

The use of blood biomarkers in lung cancer screening in Aotearoa New Zealand: a cross-sectional survey of Māori perspectives and preferences

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ABSTRACT

AIM: As part of a broader lung cancer screening (LCS) research programme, this study explored Māori views on providing blood samples for LCS to inform future development in Aotearoa New Zealand.

METHODS: Two groups (potential “screenees”, and their whānau tautoko [support people]) from Te Tai Tokerau (Northland) and Tāmaki Makaurau (Auckland) completed surveys about LCS design, including comfort with blood donation and key factors in blood collection and use. Descriptive statistics and Fisher’s tests were used to analyse responses and demographic differences.

RESULTS: Most participants (83.7% screenees; 81.4% whānau) were at least “comfortable” donating blood. Key priorities were clear information about blood use (35.0%; 35.8%), protecting the health of future generations (24.1%; 23.8%) and being able to consent to specific uses (23.6%; 27.6%). Participants from Te Tai Tokerau were less comfortable donating blood than those in Tāmaki Makaurau, with additional demographic differences noted.

CONCLUSIONS: Māori participants generally supported using blood samples in LCS but with regional differences. Future LCS initiatives should uphold Māori principles, including community partnership, return of benefit to whānau, management of potential harms and protection of Indigenous data and tissue sovereignty through transparent, culturally safe and trusted engagement processes.

In Aotearoa New Zealand, Māori lung cancer incidence and mortality rates are substantially higher than those of non-Māori, contributing greatly to health inequities.¹ An equitably designed lung cancer screening (LCS) programme has the potential to enable stage shift and earlier diagnosis when curative intent treatment is more likely to be effective, which in turn has the potential to reduce Māori health inequities.^{2,3} Although still a novel aspect of LCS programme development around the world, incorporating biomarker identification and analyses is promising as a non-invasive technique to enhance early detection of, and guide treatment decisions for, lung cancer. Within LCS programmes, biomarkers derived from blood samples have three potential purposes: 1) to identify those most at risk of lung cancer who may benefit from screening, 2) to improve ways of managing nodules that are identified by a low-dose computed tomography scan, including differentiating between malignant and benign nodules, and 3) to optimise treatment regimens for peo-

ple with lung cancer in the treatment space, and to monitor responses to those treatments.⁴⁻⁸ A number of circulating biomarkers have been identified, including germline gene variants, micro ribonucleic acid, epigenetic markers, autoantibodies, protein markers and circulating tumour deoxyribonucleic acid (DNA).⁶ However, only a small number have undergone validation, and none have been widely adopted for screening purposes.⁶ While biomarkers may soon play a key role in optimising LCS, not all population groups at high risk of developing lung cancer may be comfortable with blood collection and analysis.

Despite initiatives to enhance diversity in research studies, Indigenous populations continue to be significantly under-represented in genomic datasets.⁹ Unethical research, poor communication, disregard for cultural and spiritual beliefs, exploitation and failure to prioritise Indigenous interests have historically created mistrust between Indigenous communities and researchers and a hesitancy to engage in research.⁹⁻¹² For example, the 1990s Human

Genome Diversity Project failed to consult with Indigenous communities or to be transparent over sample use, and the benefits to Indigenous communities were not identified.¹³ In response, the international movement of Indigenous Data Sovereignty has gained significant momentum among Indigenous scholars and activists, particularly following the adoption of the United Nations Declaration on the Rights of Indigenous Peoples in 2007.¹⁴ Indigenous communities globally have developed principles and guidelines for the management and use of their data.¹⁴ These communities expect that the use of blood samples will contribute insights into diseases (and their treatments) that affect their communities, and that the knowledge gained will benefit current and future generations.^{9,11–17} Despite previous historical issues, Māori have, for a long time now, been proactively seeking to ensure the benefit of new technologies to do with tissue, genomics and biomarkers, and developing world-leading guidance, expectations and standards to establish best-practice trusted processes that are guided by mātauranga Māori (Māori knowledge), Māori rights and interest in tissue and data and are grounded in Te Tiriti.

Guidelines for genomic research with Māori, *Te Mata Ira*, were outlined in a 3-year research project. These guidelines were published after extensive consultation with iwi (tribes) and other stakeholders and draw on mātauranga and tikanga Māori (Māori protocols and practices).^{15,16} While Māori views towards genomic research are not homogenous,¹⁵ the guidelines set out considerations ensuring: Māori rights and interests are protected; Māori health is prioritised; there is oversight of samples and data; appropriate consultation and consent is undertaken; and an open feedback loop is maintained.^{15,16} A further set of guidelines, *He Tangata Kei Tua*, was developed to facilitate best practice in addressing Māori ethical concerns by guiding culturally informed policy and practice for biobanks in relation to governance, operational and community engagement activities.¹⁸ These guidelines categorise cultural and trust issues in three ways: 1) the level of comfort that participants and communities have in the research project, 2) the level of control that donors and communities have in relation to the use of tissue in biobanks, and 3) the level of integrity present within systems that contribute to the research endeavour.¹⁶ Additionally, there has been further development within the Rakaioa programme of work

under the National Science Challenge, with new standards expected to be published soon.¹⁹

If Māori participants decline to participate in research, this may lead to under-representation, potentially exacerbating existing health inequities.^{9,10} It is therefore essential to be aware of how Māori view biomarker collection and analysis to address concerns and ensure equitable participation. While New Zealand does not currently have a national LCS programme, research efforts are underway to understand how such a programme could be equitably implemented.^{20,21} Planning for the future inclusion of blood biomarkers is an important implementation issue. Our research, *Te Oranga Pūkahu: The Lung Cancer Screening Research Programme*, is a Māori-led approach to ensure that a future national lung screening programme benefits Māori—the population group most in need of LCS—by providing policy- and programme-relevant evidence to inform future implementation of LCS in Aotearoa New Zealand.²⁰ One example of a specific biomarker that has shown potential in identifying participants who may benefit from LCS, which is of interest to our research group, is DNA methylation at CpG site cg05575921 in the aryl hydrocarbon receptor repressor (*AHRR*) gene, which is closely related to smoking intensity and duration.^{22–26} An important challenge for LCS is that self-reported smoking data are often inaccurate due to factors such as recall bias, stigma, second-hand exposure and variation in smoking technique.²² Furthermore, the accuracy of smoking data in primary care has been shown to be underestimated,²⁷ potentially resulting in a substantial proportion of the target population missing out on screening. An assay to measure the level of *AHRR* methylation therefore has the potential to improve lung cancer prediction by accounting for second-hand smoke exposure and mitigating the impact of inaccurate self-reported smoking histories.²⁵

In 2020, we surveyed a cohort of Māori current or ex-smokers potentially eligible for a future LCS programme, and their whānau tautoko (self-identified family/support people), building on earlier exploratory qualitative work.²¹ The objectives of this survey were to determine the level of support of potentially eligible Māori and their whānau and to explore decision making and design preferences for an LCS programme.²⁸ The objective of this paper is to describe the acceptability of providing blood samples for the purpose of including biomarkers in an LCS programme

for potentially eligible Māori and their whānau tautoko. The STRENGTHENING the Reporting of OBSERVATIONAL studies in Epidemiology (STROBE) checklist for cross-sectional studies was used to guide this study.²⁹

Methods

Study design

Two surveys were developed, one for potentially eligible LCS participants—“screenees”—and one for whānau tautoko. Whānau were included because decision making within Māori contexts is often collective, and whānau views may influence participation. This paper focusses on two specific questions from the broader surveys, exploring attitudes and options related to blood sample collection (Appendix). The surveys were developed in collaboration with a steering committee and underwent pilot testing with focus groups comprising potential screening participants. This pilot phase enabled the refinement of the surveys to enhance their readability and cultural sensitivity, ensuring their appropriateness for the target audience. There were some further minor wording updates for Te Tai Tokerau to improve question clarity based on provider feedback. The Health and Disability Ethics Committee (ref 19/CEN/90) approved this study in June 2019. Localities approvals were obtained from the Auckland (ref A+ 8276) and Waitemata (ref RM 14431) District Health Boards, which included Māori review. All participants provided informed consent to participate.

Setting

The two surveys were administered in Tāmaki Makaurau (the largely urban area of Auckland, New Zealand’s largest city) and Te Tai Tokerau (Northland, a mostly rural region, including remote and isolated populations). These regions have distinctly different demographics, with Māori comprising 36% of the population in Te Tai Tokerau versus 12% in Tāmaki Makaurau.³⁰ The regions were selected due to future LCS research that was planned to be implemented in those regions. Participants for this study were recruited from two districts within the Auckland Region: Te Toka Tumai Auckland and Waitemata, excluding Counties Manukāu. The recruitment for participants in Tāmaki Makaurau commenced in January 2020 but was temporarily halted due to the national COVID-19 lockdown in March. The recruitment process resumed in April and

was completed by June 2020. In Te Tai Tokerau, recruitment began in May 2020 and was completed by August 2020.

Participants

The eligibility criteria for potential screenees consisted of: 1) self-identifying as Māori, 2) aged between 50 and 80 years, and 3) having a history of smoking at some point in their lives. Participants were excluded if they had a previous diagnosis of lung cancer or were unable to provide informed consent. Whānau tautoko, of any ethnicity, aged 16 and older who were able to provide informed consent were eligible to participate. The research team employed a range of recruitment strategies to reach potential participants. Due to COVID-19 lockdowns, the surveys in Tāmaki Makaurau were primarily completed using relevant clinical databases (e.g., Abdominal Aortic Aneurysm screening database) and recent hospital discharge information. The majority were completed over the phone with a trained researcher (who was either Māori or spoke te reo Māori [the Māori language]) instead of the originally intended in-person format. A small number of participants opted for alternative methods, including completing a mailed questionnaire or accessing an online link. In Te Tai Tokerau, the majority of participants completed paper surveys, which were distributed with the assistance of volunteer Māori health organisations. Others were opportunistically recruited by a medical receptionist at participating practices during routine medical clinic interactions. A smaller number of participants in Te Tai Tokerau completed the survey either over the phone or online. All participants received a \$20 gift voucher at the completion of the survey, and kai (food) at the community hui (meeting) as koha (gift, offering) for their contribution. If required, participants were also supported with transport to address participation barriers.

Variables

The surveys aimed to explore and gain insight into the attitudes and perceptions of Māori participants and whānau tautoko regarding the acceptability and processes involved in a potential lung screening programme. Previous research has described the results relating to the acceptability and preferences for a lung screening programme.²⁸ This paper focusses on the two questions relating to blood sampling: the first question assessed participants’ comfort with providing a blood sample

for use in future LCS, while the second question explored the factors that would be important to them if blood sample donation were an option within LCS (Appendix).

Demographic information included gender, age, ethnic group and region. Participants self-identified their gender as male, female, gender diverse, or prefer not to answer. Potential screenees were categorised into three age groups, 50–59, 60–69 and 70+, while whānau tautoko were divided into two categories, under 50 and 50+. These age groups were selected because they correspond to the age at which individuals would be either eligible or ineligible for LCS. Ethnicity was self-reported. When a participant identified multiple ethnicities, the recommended prioritisation process was used to determine their primary ethnicity (Māori>Pacific>Asian>Other).³¹ The region was either Te Tai Tokerau or Tāmaki Makaurau.

Study size

Our objective was to collect 300 surveys from screenee participants and 100 surveys from whānau tautoko, determined by the level of confidence in estimates when comparing responses across age group, gender and region.

Statistical methods

The two surveys (screenees and whānau tautoko) were analysed separately using R (version 4.3.1). For each question, frequencies and percentages were examined. Fisher's exact tests were used to compare responses by region, age group and gender, with a p-value <0.05 considered statistically significant. For cases where Fisher's exact test revealed significant differences, pairwise comparisons with a Bonferroni correction were conducted to identify which specific groups differed.

Results

Screenee survey

In total, 388 screenee participant surveys were completed; however, 11 were excluded because they did not self-identify as Māori at survey completion, despite initially being identified as Māori through recruitment lists, leaving a total of 377 surveys included in the analysis. Most Māori individuals who participated in the screenee survey resided in Tāmaki Makaurau (79.0%). The group consisted of slightly more females (54.9%) than males (45%). Most participants were in the

50–59 (38.7%) and 60–69 (44.0%) age brackets, with 17.0% over the age of 70 (Table 1).

Question one: comfort with blood donation

Most participants (61.9%) reported feeling “very comfortable” providing a blood sample, while an additional 21.5% felt “comfortable” with the process. A small proportion of participants indicated they were “uncomfortable” (4.4%) or “very uncomfortable” (2.7%), and 9.3% reported being neutral on the matter (Table 2). Ten participants did not respond to this question and were therefore excluded from analysis.

Significant regional differences in responses were observed ($p < .001$) (Table 2). Participants from Tāmaki Makaurau were significantly more likely to be “very comfortable” compared with those from Te Tai Tokerau (70.1% cf. 28.88% [$p < .001$]), while Te Tai Tokerau participants were more likely to be neutral (20.5% cf. 6.5% [$p = .005$]), uncomfortable (12.3% cf. 2.4% [$p = .005$]) or very uncomfortable (8.2% cf. 1.4% [$p = .027$]) with providing blood samples.

There were also significant differences by gender ($p = .012$); however, *post hoc* pairwise comparisons using the Bonferroni correction found no significant differences between the groups. Responses to this question did not vary significantly by age.

Question two: important factors regarding blood donation

When selecting from a list of factors “important” to them regarding blood sample provision, participants were able to select more than one response. The majority of participants (57.8%) selected “nothing, I’m fine with it anyway”. The next most important factor was “clear information about how it is going to be used” (35.0%), followed by “knowing how this might protect the health of future generations (tamariki/mokopuna)” (24.1%) and “being able to say yes or no to some uses” (23.6%) (Table 3).

There were significant regional differences in response to this question ($p < .001$). Participants from Tāmaki Makaurau were significantly more likely to select “nothing, I’m fine with it anyway” (63.0% cf. 39.2% [$p < .002$]). In contrast, almost all aspects of blood collection and storage were significantly more important to Te Tai Tokerau participants. For example, almost twice as many participants from Te Tai Tokerau identified “knowing how this might protect the health of future generations (tamariki/mokopuna)” as important (38.0% cf.

20.5% [$p=.018$]). Furthermore, almost one-quarter (22.8%) of Te Tai Tokerau participants indicated they would not participate in research if blood tests were involved, compared with only 2.4% of those from Tāmaki Makaurau ($p<.001$). There were no significant differences in response by age group or gender.

Whānau tautoko survey

A total of 134 whānau tautoko surveys were completed. Most resided in Tāmaki Makaurau (77.6%). The group had slightly more females than males (55.2% cf. 44.8%), and a larger number of participants over the age of 50 compared to those under (60.4% cf. 39.6%). There was also a substantial representation of Māori participants compared with non-Māori (79.9% cf. 20.1%) (Table 1).

Question one: comfort with blood donation

The majority of whānau tautoko (62.0%) reported they felt “very comfortable” provid-

ing a blood sample and an additional 19.4% indicated they were “comfortable” with the process. A smaller proportion of participants indicated they were “uncomfortable” (7.8%) or “very uncomfortable” (2.3%), and 8.5% remained neutral (Table 4). Five participants preferred not to answer this question and were therefore excluded from analysis.

Significant regional differences were observed for whānau tautoko ($p<.001$). While almost three-quarters (73.2%) of whānau tautoko participants from Tāmaki Makaurau reported being “very comfortable” providing a blood sample, less than one-quarter of Te Tai Tokerau participants reported feeling this way (21.4%) ($p<.001$). Significantly more participants from Te Tai Tokerau indicated they felt neutral (25.0% cf. 4.0% [$p=.010$]) compared with respondents from Tāmaki Makaurau.

Whānau tautoko responses also differed by age ($p=.006$). Almost three-quarters of participants over the age of 50 were “very comfortable” with

Table 1: Participant demographics.

	Screenees (n=377) N (%)	Whānau (n=134) N (%)
Region		
Tāmaki Makaurau	298 (79.0%)	104 (77.6%)
Te Tai Tokerau	79 (21.0%)	30 (22.4%)
Gender		
Female	207 (54.9%)	74 (55.2%)
Male	169 (44.8%)	60 (44.8%)
Preferred not to answer	1 (~0%)	0 (0%)
Age		
50–59	146 (38.7%)	-
60–69	166 (44.0%)	-
70+	64 (17.0%)	-
Under 50	-	53 (39.6)
Over 50	-	81 (60.4%)
Ethnicity		
Māori	377 (100%)	107 (79.9%)
Non-Māori	0 (0%)	27 (20.1%)

Table 2: Regional, gender and age differences in comfort with providing a blood sample for screenee participants.

	Total N%	Female N%	Male N%	Tāmaki Makaurau N%	Te Tai Tokerau N%	50–59 N%	60–69 N%	70+ N%
Very comfortable	227 (61.9%)	112 (56.0%)	115 (68.9)	206 (70.1%)	21 (28.8%)	92 (65.2%)	99 (60.0%)	36 (59.0%)
Comfortable	80 (21.8%)	43 (21.5%)	37 (22.2%)	58 (19.7%)	22 (30.1%)	24 (17.0%)	40 (24.2%)	16 (26.2%)
Neither comfortable nor uncomfortable	34 (9.3%)	25 (12.5%)	9 (5.4%)	19 (6.5%)	15 (20.5%)	17 (12.1%)	14 (8.5%)	3 (4.9%)
Uncomfortable	16 (4.4%)	12 (6.0%)	4 (2.4%)	7 (2.4%)	9 (12.3%)	4 (2.8%)	7 (4.2%)	5 (8.2%)
Very uncomfortable	10 (2.7%)	8 (4.0%)	2 (1.2%)	4 (1.4%)	6 (8.2%)	4 (2.8%)	5 (3.0%)	1 (1.6%)
Fisher's exact test p-value		0.012		<0.001		0.387		

Table 3: Factors important in decision making about providing a blood sample by region, gender and age (screenee participants).

	Total N%	Female N%	Male N%	Tāmaki Makaurau N%	Te Tai Tokerau N%	50–59 N%	60–69 N%	70+ N%
Nothing, I'm fine with it anyway	218 (57.8%)	109 (52.7%)	109 (64.5%)	187 (63.0%)	31 (39.2%)	86 (59.3%)	97 (58.4%)	35 (54.7%)
Clear information about how it is going to be used	132 (35.0%)	80 (38.6%)	52 (30.8%)	98 (33.0%)	34 (43.0%)	53 (36.6%)	57 (34.3%)	22 (34.4%)
Knowing how this might protect the health of future generations (tamariki/ mokopuna)	91 (24.1%)	58 (28.0%)	33 (19.5%)	61 (20.5%)	30 (38.0%)	32 (22.1%)	42 (25.3%)	17 (26.6%)
Being able to say yes or no to some uses	89 (23.6%)	53 (25.6%)	36 (21.3%)	61 (20.5%)	28 (35.4%)	39 (26.9%)	37 (22.3%)	13 (20.3%)
Knowing who makes decisions about its use	57 (15.1%)	32 (15.5%)	25 (14.8%)	35 (11.8%)	22 (27.8%)	22 (15.2%)	27 (16.3%)	8 (12.5%)
Following tikanga when handling blood tissue	49 (13.0%)	34 (16.4%)	15 (8.9%)	27 (9.1%)	22 (27.8%)	24 (16.6%)	19 (11.4%)	5 (7.8%)

Table 3 (continued): Factors important in decision making about providing a blood sample by region, gender and age (screenee participants).

	Total N%	Female N%	Male N%	Tāmaki Makaurau N%	Te Tai Tokerau N%	50–59 N%	60–69 N%	70+ N%
Return of samples if not used	36 (9.5%)	21 (10.1%)	15 (8.9%)	21 (7.1%)	15 (19.0%)	21 (14.5%)	10 (6.0%)	5 (7.8%)
Māori governance for storage and use	34 (9.0%)	21 (10.1%)	13 (7.7%)	16 (5.4%)	18 (22.8%)	18 (12.4%)	13 (7.8%)	3 (4.7%)
Nothing—I wouldn't participate if blood tests were involved	25 (6.9%)	16 (7.7%)	9 (5.3%)	7 (2.4%)	18 (22.8%)	5 (3.4%)	15 (9.0%)	5 (7.8%)
Iwi involvement in decisions about storage/ use	25 (6.6%)	14 (6.8%)	11 (6.5%)	12 (4.0%)	13 (16.5%)	13 (9.0%)	11 (6.6%)	1 (1.6%)
Fisher's exact test p-value		0.303		<0.001		0.393		

Table 4: Whānau tautoko participants' comfort with providing a blood sample blood sample by region, sex, age and ethnicity.

	Total N%	Female N%	Male N%	Tāmaki Makaurau N%	Te Tai Tokerau N%	Under 50 N%	Over 50 N%	Māori N%	Non-Māori N%
Very comfortable	80 (62.0%)	46 (65.7%)	34 (57.6%)	74 (73.3%)	6 (21.4%)	23 (44.2%)	57 (74.0%)	63 (61.8%)	17 (63.0%)
Comfortable	25 (19.4%)	11 (15.7%)	14 (23.7%)	15 (14.9%)	10 (35.7%)	15 (28.9%)	10 (13.0%)	19 (18.6%)	6 (22.2%)
Neither comfortable nor uncomfortable	11 (8.5%)	5 (7.1%)	6 (10.2%)	4 (4.0%)	7 (25.0%)	6 (11.5%)	5 (6.5%)	10 (9.8%)	1 (3.7%)
Uncomfortable	10 (7.8%)	6 (8.6%)	4 (6.8%)	5 (5.0%)	5 (17.9%)	7 (13.5%)	3 (3.9%)	7 (6.9%)	3 (11.1%)
Very uncomfortable	3 (2.3%)	2 (2.9%)	1 (1.7%)	3 (3.0%)	0 (0%)	1 (1.9%)	2 (2.6%)	3 (2.9%)	0 (0%)
Fisher's exact test p-value		0.724		<0.001		0.006		0.758	

Table 5: Factors important in decision making about providing a blood sample by region, gender, age and ethnicity (whānau tautoko participants).

	Total N%	Female N%	Male N%	Tāmaki Makaurau N%	Te Tai Tokerau N%	Under 50 N%	Over 50 N%	Māori N%	Non-Māori N%
Nothing, I'm fine with it anyway	73 (54.5%)	34 (45.9%)	39 (65.0%)	62 (59.6%)	11 (36.7%)	26 (49.1%)	47 (58.0%)	53 (49.5%)	20 (74.1%)
Clear information about how it is going to be used	48 (35.8%)	31 (41.9%)	17 (28.3%)	39 (37.5%)	9 (30.0%)	22 (41.5%)	26 (32.1%)	42 (39.3%)	6 (22.2%)
Being able to say yes or no to some uses	37 (27.6%)	24 (32.4%)	13 (21.7%)	31 (29.8%)	6 (20.0%)	20 (37.7%)	17 (21.0%)	34 (31.8%)	3 (11.1%)
Knowing how this might protect the health of future generations (tamariki/mokopuna)	32 (23.8%)	22 (29.7%)	10 (16.7%)	22 (21.2%)	10 (33.3%)	18 (34.0%)	14 (17.3%)	28 (26.2%)	4 (14.8%)
Knowing who makes decisions about its use	21 (15.7%)	14 (18.9%)	7 (11.7%)	16 (15.4%)	5 (16.7%)	14 (26.4%)	7 (8.6%)	19 (17.8%)	2 (7.4%)
Following tikanga when handling blood tissue	17 (12.7%)	12 (16.2%)	5 (8.3%)	11 (10.6%)	6 (20.0%)	12 (22.6%)	5 (6.2%)	16 (15.0%)	1 (3.7%)
Return of samples if not used	13 (9.7%)	8 (10.8%)	5 (8.3%)	11 (10.6%)	2 (6.7%)	10 (18.9%)	3 (3.7%)	13 (12.1%)	0 (0%)

Table 5 (continued): Factors important in decision making about providing a blood sample by region, gender, age and ethnicity (whānau tautoko participants).

	Total N%	Female N%	Male N%	Tāmaki Makaurau N%	Te Tai Tokerau N%	Under 50 N%	Over 50 N%	Māori N%	Non-Māori N%
Māori governance for storage and use	10 (7.5%)	7 (9.5%)	3 (5.0%)	7 (6.7%)	3 (10.0%)	8 (15.1%)	2 (2.5%)	9 (8.4%)	1 (3.7%)
Iwi involvement in decisions about storage/ use	7 (5.2%)	4 (5.4%)	3 (5.0%)	4 (3.8%)	3 (10.0%)	5 (9.4%)	2 (2.5%)	7 (6.5%)	0 (0%)
Nothing—I wouldn't partici- pate if blood tests were involved	6 (4.8%)	3 (4.1%)	3 (5.0%)	2 (1.9%)	4 (13.3%)	1 (1.9%)	5 (6.2%)	4 (3.7%)	2 (7.4%)
Fisher's exact test p-value		0.424		0.073		0.005		0.0656	

donating blood (74.0%) compared with less than half of those under 50 (44.2%) ($p=.004$). There was no evidence of a statistical difference in responses by gender or ethnicity.

Question two: important factors regarding blood donation

When choosing from the list of factors that could influence their willingness to provide blood samples, over half of the whānau tautoko participants (54.5%) selected “nothing, I’m fine with it anyway”. The next most common response was “clear information about how it is going to be used” (35.8%), followed by “being able to say yes or no to some uses” (27.6%) and “knowing how this might protect the health of future generations (tamariki/mokopuna)” (23.8%). Less important factors included “knowing who makes decisions about its use” (15.7%), “return of samples if not used” (9.7%) and “iwi involvement in decisions about storage/use” (5.2%). Very few participants would not participate if blood tests were involved (4.8%) (Table 5).

A significant difference in responses was observed between whānau members in the under-50 age bracket and those 50 or over ($p=.005$) (Table 5). *Post hoc* comparisons did not identify any specific group differences after adjustment. There were no statistically significant differences in blood comfort factors between gender, region or ethnicity for whānau tautoko.

Discussion

Both lung cancer screenees and their whānau tautoko were strongly supportive of the use of blood samples in LCS. The majority of screenees (82%) and whānau (79%) participants were either “very comfortable” or “comfortable” with blood donation. Although most did not report needing further information, those who did identified “clear information about how it would be used”, “being able to say yes or no to some uses” and “knowing how this might protect the health of future generations” as key determinants influencing their decision to donate blood. Results for each survey were heavily region-dependent, with the more northern and rural Te Tai Tokerau participants indicating relatively less comfort with blood donation and more caveats around its use than participants from the large urban centre of Tāmaki Makaurau. Some other statistically significant differences by demographic factors were noted. For example, among whānau tautoko

participants, those aged over 50 years were significantly more likely to be “very comfortable” with donating blood. For screenees, males were also significantly more likely to be “very comfortable” with donating blood compared with females. While we did not find any significant differences between ethnic groups in the whānau tautoko survey, we note that in our sample non-Māori participants are not likely to be representative of the wider population of non-Māori, since whānau tautoko participants may share similar beliefs and attitudes to their Māori whānau members.

Māori support for donating blood within the context of an LCS programme is promising in terms of lending support to the use of biomarkers to help streamline future implementation of LCS, including better identification of at-risk individuals, diagnosis and work-up of tumours and informed treatment regimes. While the literature explicitly exploring the views of Indigenous communities is limited,¹⁰ our findings support the issues identified in international and local guidelines for best practice.^{9–17,32} As per international and New Zealand-specific guidelines,^{15,16} research involving blood samples needs to engage with communities and include them as partners in the research.¹⁵ The relationship between researchers and communities must be trusting¹⁶ and all blood samples must be treated respectfully with an open dialogue with communities about their use.¹⁵ It is vital that communities where blood is being taken feel comfort, control and integrity in these processes.¹⁶ This requires not just following guidelines, but also demonstrating trustworthiness through good governance, transparent processes and adherence to the standards of excellence identified by Indigenous people. In our survey, Māori potential screenees and their whānau valued being informed about how blood would be used and having the opportunity to say yes or no about some uses. These results reinforce the importance of the earlier work of *Te Mata Ira*. A very small proportion of participants stated they would not participate in an LCS programme if it included the taking of blood samples. There was some variation in wording for this question—in Te Tai Tokerau, responses were explicitly in the context of research, whereas in Tāmaki Makaurau, participants were asked about a “lung health check”, which could be interpreted as either a research setting or a national screening programme. Our programme is cognisant of these views and is aware that the inclusion of biomarkers in LCS may potentially discourage a very small number

of people from participating. These views have implications for future programme messaging around biomarkers.

The regional differences observed for both screenees and whānau members have important implications for the collection of blood samples in LCS research and in the implementation of a future LCS programme. Researchers and programme developers will need to ensure that the issues identified as important considerations are appropriately addressed in project and programme design and in the information they provide to communities and participants.

Strengths and limitations

Provision of blood samples is an important issue within the context of barriers and facilitators to participation in a potential LCS programme. There is a clear gap in the literature specifically regarding potential participants' perspectives of biomarkers within LCS programmes. A key strength of this research is that it provides insight into potential participant views on the use of blood biomarkers in LCS, and specifically into Indigenous views, a little-researched area internationally. Additionally, the two questions regarding Māori views about blood sampling were specifically designed to address the issue of blood sample provision within a wider survey that examined a range of views and perspectives on LCS. Limitations of this research include that due to COVID-19, the methods of data collection varied; therefore, there may have been differences in responses depending on whether participants completed the survey in-person or over the phone, or whether it was entirely self-administered or facilitated by a researcher. Another limitation was that the survey questions were solely quantitative in nature, restricting respondents to selecting pre-defined options without the opportunity to provide qualitative feedback. There was also some variation in the wording of the questions across regions (see Appendix), which could have influenced answers. Additionally, we did not explore participants' perspectives on specific biomarkers versus future unspecified uses of their blood. Finally, the views captured were from potential participants and may differ to responses

from participants who actually take part in an LCS programme.

Future directions

Our two survey questions are a first step towards understanding Indigenous Māori views regarding biomarker use in potential future LCS. More research is needed to understand the regional differences that we observed. A qualitative study specifically focussed on biomarker collection and use for LCS, one that seeks to include diverse rural and urban Māori voices, would shed further light on these regional variations. Further research could examine whether Māori attitudes differ towards the different ways that biomarkers can be used within LCS, such as identifying high-risk individuals versus determining treatment regimes. Additionally, research that examines existing programmes that involve blood collection could provide valuable feedback from participants who decline to take part, helping to identify their concerns. This could involve distinguishing between concerns related to specific biomarkers, such as those linked to smoking history, versus broader concerns about blood testing in general.

Conclusions

Māori participants were comfortable with the use of blood sampling for biomarkers in LCS although those from a more rural region were slightly less comfortable and had more caveats. Future research could usefully examine whether the use of biomarkers in determining LCS programme eligibility might be viewed differently than those used for improving screening or treatment outcomes, and whether Māori views are similar or different to other ethnic groups; it could also explore regional differences in-depth. Any future collection of blood samples for the purposes of LCS in New Zealand should apply the same principles and guidance as has been articulated for research purposes, including community partnership, ensuring return of benefit to whānau, management of potential harms and processes to ensure Indigenous data and tissue sovereignty.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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REFERENCES

1. Te Aho o Te Kahu – Cancer Control Agency. He Pūrongo Mate Pukupuku o Aotearoa 2020, The State of Cancer in New Zealand 2020 [Internet]. Wellington, New Zealand: Te Aho o Te Kahu – Cancer Control Agency; 2021 [cited 2024 May 16]. Available from: <https://teaho.govt.nz/application/files/2817/3759/2091/state-of-cancer-in-new-zealand-2020-FINAL-FOR-WEB.pdf>
2. McLeod M, Sandiford P, Kvizhinadze G, et al. Impact of low-dose CT screening for lung cancer on ethnic health inequities in New Zealand: a cost-effectiveness analysis. *BMJ Open.* 2020;10(9):e037145. doi: 10.1136/bmjopen-2020-037145.
3. Manners D, Dawkins P, Pascoe D, et al. Lung cancer screening in Australia and New Zealand: the evidence and the challenge. *Intern Med J.* 2021;51(3):436-441. doi: 10.1111/imj.15230.
4. Robbins HA, Alcalá K, Moez EK, et al. Design and methodological considerations for biomarker discovery and validation in the Integrative Analysis of Lung Cancer Etiology and Risk (INTEGRAL) Program. *Ann Epidemiol.* 2023;77:1-12. doi: 10.1016/j.annepidem.2022.10.014.
5. Khodayari Moez E, Warkentin MT, Brhane Y, et al. Circulating proteome for pulmonary nodule malignancy. *J Natl Cancer Inst.* 2023;115(9):1060-1070. doi: 10.1093/jnci/djad122.
6. Lung Cancer Cohort Consortium (LC3). The blood proteome of imminent lung cancer diagnosis. *Nat Commun.* 2023;14(1):3042. doi: 10.1038/s41467-023-37979-8.
7. Seijo LM, Peled N, Ajona D, et al. Biomarkers in Lung Cancer Screening: Achievements, Promises, and Challenges. *J Thorac Oncol.* 2019;14(3):343-357. doi: 10.1016/j.jtho.2018.11.023.
8. Kalinke L, Thakrar R, Janes SM. The promises

- and challenges of early non-small cell lung cancer detection: patient perceptions, low-dose CT screening, bronchoscopy and biomarkers. *Mol Oncol*. 2021;15(10):2544-2564. doi: 10.1002/1878-0261.12864.
9. Boscarino N, Cartwright RA, Fox K, Tsosie KS. Federated learning and Indigenous genomic data sovereignty. *Nat Mach Intell*. 2022;4(11):909-911. doi: 10.1038/s42256-022-00551-y.
 10. Garrison NA, Hudson M, Ballantyne LL, et al. Genomic Research Through an Indigenous Lens: Understanding the Expectations. *Annu Rev Genomics Hum Genet*. 2019;20:495-517. doi: 10.1146/annurev-genom-083118-015434.
 11. Hermes A, Wiersma M, Kerridge I, et al. Beyond platitudes: a qualitative study of Australian Aboriginal people's perspectives on biobanking. *Intern Med J*. 2021;51(9):1426-1432. doi: 10.1111/imj.15223.
 12. Aramoana J, Koea J. An Integrative Review of the Barriers to Indigenous Peoples Participation in Biobanking and Genomic Research. *JCO Glob Oncol*. 2020;6:83-91. doi: 10.1200/JGO.18.00156.
 13. Elsum I, McEwan C, Kowal EE, et al. Inclusion of Indigenous Australians in biobanks: a step to reducing inequity in health care. *Med J Aust*. 2019;211(1):7-9.e1. doi: 10.5694/mja2.50219.
 14. Kowal E, Weyrich LS, Argüelles JM, et al. Community partnerships are fundamental to ethical ancient DNA research. *HGG Adv*. 2023;4(2):100161. doi: 10.1016/j.xhgg.2022.100161.
 15. Hudson M, Russell K, Uerata L, et al. Te Mata Ira-- Faces of the Gene: Developing a cultural foundation for biobanking and genomic research involving Māori. *AlterNative: An International Journal of Indigenous Peoples*. 2016;12(4):341-55. doi: 10.20507/AlterNative.2016.12.4.1.
 16. Hudson M, Beaton A, Milne M, et al. He Tangata Kei Tua: Guidelines for Biobanking with Māori [Internet]. Hamilton, New Zealand: Te Mata Hautū Taketake – Māori & Indigenous Governance Centre, University of Waikato; 2016 [cited 2024 May 16]. Available from: <https://www.waikato.ac.nz/assets/Uploads/Research/Research-institutes-centres-and-groups/Institutes/TKRI/He-Tangata-Kei-Tua-Biobanking-Guidelines-1.pdf>
 17. Hardcastle F, Ballard L, Weller S, et al. Ethical, Legal and Social Issues in Diversifying Genomic Data: Literature Review and Synthesis. 2022. doi: 10.31235/osf.io/myjtd.
 18. Beaton A, Hudson M, Milne M, et al. Engaging Māori in biobanking and genomic research: a model for biobanks to guide culturally informed governance, operational, and community engagement activities. *Genet Med*. 2017;19(3):345-351. doi: 10.1038/gim.2016.111.
 19. Healthier Lives – He Oranga Hauora. Healthier Lives He Oranga Hauora National Science Challenge (2015-2024) [Internet]. University of Otago; 2024 [cited 2024 Dec 10]. Available from: <https://healthierlives.co.nz>
 20. Parker K, Colhoun S, Bartholomew K, et al. Invitation methods for Indigenous New Zealand Māori in lung cancer screening: Protocol for a pragmatic cluster randomized controlled trial. *PLoS One*. 2023;18(8):e0281420. doi: 10.1371/journal.pone.0281420.
 21. Colhoun SR, Parker K, McCook S, et al. Perspectives of potentially eligible Indigenous Māori on a lung cancer screening programme: a qualitative study. *N Z Med J*. 2024;137(1593):45-55. doi: 10.26635/6965.6335.
 22. Fasanelli F, Baglietto L, Ponzi E, et al. Hypomethylation of smoking-related genes is associated with future lung cancer in four prospective cohorts. *Nat Commun*. 2015;6:10192. doi: 10.1038/ncomms10192.
 23. Zeilinger S, Kühnel B, Klopp N, et al. Tobacco smoking leads to extensive genome-wide changes in DNA methylation. *PLoS One*. 2013;8(5):e63812. doi: 10.1371/journal.pone.0063812.
 24. Besingi W, Johansson A. Smoke-related DNA methylation changes in the etiology of human disease. *Hum Mol Genet*. 2014;23(9):2290-2297. doi: 10.1093/hmg/ddt621.
 25. Zhang Y, Yang R, Burwinkel B, et al. F2RL3 methylation as a biomarker of current and lifetime smoking exposures. *Environ Health Perspect*. 2014;122(2):131-137. doi: 10.1289/ehp.1306937.
 26. Joehanes R, Just AC, Marioni RE, et al. Epigenetic Signatures of Cigarette Smoking. *Circ Cardiovasc Genet*. 2016;9(5):436-447. doi: 10.1161/CIRCGENETICS.116.001506.
 27. Bartholomew K, Aye PS, Aitken C, et al. Smoking data quality of primary care practices in comparison with smoking data from the New Zealand Māori and Pacific abdominal aortic aneurysm screening programme: an observational study. *BMC Public Health*. 2024;24(1):1513. doi: 10.1186/s12889-024-19021-8.
 28. Schaapveld T, Colhoun S, McNeill R, et al. Māori perspectives on a potential low dose CT lung cancer screening programme in Aotearoa New Zealand: results of a mixed-method cross-sectional survey. *BMC Public Health*. 2026. doi: 10.1186/s12889-026-27058-0.
 29. Cuschieri S. The STROBE guidelines. *Saudi J Anaesth*. 2019;13(Suppl 1):S31-s4. doi: 10.4103/sja.

- SJA_543_18.
30. Statistics NZ. Population estimates and projections [Internet]. [cited 2024 Oct 7]. Available from: <https://www.stats.govt.nz/topics/population-estimates-and-projections>.
 31. Ministry of Health – Manatū Hauora. Ethnicity Data Protocols HISO 10001:2017 [Internet]. Wellington, New Zealand; 2017 [cited 2024 May 23]. Available from: <https://www.tewhatauora.govt.nz/assets/Our-health-system/Digital-health/Health-information-standards/HISO-10001-2017-Ethnicity-Data-Protocols.pdf>
 32. Devine T, Allport T, Walsh-Tapiata W, Boulton A. Equity, Public Health Messaging, and Traditional Māori Knowledge: The Te Ranga Tupua COVID-19 Response. *J Humanist Psychol.* 2022;00221678221139013. doi: 10.1177/00221678221139013.

Appendix

Appendix Table 1: Survey questions relating to blood samples.

	Question	Response options
1	<p><i>Te Tai Tokerau (Northland):</i> How would you feel about donating your blood sample to help develop a future test for lung cancer?</p> <p><i>Tāmaki Makaurau (Auckland):</i> How comfortable would you be with storage of a blood sample for future testing about the risks of lung cancer?</p>	<p>Very comfortable</p> <p>Comfortable</p> <p>Neither comfortable nor uncomfortable</p> <p>Uncomfortable</p> <p>Very uncomfortable</p> <p>Prefer not to answer</p>
2	<p><i>Te Tai Tokerau (Northland):</i> If the option of donating blood samples for this research was available, which of the following things would be important to you? (<i>Tick as many as apply</i>)</p> <p><i>Tāmaki Makaurau (Auckland) screenees:</i> What would make you feel more comfortable with the taking and storing of your blood as part of a lung health check? (<i>Select as many as apply</i>)</p> <p><i>Tāmaki Makaurau (Auckland) whānau tautoko:</i> What would make you/whānau feel more comfortable with the taking and storing of your blood as part of a lung health check? (<i>Select as many as apply</i>)</p>	<p>Nothing, I'm fine with it anyway</p> <p>Clear information about how it is going to be used</p> <p>Being able to say yes or no to some uses</p> <p>Iwi involvement in decisions about storage/use</p> <p>Following tikanga when handling blood tissue</p> <p>Māori governance for storage and use</p> <p>Knowing who makes decisions about its use</p> <p>Knowing how this might protect the health of future generations (tamariki/mokopuna)</p> <p>Return of samples if not used</p> <p>Nothing—I wouldn't participate if blood tests were involved</p>