cancers. In 2014/5, 48.8% of respondents could not specify any risk factors for breast cancer. Only women were asked about breast and cervical cancer and men for

prostate cancer in 2001, therefore, reported changes across time are sex specific. There was a decline in the proportion of women who could not identify any risk factors for breast cancer and an increase in those identifying family history, alcohol consumption and a blow to the breast as increasing breast cancer risk. In 2014/5, women were more likely than men to report family history, alcohol and use of hormone replacement therapy as risk factors for breast cancer.

In 2014/5 over half (53.9%) of respondents could not identify any risk factors for cervical cancer, with females were more likely than males to be able to identify each of the different risk factors reported. From 2001 there were increases in proportions of women identifying having a sexually transmitted infection, genital warts or unprotected sex as risk factors for cervical cancer. For prostate cancer, in 2014/5, 60.9% of respondents could not identify any risk factors, with males were more likely than females to identify diet and not getting regular check-ups as increasing prostate cancer risk. Over time, among male participants, there was a decline in the proportions unable to identify any risk factors, with increases in proportions identifying family history and diet.

## Discussion

This study adds to the existing literature by providing new insights about diversity and change over time in cancer risk awareness. As suggested by the international literature, levels and specific risk awareness varied widely across the different cancer types. An inability to recall any

risk factors (evidence-based or otherwise) was the simplest measure of awareness used, with considerable variation observed across lung (1.6%), melanoma (3.3%), bowel (34.8%), breast (48.8%), cervical (53.9%) and prostate cancers (60.9%).

The substantial gaps between current evidence-based recommendations and public perceptions are further highlighted by varying awareness of specific evidence-based risk factors for each cancer type. While lung cancer and melanoma showed high levels of awareness of their primary risk factors, very few participants recalled key evidence-based risk factors for cervical (HPV infection), breast (alcohol consumption, being overweight and inactivity) and bowel cancer (alcohol consumption, being overweight and physical inactivity). While this, suggests relatively few individuals had a clear understanding of how to reduce their cancer risk, there were also some positive patterns observed across time.

The ability to describe changes in awareness over time is a unique aspect of this study. Proportions able to recall any risk factors for bowel cancer increased between 2001 and 2014/5 in the total sample and increased for breast cancer among female respondents. In terms of alignment with specific evidence-based risk factors, there were increases in awareness of asbestos and occupational exposures for lung cancer risk, sunlamps and tanning beds for melanoma, dietary factors (and meat and alcohol consumption in particular) for bowel cancer, and alcohol and family history for breast cancer. These gains are important achievements, showing that population awareness can be increased, even in the context of a contested and rapidly evolving cancer information environment (Richards, 2016b).

It is also important to monitor perceptions about non-evidence-based risk factors, as these may provide a false sense of security or divert attention from more effective risk reduction strategies. Most increases observed were aligned with the current evidence-base, with only a few exceptions. There was a decline in those unable to identify any risk factors for prostate cancer, despite there being only a small body of evidence for the existence of modifiable risk factors (Bostwick et al., 2004; Rider et al., 2016). The factors most commonly identified are primarily things that could potentially support early detection, including non-modifiable factors such as awareness that older age and a family history increase risk and that risk was potentially increased by avoidance of early detection opportunities such as having regular medical checks.

Clear communication, which acknowledges the diversity of cancer experiences, remains a challenge for cancer control. Supporting cancer literacy in the context of diverse cancer types and pathways across the cancer spectrum of prevention, early detection, diagnosis, treatment, supportive and palliative care, is a daunting task. Organisations providing services and support need to be adequately resourced to equitably meet the needs of their community, regardless of which cancer type has affected them.

Even within the narrow 'risk reduction' focus of this

study, key implications also vary across different cancer types. For bowel and breast cancer there is a need to raise awareness of common modifiable risk behaviours such as alcohol consumption, being overweight and physical inactivity. For cervical cancer, raising understanding of the role of HPV infection is likely to be important for supporting engagement and informed consent for vaccination programmes (Marlow et al., 2007). In the case of prostate cancer, where the focus remains largely on early detection of potentially life-threatening lesions, ongoing monitoring of cancer specific risk awareness will help identify if perceptions of non-evidence-based risk factors are emerging which distract from this goal. Finally, the existing high awareness observed for melanoma and lung cancer, in a context of continued risk behaviours for those outcomes, highlights the issue that cancer literacy alone is likely to be insufficient to create and maintain population behaviour change. Comprehensive evidence-based public health interventions are needed to change cancer risk behaviours at a population level. This means embedding elements of cancer literacy within larger intervention programmes that include social, regulatory and policy supports for behaviour change (Hill and Wakefield, 2014).

Some strengths of this study include the ability to look at risk-factor awareness for specific cancer types and to monitor changes in this over time. The use of open-ended questions was also a strength, since it allowed a broad range of responses to be collected and coded. Study limitations included that the population sampled was slightly older than the national average and under-representative of Māori, Pacific and Asian participants. Some care should be taken in interpreting change over time, given differences in sampling, but the scarcity of evidence about changes in cancer awareness over time make the insights gained valuable.

In conclusion, effective and accurate communication of cancer risk information for specific cancer types remains a challenge for cancer control. This study observed some positive changes in awareness over a 14 year period, but there is still substantial room for progress as awareness of evidence based risk factors remained low, overall. If the NZ government is to meet its 2018 goal of raising the proportion of the population aware of cancer risk behaviours (Ministry of Health, 2014), then adequate resources will be required to support cancer literacy. Strategies to increase cancer literacy should be part of broader evidence-based public health programmes to support risk behaviour change.

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#### *Statement of conflict of interest*

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