

**Ethnicity and Functional Outcome After Stroke**

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**Background and Purpose**—There is limited information on the influence of ethnicity on functional outcome after stroke. We examined functional outcomes among European New Zealanders, Māori, Pacific, and Asian people 6 months after stroke in a population-based context.

**Methods**—This was a prospective incidence and 6-month outcomes study of all new stroke patients (excluding subarachnoid hemorrhage) that occurred over 1 year in a defined geographical area in Auckland, New Zealand, during 2002 to 2003. Ethnicity was self-defined. Outcome measures included the Frenchay Activities Index, 36-item Short Form questionnaire, independence, death, composite of death and dependence, and living situation.

**Results**—Functional measures were available in 1127 patients 6 months after stroke. Frenchay Activities Index scores were associated with ethnicity on both univariable and multivariable analysis, with Asian and Pacific people having worse scores. Physical Component Summary score of the 36-item Short Form was associated with ethnicity on univariable (scores for Pacific, Māori, and Asian people were higher than those for Europeans) but not multivariable analysis. Asian people were less likely to be dead compared to Europeans, and Pacific people were more likely to be dependent on others for help than Europeans. Pacific people were more likely to be dead or dependent than Europeans. Asian and Pacific people were more likely to be living at home than Europeans.

**Conclusions**—Ethnicity was associated independently with functional outcomes. The association was attenuated when adjusted for stroke severity and other covariates. The direction of the relationship was not consistent between measures for individual ethnic groups. (Stroke. 2011;42:960-964.)

**Key Words:** ethnicity ■ functional outcome ■ stroke

StROKE incidence, subtype, risk factors, and process of care vary with ethnicity. Short-term process measures, such as length of hospital stay, in-hospital mortality, discharge destination, and recurrence, also vary by ethnic group. However, there are few studies of the association of ethnicity and functional outcome after stroke, and there is none from large, prospective, population-based cohorts. We examined 6-month functional outcomes in a large prospective stroke incidence study undertaken in the ethnically diverse population of Auckland, New Zealand. We aimed to explore any associations between ethnicity and functional outcome in this population. A previous small study found that functional outcome (Functional Independence Measure, 36-item Short Form [SF-36], London Handicap Score) scores for non-European New Zealanders after stroke were worse than those for Europeans. New Zealand has a publicly funded health system with at least theoretically equal access to medical and rehabilitation services for all. Therefore, in this large sample corrected for stroke severity and other factors, we expected there to be no difference in functional outcome 6 months after stroke for people from different ethnic groups.

**Patients and Methods**

This analysis was based on patients with first-in-a-lifetime or recurrent stroke (excluding subarachnoid hemorrhage) registered over 1 calendar year as part of the third Auckland Regional Community Stroke III study. The methods of the Auckland Regional Community Stroke III study have been described elsewhere. In brief, stroke case ascertainment was based on multiple overlapping sources and included all stroke events in adult residents in Auckland (n = 897,882) between March 1, 2002 and February 28, 2003. Ethnicity was self-identified based on the definitions used in the 2001 New Zealand census and grouped as New Zealand European, Māori, Pacific, Asian, and other. Stroke was defined according to standard World Health Organization criteria. The study was approved by the Auckland Regional Ethics Committee and

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written informed consent was obtained from all participants or their proxy (when patients were severely disabled or dead). Each stroke patient, or proxy, underwent interviews, first as face-to-face as soon as possible after stroke onset (baseline) and then by telephone 6 months after the onset of stroke by trained study nurses using a structured questionnaire. Outcome measures used were death (including search of death register, family physician and hospital records completed by 9 months), dependence (answer to question “do you need help with basic activities?”),17 composite of death or dependence, living situation (home versus institutional accommodation), Frenchay Activity Index (FAI),18 and Physical Component Summary Score and Mental Component Summary Score on the SF-36.19 The SF-36 measures health-related quality of life. In “normal” populations, the Physical Component Summary Score and Mental Component Summary Score have a mean score of 50 (SD, 10 units);20 scores >50 represent better than average scores and scores <50 represent poorer than average scores. The FAI measures the patient’s frequency of performing Instrumental Activities of Daily Living of 15 items in the recent past. Total score ranges from 0 (no activity) to 45 (maximum activity). Median (interquartile range) FAI scores in a normal population of 65- to 74-year-olds are 24 (19–28) (mean age, 65.9 years), and Maori people (mean age, 61.7 years; P=0.001). Europeans were also more likely to be living alone (405/1349 [30.0%] versus 37/412 [8.9%] for combined Pacific, Asian, and Maori people; P<0.001). Europeans had less severe strokes with higher initial Barthel Index scores than the other groups, although of marginal statistical significance (P=0.05). Europeans had lower rates of unconsciousness or drowsiness (506/1332 [38.0%]) than did Pacific, Asian, and Maori people combined (194/408 [47.5%]; P<0.001).

Statistical Analysis
Univariable associations were described by χ² tests for categorical response variables and ANOVA and regression were used for continuous response variables. European was the reference category for the ethnicity variable. For multivariable analyses with continuous response variables, ANCOVA was used with model selection based on removing nonsignificant predictors stepwise, with P=0.1 for removal. For categorical response variables, logistic regression was used with a stepwise procedure, with P=0.1 for addition or removal of variables. Ethnicity was retained in all multivariable models regardless of its statistical significance. SAS version 9.1 was used for all analyses.

Results
A total of 1842 patients with new stroke events, excluding subarachnoid hemorrhage, were registered. At 6-month follow-up, results for functional outcomes were available for 1127 patients (61.2%). Of the remaining 715 patients, 536 (29.1% of the total) had died. The remaining 179 patients (9.7% of the total) were not known to have died and did not have a functional assessment. Of the 1127 patients who had a functional assessment, 75.7% were European, 9.7% were Pacific, 8.6% were Asian, and 5.2% were Maori people. The only significant difference between the group who had a functional assessment at 6 months and those who did not was that Pacific people were significantly less likely to have had a functional assessment.

Table 1 summarizes baseline characteristics, risk factors, and stroke variables. Europeans (mean age, 76.3 years) were older than Pacific people (mean age, 64.8 years), Asians (mean age, 65.9 years), and Maori people (mean age, 61.7 years; P<0.001). Europeans were also more likely to be living alone (405/1349 [30.0%] versus 37/412 [8.9%] for combined Pacific, Asian, and Maori people; P<0.001). Europeans had less severe strokes with higher initial Barthel Index scores than the other groups, although of marginal statistical significance (P=0.05). Europeans had lower rates of unconsciousness or drowsiness (506/1332 [38.0%]) than did Pacific, Asian, and Maori people combined (194/408 [47.5%]; P<0.001).

Proxies were used for scoring the FAI in 299 of 1028 (29%) participants and none of 722 participants for the SF-36 (proxy response not permitted). Maori, Pacific, and Asian people all were more likely to have a proxy source of information than Europeans (P<0.001). Table 2 describes the outcome variables by ethnicity. Table 3 shows univariable and multivariable analyses for continuous outcome variables. Table 4 shows analyses for dichotomous outcome variables. Ethnicity was retained in multivariable models regardless of statistical significance.
FAI was associated with ethnicity on both univariable (P<0.001) and multivariable analysis (P<0.001). Asians and Pacific people had significantly lower FAI scores than Europeans, with an adjusted difference of ~7 and ~4 points, respectively, on multivariable analysis. Physical Component Summary score was associated with ethnicity on univariable analysis (Pacific, Māori, and Asian scores higher than those for Europeans; P<0.0063) but not multivariable analysis, and Mental Component Summary score was not associated with ethnicity on either univariable or multivariable analysis.

Living at home at follow-up after stroke was associated with ethnicity on both univariable (P<0.0025) and multivariable analysis (P<0.0034). Pacific (OR, 5.0; 95% CI, 2.0–12.7) and, to a lesser extent, Asian people (OR, 2.0; 95% CI, 0.89–4.5) were more likely to be living at home compared to Europeans. Dependency was weakly associated with ethnicity on univariable analysis (P<0.04) but not multivariable analysis. Pacific people were more likely to be dependent compared to Europeans (OR, 2.0; 95% CI, 1.1–3.7).

Death by 9 months was associated with ethnicity on multivariable analysis (P<0.015), with Asian people less likely to die than Europeans (OR, 0.4; 95% CI, 0.2–0.7). The composite outcome of death by 9 months or known to be dependent at follow-up was associated with ethnicity on multivariable analysis (P<0.032), with Pacific people more

Table 2. Description of Outcomes at Follow-Up

<table>
<thead>
<tr>
<th>Variable</th>
<th>Ethnic Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
</tr>
<tr>
<td>FAI, mean (SD)</td>
<td>20.4 (12.2)</td>
</tr>
<tr>
<td>N</td>
<td>1028</td>
</tr>
<tr>
<td>PCS, mean (SD)</td>
<td>40.1 (11.5)</td>
</tr>
<tr>
<td>N</td>
<td>722</td>
</tr>
<tr>
<td>MCS, mean (SD)</td>
<td>52.0 (10.1)</td>
</tr>
<tr>
<td>N</td>
<td>722</td>
</tr>
<tr>
<td>Living at home, n/N (%)</td>
<td>917/1122 (81.7)</td>
</tr>
<tr>
<td>Dependent, n/N (%)</td>
<td>441/1090 (40.5)</td>
</tr>
<tr>
<td>Dead by 9 mo, n/N (%)</td>
<td>570/1842 (30.9)</td>
</tr>
<tr>
<td>Dead by 9 mo or dependent, n/N (%)</td>
<td>990/1631 (60.7)</td>
</tr>
</tbody>
</table>

FAI indicates Frenchay Activities Index; MCS, Mental Component Summary of the Short Form 36; PCS, Physical Component Summary of the Short Form 36.

Table 3. ANCOVA for Continuous Functional Outcome Variables at Follow-Up

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Variables in Final Multivariable Regression Model (in Addition to Ethnicity)</th>
<th>Unadjusted Effect Size</th>
<th>P for Ethnicity</th>
<th>Multivariable-Adjusted Effect Size</th>
<th>P for Ethnicity (r² for Multivariable Model)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAI</td>
<td>Age, BI, previous dependency, diabetes</td>
<td>Pacific minus European</td>
<td>-3.9 (-7.3 to -0.5)</td>
<td>&lt;0.001</td>
<td>Pacific minus European</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asian minus European</td>
<td>-6.6 (-10.1 to -3.1)</td>
<td></td>
<td>Asian minus European</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Māori minus European</td>
<td>0.5 (-3.9 to 4.8)</td>
<td></td>
<td>Māori minus European</td>
</tr>
<tr>
<td>PCS</td>
<td>Age, BI, gender, initial unconsciousness, previous dependency, diabetes, AF</td>
<td>Pacific minus European</td>
<td>4.8 (-0.3 to 7.2)</td>
<td>0.01</td>
<td>Pacific minus European</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asian minus European</td>
<td>3.3 (-1.9 to 8.5)</td>
<td></td>
<td>Asian minus European</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Māori minus European</td>
<td>4.6 (-0.6 to 9.8)</td>
<td></td>
<td>Māori minus European</td>
</tr>
<tr>
<td>MCS</td>
<td>Age, previous dependency</td>
<td>Pacific minus European</td>
<td>-0.9 (-5.4 to 3.5)</td>
<td>0.12</td>
<td>Pacific minus European</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asian minus European</td>
<td>-1.5 (-3.0 to 6.5)</td>
<td></td>
<td>Asian minus European</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Māori minus European</td>
<td>-4.0 (-8.5 to 0.6)</td>
<td></td>
<td>Māori minus European</td>
</tr>
</tbody>
</table>

AF indicates atrial fibrillation; BI, Barthel Index; FAI, Frenchay Activities Index; MCS, Mental Component Summary of the Short Form 36; PCS, Physical Component Summary of the Short Form 36.

The r² indicates the amount of variance explained in ANCOVA.
likely to be dependent or dead than Europeans (OR, 2.3; 95% CI, 1.3–4.0).

**Discussion**

These results show that FAI, SF-36, independence, death, composite of death and dependence, and living situation vary according to ethnicity 6 months after stroke. Pacific and Asian people had worse function, as reflected in scores on the FAI after stroke but were more likely to be living at home than Europeans. The difference in the frequency of institutionalization after stroke between non-Europeans and Europeans, despite there being similar or better measures of physical aspects of health-related quality of life (Physical Component Summary Score) among these groups.

These results are broadly similar to those of other studies of functional outcome after stroke. A much smaller (n=161) U.S. study found better Functional Independence Measure scores in non-Hispanic white stroke patients at hospital discharge from postacute rehabilitation facilities than for other ethnic groups after controlling for covariates. Non-Hispanic white participants were less likely to be discharged home despite their better functional status at discharge, a finding that is similar to that in our study. Black ethnicity was independently associated with lower odds of return to work 1 year after stroke in multivariable analysis in the South London Stroke Register study. Although FAI was measured in that study, ethnic-specific results were not presented.

The strengths of the current study include the relatively large sample size, population-based design, and multiple functional end points. However, there are some limitations. First, there was no suitable variable to account for socioeconomic status. Although we included income level in the baseline questionnaire, it was not used in the multivariable analysis because of a large number of missing data. The final models were similar with and without this variable included in the model building process. However, we cannot exclude the possibility that some of the apparent association of outcome with ethnicity was predominantly a function of socioeconomic status. Second, there were significant amounts of missing data, particularly for the SF-36, because we did not allow proxy completion for this measure. Third, we were not able to capture use, timing, and completeness of stroke management and rehabilitation, which could have played an important role in the observed ethnic differences in outcomes. Fourth, the use of proxy information may have introduced bias, with Europeans less likely to have a proxy source of information than all other groups for the FAI. This may explain some of the measured difference in FAI results for Pacific and Asian people compared to Europeans. Last, overall follow-up in the study was 90.3%, with Pacific people...
being less likely to be followed-up. Our experience in this and other studies in New Zealand is that a significant proportion of Pacific people return to their Pacific Island of origin after stroke, making follow-up difficult and potentially introducing bias into the results.

Despite these limitations, the study remains large by international standards for any study of functional outcome in a multi-ethnic population. The results, reassuringly, fail to show a substantial independent effect of ethnicity on outcome. We suggest that there is no discrete ethnicity factor in stroke outcome, but rather a complex interplay of cultural factors. Differing cultural attitudes toward stroke, differing roles of families in managing disabled relatives in different societies, and, possibly, cross-cultural care in stroke rehabilitation and community services may impact outcomes. Good-quality stroke care requires us to continue improving cultural awareness, incorporating staff from different communities into stroke service teams and achieving fluency in liaison with ethnicity-specific health care providers and support people in the community.

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Disclosure
None.

References
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