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### Stroke awareness and knowledge in an urban New Zealand population

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**Authors' contributions:** JLB, LFR, CMM and RLF conceived and designed the study; JLB coordinated data collection; JLB and AMS analysed data; JLB and AMS wrote the paper.

**Keywords.** Non-communicable disease, stroke awareness, F.A.S.T., New Zealand, urban population

**Abbreviations:** Confidence interval (CI), Developmental Origins of Health and Disease (DOHaD), Middle Eastern/Latin American/African (MELAA), national certificate of educational achievement (NCEA), non-communicable disease (NCD), New Zealand Socioeconomic Index (NZSEI), odds ratio (OR), socioeconomic status (SES).

## Abstract

**Background:** Stroke is the third most common cause of death and a major cause of chronic disability in New Zealand. Linked to risk factors that develop across the life course, stroke is considered to be largely preventable. This study assessed awareness of stroke risk, symptoms, detection, and prevention behaviours in an urban New Zealand population.

**Methods:** Demographics, stroke risk factors awareness, symptoms, responsiveness, and prevention behaviour were evaluated using a structured oral questionnaire. Binomial logistic regression analyses were used to identify predictors of stroke literacy.

**Results:** Whilst personal experience of stroke increased awareness of symptoms and their likeliness to indicate the need for urgent medical attention, only 42.7% of respondents ( $n=850$ ) identified stroke as involving both blood and the brain. Educational attainment at or above a trade certificate, apprenticeship, or diploma increased awareness of stroke symptoms compared to those with no formal educational attainment. Pacific Island respondents were less likely than New Zealand Europeans to identify a number of stroke risk factors. Māori, Pacific Island, and Asian respondents were less likely to identify symptoms of stroke and indicate the need for urgent medical attention.

**Conclusions:** The variability in stroke awareness and knowledge may suggest the need to enhance stroke-related health literacy that facilitates understanding of risk as well as of factors that reduce morbidity and mortality following stroke in people of Māori and Pacific Island descent, and in those with lower educational attainment or socioeconomic status. It is therefore important that stroke awareness campaigns include tailored components for target audiences.

## Introduction

Stroke, a preventable non-communicable disease (NCD) associated with potentially modifiable lifestyle factors (1), is associated with long-term disability and is the second-leading cause of death worldwide (2). New Zealand has the second highest age-adjusted incidence of stroke among developed countries (3). When stroke occurs, early detection and treatment are critical in reducing the risk of disability and death (4). Early recognition and urgent transfer to stroke centres to ensure patients receive medical treatment within hours of stroke onset significantly improves survival rates (5). Although dramatic improvements in medical care in recent years has resulted in improved outcomes (6), increasing rates of survival and a trend towards greater indirect costs following stroke (7) could have significant economic impact for low income and developing countries (2).

Although the incidence of stroke in the total New Zealand population is high (3, 8, 9 151), within New Zealand, significant variability exists in rates of stroke-related risk, morbidity and mortality (6, 10, 11). Increased burden of modifiable risk factors for stroke, including NCDs such as hypertension, hypercholesterolemia, metabolic syndrome and diabetes, overweight and obesity (12), are apparent in non-European ethnicities, low socioeconomic status (SES) populations (13) and in those with lower levels of educational attainment (14). Higher proportions of Māori and peoples of Pacific descent, whom live in the most deprived areas of New Zealand (15, 16), have greater incidence of a number of NCDs.

Māori adults are more than twice as likely to smoke as non-Māori, and have increased NCD burden including cardiovascular disease, diabetes, hypertension, obesity, and poor dietary habits (16). Peoples of Pacific descent have an increased incidence of diabetes, obesity, poor dietary habits, and a greater prevalence of hazardous drinking patterns compared with non-Pacific peoples (17). These factors could contribute to increased incidence of NCDs, including stroke, in these populations. Māori have increased incidence of stroke compared with New Zealanders of European origin (18), sustain greater loss of health from cerebrovascular disease compared with non-Māori, and greater mortality compared with non-Māori in individuals below the age of 65 (35.6% vs. 6.6%, respectively) (19, 20). In New Zealand,

peoples of Pacific descent have greater hospitalisation rates from stroke compared with non-Pacific peoples of the same gender and age, and are more likely to die from cerebrovascular disease compared with non-Pacific peoples (17).

Despite ongoing campaigns to increase stroke awareness in New Zealand, and with a recent focus on Pacific populations (21), public awareness of stroke in New Zealand has not been assessed to determine where knowledge inadequacies exist. New Zealand data suggests that although awareness of stroke as a disease is high (99%), only 53% of respondents have adequate knowledge of stroke, defined by an ability to relate stroke to the brain and blood vessels (22). Knowledge of risk factors of stroke, and knowledge of appropriate responses to stroke signs or symptoms have not been assessed. A survey of the public awareness of stroke in New Zealand could inform the development of community health literacy and population-appropriate stroke intervention programs in order facilitate effective knowledge translation. Identifying inconsistencies in public awareness of stroke within a representative sample of the New Zealand population could inform future public awareness campaigns. The purpose of this study was to assess public awareness and knowledge of stroke in an urban adult population with a demographic distribution representative of New Zealand.

## **Methods**

### *Ethical Approval*

The University of Auckland Human Participants Ethics Committee (Reference Number 2011/7772) approved this study.

### *Subject Sampling*

Adult members of the general public were approached by trained research assistants working in five convenience-based sample sites outside major retail stores on public streets in the Auckland area. Ethnic diversity within the group of research assistants was reflective of those represented within the target population. Sampling sites were identified following the method established for a similar survey of public awareness of aphasia in New Zealand (22). Sampling was carried out on a variety of days and occurred throughout the morning and afternoon on any single collection day. Shoppers who appeared

to be over the age of 16 years were approached as they entered the store. Collection continued until data was broadly representative of the demographic diversity found in the New Zealand adult population according to the most recent New Zealand census data available at the time of data collection (2012).

### *Study Design*

A brief explanation of the study was given and verbal consent obtained prior to participation. Demographic data, including age, gender, highest level of educational qualification, and occupation were collected. Participants were asked to state which ethnic groups they identified with and were able to state as many as were applicable. A brief face-to-face, interview-based questionnaire (see Supplement 1) was administered to ascertain awareness and knowledge of stroke. Questions were designed to assess stroke literacy factors and to enable comparison to similar international studies (23). Questions investigated stroke awareness and knowledge of stroke, stroke risk factors, stroke symptoms, and immediate actions required in response to observation of stroke symptoms.

Open-ended questions were used to enable respondents to answer 'in their own words', and allowed researchers insight into stroke literacy (24, 25). Response recording was completed by the interviewer at the time of the interview using a combination of verbal and written records and common response check-lists. The common response list (see Supplement 1) was not visible to the interviewee but allowed the interviewer to rapidly record responses. Common response lists were established prior to data collection from similar international studies and were confirmed following analysis of responses from the first 50 respondents in this study. Written information about stroke awareness was offered to all participants on conclusion of the interview.

### *Coding and Statistical Analyses*

Responses were coded using the prioritised coding schedule outlined by the New Zealand Department of Statistics (26). Although use of prioritisation is no longer recommended, it allows statistical identification of minority groups about whom policy decisions are made and is relevant given the high incidence of stroke in Māori and Pacific populations (6). Socioeconomic status was estimated using the New Zealand Socioeconomic Index (NZSEI) 1996 (27). The NZSEI-96 combines educational

qualification and occupation to determine a socioeconomic index factor. Socioeconomic index factors were defined in SES quintiles based on the NZSEI-96 and coded appropriately. Quintiles are categorised from lowest SES (5) to highest SES (1). Educational attainment was defined in five groups according to the highest reported academic qualification: no formal qualification; national certificate of educational achievement (NCEA) level 1; NCEA level 2/3 attained at school, trade certificate/apprenticeship/diploma; Bachelor's or Postgraduate degree; postgraduate degree.

Coding of responses to questions examining stroke awareness and knowledge followed the previously defined methods (22). This defined stroke awareness as responding positively to the question: 'Have you heard of stroke?' Adequate stroke knowledge was defined as knowing that stroke involved both 'blood' and 'brain', (or a variation of these terms such as 'vascular' or 'nervous system') and not stating additional incorrect factors (e.g. 'it is a heart attack'). Correctly identified symptoms of stroke, as defined by the F.A.S.T mnemonic, which is active in New Zealand via the Stroke Foundation (28) were coded according to the National Institute of Neurological Disorders and Stroke (NINDS) symptom classification (29).

Responses to questions examining knowledge of stroke risk factors were coded according to non-modifiable and modifiable risk factors. Classifications were based on those described in similar studies (22, 30, 31), and inter-coder consistency was verified throughout the study. Participants' personal experience of stroke was coded depending on whether the person they knew who had experienced a stroke was (a) themselves, (b) family and friends with whom the participant would likely have had close personal involvement (e.g. spouse, parent, child, sibling, cousin, aunt/uncle, grandparent/great-grandparent, friend, extended family), or (c) patients (if participant worked in the health care field). In cases where work colleagues, or acquaintances had experienced a stroke, this was not coded as personal experience as it was not possible to assess the likelihood of this being a relationship close enough to involve close, personal involvement with the affected person. Responses to questions assessing knowledge of appropriate actions to take when stroke symptoms are observed were coded according to whether the need for urgent medical attention had been identified. Incorrect responses were coded

according to whether they involved non-urgent medical attention (e.g. ‘go see the GP’ (non-emergency medical practitioner)) or self-management (e.g. ‘have a lie down’).

Statistical analyses used were consistent with the stroke literacy literature to enable comparison. Binomial logistic regression analyses were performed to estimate odds ratios (OR) with a 95% (CI), comparing gender, age, ethnicity, socioeconomic status, educational attainment and personal experience with stroke. Potential for impact of the variables listed in Table 1 was explored. The frequency of correct identification of stroke symptoms, as determined by the F.A.S.T. campaign, were analysed with Cochran’s Q Test.

## **Results**

### *Demographics*

A total of 850 respondents completed the survey. The sample was broadly representative of the Auckland, New Zealand population (32) (Table 1).

### *Stroke Awareness and Responsiveness*

Data presented represents that in which significant variance is apparent. Of the total respondents, 97.5% ( $n=829$ ) had previously heard of stroke, 42.7% could correctly define a stroke as involving both blood and the brain, and 82.4% identified the need for urgent medical attention.

The ability to define a stroke as involving both blood and the brain varied by ethnicity (Figure 1), educational attainment, age and personal experience of stroke (Table 2). Responders with educational attainment at or above a trade or apprenticeship certificate, or a diploma were significantly more likely to define a stroke as involving both blood and the brain compared with respondents with no formal educational attainment. Respondents identifying as Māori, Pacific Island and Asian were significantly less likely to be able to define a stroke as involving both blood and the brain. Respondents aged from 50-59 years were more likely to be able to define a stroke as involving both blood and the brain compared with 70+ year-old respondents. Respondents who had personal experience with stroke were significantly more likely to be able to define a stroke as involving both blood and the brain and to



suggest the need for urgent medical attention. Of those who could not identify stroke as relating to blood and brain, 17.9% ( $n=150$ ) of total respondents defined a stroke as being a ‘heart attack’. Inappropriately identified symptoms of stroke included seizure or fitting (6.1%,  $n=52$ ) and chest pain (5.2%,  $n=44$ ).

While knowledge that urgent medical attention was required in response to a stroke was high (82.4%), this varied by SES, ethnicity, educational attainment, age and personal experience of stroke (Table 2). Respondents from SES quintile 4 were significantly less likely to suggest self-management of stroke compared with quintile 5 (lowest SES). Respondents identifying as Māori, Pacific Island and Asian were less likely to suggest the need for urgent medical attention compared with respondents identifying as New Zealand European/European. Respondents identifying as Pacific Island and Asian were significantly more likely to suggest actively seeking non-urgent medical attention (i.e., seeing a non-emergency medical practitioner) compared those identifying as New Zealand European/European, whilst Asian respondents were less likely to suggest self-management. Compared with 70+ year-old respondents, 60-69 year-old respondents had significantly greater stroke awareness. Respondents who had personal experience with stroke were significantly more likely to suggest the need for urgent medical attention.

#### *Stroke Symptom Knowledge: Knowledge of the Components of F.A.S.T.*

The F.A.S.T. campaign has four components (Face, Arm, Speech, Time). Of all respondents, 114 (13.4%) did not correctly identify any components, 356 (41.8%) identified one, 266 (31.6%) identified two, 98 (11.5%) identified three, and 14 (1.7%) identified four components. The “Time” component of F.A.S.T. was most frequently identified (Figure 2). Using Cochran’s Q Test, there was a significant difference in the frequency of identification ( $Q=1,184.7, p<0.001$ ) amongst the four components of the F.A.S.T. campaign.

#### *Identification of Risk Factors for Stroke*

Whilst MELAA/Other respondents were significantly more likely to suggest diabetes as a risk factor for stroke compared with New Zealand European/European respondents, Asian respondents were

significantly less likely to suggest family history of stroke and smoking as risk factors for stroke. Pacific Island respondents were significantly less likely to suggest family history of stroke, high cholesterol, obesity, and smoking as risk factors for stroke, but significantly more likely to suggest stress as a risk factor for stroke compared with New Zealand European/European respondents (Table 3).

Respondents in SES quintile 4 were significantly more likely to identify lack of exercise and poor dietary habits as risk factors for stroke compared with respondents in quintile 5 (lowest quintile) (Table 4).

#### *Identification of factors that could Reduce Risk of Stroke*

MELAA/Other respondents were significantly more likely to suggest a healthy lifestyle as a modifiable factor that could contribute to reduced risk of stroke, whilst Māori respondents were significantly more likely to suggest controlling diabetes as a factor which could reduce the risk of stroke compared with New Zealand European/European respondents. Pacific Island respondents were significantly less likely to suggest controlling blood pressure, not smoking, and moderating alcohol intake as modifiable factors that could contribute to reduced risk of stroke, whilst Asian respondents were significantly less likely to suggest controlling blood pressure, and not smoking as modifiable factors compared with New Zealand European/European respondents (Table 5).

Female respondents were significantly less likely to identify managing stress (0.7 (0.4-0.9),  $p < 0.05$ ) as a modifiable factor that could contribute to reduced risk of stroke compared with males.

#### **Discussion**

This is the first published study that examined baseline awareness of stroke symptoms, risk factors and response in a large sample of an ethnically diverse New Zealand population. This study has shown that while there is a moderate overall knowledge of stroke, this varies depending on ethnicity with particularly low levels of awareness in people of Māori, Pacific and Asian descent. The burden of stroke falls disproportionately on these people, many of whom reside in low SES communities (9, 15, 33). Increased prevalence of multiple risk factors for stroke in Māori, Pacific and low SES populations in New Zealand suggests that improved public stroke awareness, in conjunction with strategies to reduce

social inequity, could help reduce disparities in these populations. The developmental origins of health and disease (DOHaD) hypothesis suggests that, although preventable, the development of NCDs in adulthood begins in early life (34). Stroke, an NCD for which developmental programming in the womb impacts on risk in adulthood (35-38), requires a life-course approach to reducing incidence and must, thus, address lifestyle factors which are associated with low SES and deprivation. Improved public understanding of factors throughout the life-course, which contribute to risk of stroke, should be targeted to communities where the double burden of increased risk and reduced accessibility to resources are found.

Educational attainment below the level of a trade certificate, apprenticeship or a diploma below a Bachelor's degree was associated with reduced knowledge of stroke. Although, generally, the population sampled was an appropriate representation of Auckland based on the 2006 census, educational attainment was greater in the study population. As greater educational attainment is associated with improved stroke literacy (39), this could influence results, suggesting that this study may over-estimate stroke knowledge and awareness for the wider Auckland area. Limited knowledge of stroke in a significant proportion of New Zealanders, as a function of lower levels of educational attainment, could have a pervasive impact on the identification of stroke symptoms and the ability to respond appropriately. Improved public stroke awareness may increase the ability to identify stroke, reduce pre-hospital delay (40), and reduce the likelihood of death and disability (4).

Worldwide, public awareness of stroke is poor and is associated with lower educational attainment (23). Whilst a low level of basic literacy is associated with barriers to preventative healthcare and reduced public awareness of stroke symptoms (41), low health literacy regarding stroke could be a primary impediment to improving health behaviours which may reduce the incidence of stroke. Health literacy refers to the motivation and ability to access, understand and use information relating to health-related issues in decision making at a personal, community or societal level (42, 43). While generic dispositions and capabilities are associated with health literacy, it is also contextual and situated. Individuals and communities experience variable levels of access to information, and relevant knowledge of and about different contexts such as stroke.

Reduced knowledge and awareness of stroke is associated with delay in obtaining urgent medical attention (40, 44, 45), which in turn is associated with negative clinical outcomes (4, 5). Inability to identify and respond to stroke could delay medical intervention and have far-reaching economic impact on the direct and indirect costs (7, 46, 47) associated with long-term care following stroke. Educational campaigns utilising the F.A.S.T. mnemonic have been shown to increase knowledge of stroke symptoms, which are sustained beyond 3 months (28). Whilst the Stroke Foundation of New Zealand has actively promoted the F.A.S.T mnemonic for ~ 10 years, limited funding has prohibited a large-scale multi-channel campaign. However, it is reasonable to hypothesise that stroke awareness based on components of the F.A.S.T. mnemonic are recognised within the New Zealand population.

The current study used open-ended, un-aided questions, such as, “*What are the signs that someone is having a stroke?*” Comparison of results from studies utilising open vs. closed questions suggests that the use of closed questions increases the rate of positive responses (23). Therefore, we consider that measures of awareness and knowledge may be underestimated when unaided, or open-ended questions are used, and overestimated when aided questions are used (48). It is therefore possible that the open-ended questions used in this study have contributed to under-estimation of knowledge of signs and symptoms of stroke. Although over 80% of respondents identified the importance of seeking urgent medical attention in the instance of stroke, it is of concern that a high proportion of respondents were unable to define key symptoms of stroke. In a life-situation, when a response to act on visible stroke symptoms is required the observer will see something unusual in the affected individual. Therefore it may be that questions supported by visual stimuli (such as images of people with and without stroke symptoms) could be a more effective way of measuring the likelihood of a positive response to observation of stroke signs or symptoms.

A more expansive assessment of stroke-related health literacy could evaluate the ability of individuals and communities to access and apply information about stroke risk factors, symptoms, and responses. Additionally, engagement and effectiveness of stroke awareness campaigns could be assessed. Whilst more difficult to measure, investigating access to stroke-relevant information in high-risk populations could also help inform future stroke awareness campaigns. Repeating this study in rural and smaller

urban populations could help to determine potential differences in awareness and knowledge of stroke that could come about as a result of variable access to information and, possibly, healthcare services associated with location.

These data emphasise the importance of addressing the recommendations for population-wide education around stroke risk factors, symptoms and responsiveness made by Feigin, *et al.* (2007) when considering how to address health inequities. The variability in stroke awareness and knowledge identified in this study may suggest that current stroke awareness campaigns are not adequately meeting the needs of low SES, Māori, and Pacific populations within New Zealand. It is therefore important that population-wide awareness campaigns address access issues and include tailored components for target audiences, a strategy that has been shown to be effective in New Zealand populations (49).

In conclusion, this study indicates that, as in many developed nations, knowledge and awareness of stroke in an urban New Zealand population is poor. Whilst recognizing and controlling modifiable risk factors for stroke could reduce the risk of stroke, the ability to identify and respond appropriately in the instance of stroke has the potential to improve long-term health outcomes. The development of targeted campaigns that recognise and respond to the needs of different sectors within New Zealand could improve health outcomes and reduce the future burden of disease and disability at the individual, community, and national level. The results of this study provide compelling support for the development of an educational programme to enhance stroke-related health literacy, employing an approach that facilitates understanding of life-course risk reduction, symptomatology of stroke and appropriate responses, for current and future generations.

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**Disclosures:** None

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## References

1. Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, et al. Priority actions for the non-communicable disease crisis. *The Lancet*. 2011;377(9775):1438-47.
2. Feigin V, Forouzanfar M, Krishnamurthi R, Mensah G, Connor M, Bennett D, et al. Global and regional burden of stroke during 1990–2010: findings from the Global Burden of Disease Study 2010. *The Lancet*. 2014;383(9913):245-55.
3. Murray C, Vos T, Lozano R, Naghavi M, Flaxman A, Michaud C, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet*. 2012;380(9859):2197-223.
4. Marler J, Tilley B, Lu M, Brott T, Lyden P, Grotta J, et al. Early stroke treatment associated with better outcome. The NINDS rt-PA stroke study. *Neurology*. 2000;55(11):1649-55.
5. Wardlaw J, Sandercock P, Berge E. Thrombolytic therapy with recombinant tissue plasminogen activator for acute ischaemic stroke: Where do we go from here? A cumulative meta-analysis. *Stroke*. 2003;34(6):1437-42.
6. Carter K, Anderson C, Hacket M, Feigin V, Barber P, Broad J, et al. Trends in ethnic disparities in stroke incidence in Auckland, New Zealand, During 1981 to 2003. *Stroke*. 2006;37(1):56-62.
7. Joo H, George M, Fang J, Wang G. A literature review of indirect costs associated with stroke. *Journal of Stroke and Cerebrovascular Diseases*. 2014;23(7):1753-63.
8. Feigin V, McNaughton H, Dyal L. Burden of stroke in Maori and Pacific peoples of New Zealand. *International Journal of Stroke*. 2007;2(3):208-10.
9. New Zealand Ministry of Health. Mortality and Demographic Data 2009. Wellington, New Zealand: New Zealand Ministry of Health, 2012.
10. Bonita R, Broad J, Beaglehole R. Ethnic differences in stroke incidence and case fatality in Auckland, New Zealand. *Stroke*. 1997;28(4):758-61.

11. Feigin V, Carter K, Hackett M, Barber P, McNaughton H, Dyal L, et al. Ethnic disparities in incidence of stroke subtypes: Auckland regional community stroke study, 2002–2003. *The Lancet Neurology*. 2006;5(2):130-9.
12. Lloyd-Jones D, Adams R, Carnethon M, De Simone G, Ferguson T, Flegal K, et al. Heart disease and stroke statistics-2009 Update: A report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation*. 2009;119(3):e21-e181.
13. Hayes D, Greenlund K, Denny C, Croft J, Keenan N. Racial/ethnic and socioeconomic disparities in multiple risk factors for heart disease and stroke-United States, 2003. *Morbidity and Mortality Weekly Report*. 2005;54(5):113-7.
14. Alkadry M, Wilson C, Nicholas D. Stroke Awareness Among Rural Residents. *Social Work in Health Care*. 2006;44(2):73-92.
15. Statistics New Zealand and Ministry of Pacific Island Affairs. *Health and Pacific Peoples in New Zealand*. Wellington, New Zealand: Statistics New Zealand and Ministry of Pacific Island Affairs, 2011.
16. New Zealand Ministry of Health. *New Zealand Health Survey: Annual Update of Key Findings 2012/13*. Wellington, New Zealand: New Zealand Ministry of Health, 2013.
17. New Zealand Ministry of Health. *Tupu Ola Mōui: Pacific Health Chart Book 2012*. Wellington, New Zealand: New Zealand Ministry of Health, 2012.
18. Stroke Foundation of New Zealand. *Understanding and Preventing Stroke and Transient Ischaemic Attack*. Wellington, New Zealand, 2012.
19. New Zealand Ministry of Health. *Mortality and Demographic Data 2006*. Wellington, New Zealand: New Zealand Ministry of Health, 2009.
20. New Zealand Ministry of Health. *Mātātūhi Tuawhenua: Health of Rural Māori 2012*. Wellington, New Zealand: New Zealand Ministry of Health, 2012.
21. The Stroke Foundation of New Zealand. *Pacific Stroke Prevention Project 2014 [01/07/2014]*. Available from: <http://www.stroke.org.nz/pacific>.
22. McCann C, Tunnicliffe K, Anderson R. Public awareness of aphasia in New Zealand. *Aphasiology*. 2012;27(5):568-80.



23. Jones S, Jenkinson A, Leathley M, Watkins L. Stroke knowledge and awareness: an integrative review of the evidence. *Age and Ageing*. 2010;39(1):11-22.
24. Dillman D, Salant P. *How to conduct your own survey*: John Wiley and Sons, Inc., New York; 1994.
25. Glasow P. *Fundamentals of survey research methodology*. MITRE; 1-12/4/2005; Washington C3 Center2005.
26. New Zealand Department of Statistics. *New Zealand Standard Classification of Ethnicity*. Wellington, New Zealand: New Zealand Department of Statistics 1993.
27. Galbraith L, Jenkin G, Coope P. *New Zealand Socio-Economic Index 1996*. Wellington, New Zealand: Statistics New Zealand, 2003.
28. Wall H, Beagan B, O'Neill H, Foell K, Boddie-Willis C. Addressing heart disease and stroke prevention through comprehensive population-level approaches. *Preventing Chronic Disease*. 2008;5(2).
29. National Institute of Neurological Disorders and Stroke. NINDS Stroke Information Page online2014 [updated 18/07/2014; cited 2014 18/07/2014]. Available from: <http://www.ninds.nih.gov/disorders/stroke/stroke.htm>
30. Kraywinkel K, Heidrich J, Heuschmann P, Wagner M, Berger K. Stroke risk perception among participants of a stroke awareness campaign. *BMC Public Health*. 2007;7(1):39.
31. Morren J, Salgado E. Stroke literacy, behavior, and proficiency in a south Florida population. *Journal of Stroke and Cerebrovascular Diseases*. 2013;22(7):962-8.
32. Statistics New Zealand. *New Zealand Census*. Wellington, New Zealand: Statistics New Zealand, 2006.
33. Maré D, Mawson P, Timmins J. *Deprivation in New Zealand: Regional patterns and change*. Wellington, New Zealand: New Zealand Treasury, 2001 Contract No.: WP 01/09.
34. Barker D. In utero programming of chronic disease. *Clinical Science*. 1998;95(2):115-28.
35. Eriksson J, Forsén T, Tuomilehto J, Osmond C, Barker D. Early growth, adult income, and risk of stroke. *Stroke*. 2000;31(4):869-74.

36. Gluckman P, Hanson M. The Developmental Origins of Health and Disease. In: Wintour E, Owens J, editors. Early Life Origins of Health and Disease. Advances in Experimental Medicine and Biology. 573: Springer US; 2006. p. 1-7.
37. Lawlor D, Ronalds G, Clark H, Davey Smith G, Leon D. Birth weight is inversely associated with incident coronary heart disease and stroke among individuals born in the 1950s: Findings from the Aberdeen children of the 1950s prospective cohort study. *Circulation*. 2005;112(10):1414-8.
38. Esrond C, Kajantie E, Forsén T, Eriksson J, Barker D. Infant growth and stroke in adult life: The Helsinki birth cohort study. *Stroke*. 2007;38(2):264-70.
39. Nicol M, Thrift A. Knowledge of risk factors and warning signs of stroke. *Vascular Health and Risk Management*. 2005;1(2):137-47.
40. Das K, Mondal G, Dutt A, Mukherjee B, Mukherjee B. Awareness of warning symptoms and risk factors of stroke in the general population and in survivors stroke. *Journal of Clinical Neuroscience*. 2007;14(1):12-6.
41. DuBard C, Garrett J, Gizlice Z. Effect of language on heart attack and stroke awareness among U.S. hispanics. *American Journal of Preventive Medicine*. 2006;30(3):189-96.
42. Nutbeam D. Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International*. 2000;15(3):259-67.
43. World Health Organisation. The WHO Health Promotion Glossary. Geneva Switzerland: World Health Organization Division of Health Promotion Education and Communications Health Education and Health Promotion Unit, 1998;Contract No.: WHO/HPR/98.1.
44. Wester P, Rådberg J, Lundgren B, Peltonen M. Factors associated with delayed admission to hospital and in-hospital delays in acute stroke and TIA: A prospective, multicenter study. *Stroke*. 1999;30(1):40-8.
45. Kim Y, Park S-S, Bae H-J, Heo J, Kwon S, Lee B-C, et al. Public awareness of stroke in Korea: A population-based national survey. *Stroke*. 2012;43(4):1146-9.

46. Cadilhac D, Carter R, Thrift A, Dewey H. Estimating the long-term costs of ischemic and hemorrhagic stroke for Australia: New evidence derived from the North East Melbourne Stroke Incidence Study (NEMESIS). *Stroke*. 2009;40(3):915-21.
47. Evers S, Struijs J, Ament A, van Genugten M, Jager J, van den Bos G. International comparison of stroke cost studies. *Stroke*. 2004;35(5):1209-15.
48. Rowe A, Frankel M, Sanders K. Stroke awareness among Georgia adults: epidemiology and considerations regarding measurement. *Southern Medical Journal*. 2001;94(6):613-8.
49. Blakely T, Simmers D, Sharpe N. Inequities in health and the Marmot Symposia: time for a stocktake. *The New Zealand Medical Journal*. 2011;124(1338):7.

**Table 1:** Demographic data of respondents, and Auckland regional demographic data (2006).

	<b>Responses</b>	<b>Study Respondents</b>	<b>Auckland Population</b>
	<i>n</i>	<b>Percent (%)</b>	
<b>Gender</b>			
Female	470	55.2	51.3
Male	367	43.1	48.7
<b>Age</b>			
16-19	41	4.8	7.6 <sup>#</sup>
20-29	133	15.6	14.5
30-39	170	20.3	15.6
40-49	191	22.4	15.2
50-59	165	19.4	11.1
60-69	91	10.7	7.0
70+	46	5.4	7.1
<b>SES Quintile</b>			
1	165	19.3	24.4
2	339	39.8	20.4
3	110	12.9	17.1
4	147	17.3	16.4
5	76	8.9	21.9
<b>Ethnicity</b>			
Māori	94	11.0	11.1
Pacific Island	108	12.7	14.4
Asian	119	14.0	18.9
Middle Eastern, Latin American, African/Other	35	4.1	1.0
New Zealand European/European	481	56.5	56.5
<b>Educational Attainment</b>			
No Formal Qualification	68	8.0	18.1
NCEA Level 1	101	11.9	10.4
NCEA Level 2/3	174	20.4	26.6 <sup>##</sup>
Trade Certificate/Apprenticeship/ Diploma below Bachelor's	190	22.3	16.3
Bachelor's/Postgraduate Diploma	228	26.8	4.6
Master's/Doctorate	76	8.9	3.1
<b>Personal Experience with Stroke</b>	521	61.2	-

<sup>#</sup>16-19 years of age; <sup>##</sup>national certificate of educational achievement (NCEA) level 2, 3 and 4 attained at school; level 1, 2 or 3 attained post-school; overseas secondary school qualification

**Table 2:** The effect of SES compared with quintile 5 (lowest), educational attainment compared with no formal educational attainment, ethnicity compared with New Zealand European/European, age compared with 70+, and personal experience with stroke compared with no previous experience on public awareness of stroke and stroke responsiveness.

	Stroke Awareness	Urgent Medical	Non-Urgent Medical	Self-Manage
<b>Age</b>				
16-19	0.7 (0.2-2.1)	3.6 (0.8-15.5)	1.0 (0.9-1.0)	0.9 (0.3-2.5)
20-29	1.1 (0.5-2.4)	1.0 (0.4-3.0)	0.9 (0.1-8.7)	0.9 (0.4-1.9)
30-39	1.1 (0.5-2.3)	1.0 (0.4-2.8)	1.1 (0.1-10.5)	0.9 (0.4-2.0)
40-49	1.6 (0.8-3.3)	1.0 (0.4-2.7)	0.6 (0.1-6.2)	1.1 (0.5-2.2)
50-59	1.4 (0.7-2.8)	1.1 (0.4-3.0)	0.9 (0.1-8.7)	1.3 (0.6-2.7)
60-69	2.6 (1.2-5.7)*	0.5 (0.2-1.5)	1.7 (0.2-17.8)	1.2 (0.5-2.5)
<b>SES Quintile</b>				
1 (High)	1.5 (0.8-2.9)	1.2 (0.5-2.7)	0.8 (0.1-4.7)	0.7 (0.4-1.4)
2	1.2 (0.6-2.1)	1.1 (0.6-2.2)	0.8 (0.2-4.2)	1.1 (0.6-2.0)
3	0.9 (0.5-1.7)	0.8 (0.4-1.8)	1.3 (0.2-7.9)	0.8 (0.4-1.5)
4 (Low)	0.8 (0.4-1.5)	1.0 (0.5-2.1)	0.7 (0.1-4.3)	0.5 (0.3-1.0)*
<b>Ethnicity</b>				
Māori	0.6 (0.4-0.9)	0.4 (0.2-0.7)**	2.7 (0.7-11.0)	1.5 (0.9-2.5)
Pacific Island	0.2 (0.1-0.3)**	0.3 (0.2-0.6)***	4.1 (1.2-14.2)*	1.0 (0.6-1.6)
Asian	0.2 (0.1-0.3)***	0.2 (0.1-0.4)***	5.7 (2.0-16.3)**	0.6 (0.3-1.0)*
MELAA/Other	0.6 (0.3-1.2)	1.0 (0.5-2.9)	1.0 (0.9-1.1)	0.6 (0.3-1.4)
<b>Educational Attainment</b>				
NCEA Level 1	1.8 (0.9-3.7)	1.0 (0.4-2.2)	1.6 (0.1-18.8)	0.6 (0.3-1.3)
NCEA Level 2/3	1.5 (0.8-3.1)	0.9 (0.4-2.0)	1.0 (0.1-11.8)	0.7 (0.4-1.3)
Trade Certificate/Apprenticeship/ Diploma below Bachelor's	2.7 (1.4-5.3)**	0.9 (0.4-1.9)	2.9 (0.3-27.3)	0.8 (0.4-1.5)
Bachelor's/Postgraduate Diploma	2.9 (1.4-5.8)**	1.4 (0.6-3.2)	3.7 (0.4-38.5)	0.8 (0.4-1.5)
Master's/Doctor of Philosophy	2.8 (1.2-6.4)*	1.5 (0.6-4.3)	3.9 (0.3-48.4)	0.8 (0.4-1.8)
<b>Personal Experience with Stroke</b>				
	1.4 (1.0-2.0)*	1.5 (1.0-2.2)*	1.0 (0.4-2.7)	1.0 (0.7-1.4)

\*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$

**Table 3:** The effect of ethnicity on the identification of modifiable and non-modifiable factors contributing to the risk of stroke compared with New Zealand European/European respondents.

	Diabetes	Family History of Stroke	High Cholesterol	Obesity	Smoking	Stress
<b>Ethnicity</b>						
Māori	1.9 (0.8-4.2)	0.7 (0.4-1.4)	0.8 (0.4-1.4)	0.8 (0.5-1.5)	0.8 (0.5-1.2)	1.2 (0.7-2.1)
Pacific Island	1.1 (0.5-2.7)	0.3 (0.1-0.6)**	0.4 (0.2-0.9)*	0.5 (0.3-0.9)*	0.3 (0.2-0.4)***	2.1 (1.2-3.4)**
Asian	1.8 (0.9-3.7)	0.3 (0.2-0.6)**	0.6 (0.3-1.2)	0.6 (0.3-1.0)	0.3 (0.2-0.5)***	1.3 (0.8-2.2)
MELAN/Others	2.9 (1.0-8.1)*	0.4 (0.1-1.3)	1.7 (0.8-3.9)	1.0 (0.4-2.3)	0.9 (0.4-1.8)	1.2 (0.5-2.7)

\*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$

**Table 4:** The effect of SES compared with quintile 5 on the identification of modifiable factors contributing to the risk of stroke.

	Lack of Exercise	Obesity	Poor Dietary Habits
<b>SES Quintiles</b>			
1 (High)	1.5 (0.7-3.2)	2.0 (0.9-4.2)	1.1 (0.6-2.0)
2	1.5 (0.7-2.9)	2.1 (1.1-4.2)*	0.9 (0.5-1.5)
3	1.5 (0.7-3.3)	1.1 (0.5-2.5)	1.0 (0.5-1.8)
4 (Low)	2.9 (1.4-6.0)**	1.4 (0.7-2.7)	2.0 (1.1-3.6)*

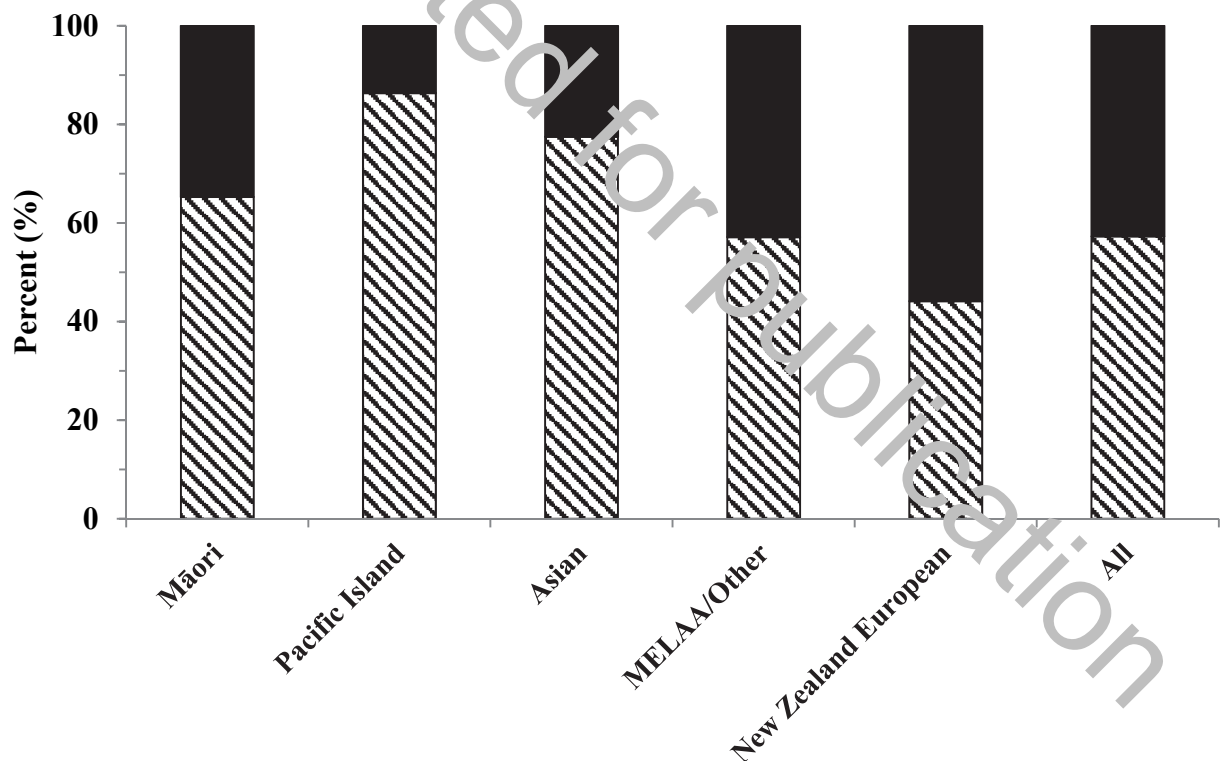
\*\* $p < 0.01$ ; \* $p < 0.05$

**Table 5:** The effect of ethnicity compared with New Zealand European/Europeans on the identification of modifiable and factors which could reduce the risk of stroke.

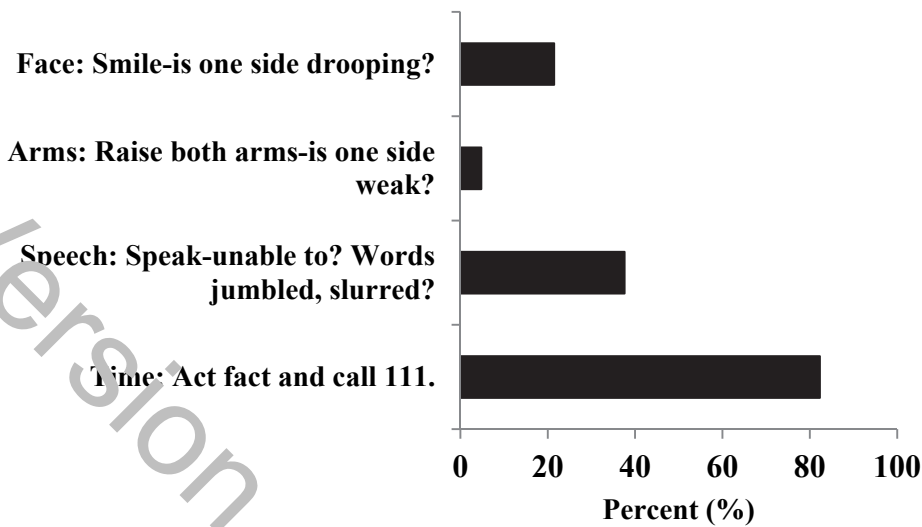
	Controlling Diabetes	Controlling Blood Pressure	Healthy Lifestyle	Not Smoking	Moderating Alcohol Intake
<b>Ethnicity</b>					
Māori	6.3 (1.1-35.8)*	0.2 (0.1-1.0)	1.8 (0.9-3.6)	1.1 (0.7-1.8)	0.8 (0.5-1.5)
Pacific Island	1.0 (0.9-1.1)	0.2 (0.1-0.9)*	1.6 (0.8-3.2)	0.3 (0.2-0.6)***	0.4 (0.2-0.9)*
Asian	0.7 (0.1-6.3)	0.3 (0.1-0.9)*	0.7 (0.3-1.7)	0.4 (0.3-0.7)**	0.8 (0.4-1.4)
MELAA/Other	2.5 (0.2-25.0)	1.1 (0.4-3.6)	3.6 (1.5-9.0)**	0.9 (0.4-1.9)	1.3 (0.6-3.0)

\*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ .

**Figure 1:** Public awareness of the mechanisms of stroke incorrectly (diagonal shading) or correctly (black shading) identified, by ethnicity.



**Figure 2:** Knowledge of stroke symptoms as categorised by the F.A.S.T. campaign.



**Figure 3:** Public awareness of stroke symptoms as categorised by F.A.S.T. campaign components, by ethnicity: the inability to identify a component (white), the ability to identify a single component (diagonal shading), the ability to identify two components (horizontal shading) or the ability to identify three or four components (black shading).

