Healthy country, healthy people: the relationship between Indigenous health status and “caring for country”

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Objective:

To investigate associations between “caring for country” — an activity that Indigenous peoples assert promotes good health — and health outcomes relevant to excess Indigenous morbidity and mortality.

Design, setting and participants:

Cross-sectional study involving 298 Indigenous adults aged 15–54 years in an Arnhem Land community, recruited from March to September 2005.

Main outcome measures:

Self-reported involvement in caring for country, health behaviours and clinically measured body mass index (BMI), waist circumference, blood pressure, type 2 diabetes status, albumin to creatinine ratio (ACR), levels of glycated haemoglobin (HbA_{1c}) and high-density lipoprotein (HDL) cholesterol, lipid ratio, score on the five-item version of the Kessler Psychological Distress Scale (K5), and 5-year cardiovascular disease (CVD) risk.

Results:

Controlling for sociodemographic characteristics and health behaviours, multivariate regression revealed significant and substantial associations between caring for country and health

outcomes. An interquartile range rise in the weighted composite caring-for-country score was significantly associated with more frequent physical activity, better diet, lower BMI (regression coefficient [b] = – 2.83; 95% CI, – 4.56 to – 1.10), less abdominal obesity (odds ratio [OR], 0.43; 95% CI, 0.26–0.72), lower systolic blood pressure (b = – 7.59; 95% CI, – 12.01 to – 3.17), less diabetes (OR, 0.12; 95% CI, 0.03–0.52), lower HbA_{1c} level (b = – 0.45; 95% CI, – 0.79 to – 0.11), non-elevated ACR (OR, 0.28; 95% CI, 0.13–0.60), higher HDL cholesterol level (b = 0.06; 95% CI, 0.01–0.12), lower K5 score (b = – 0.97; 95% CI, – 1.64 to – 0.31) and lower CVD risk (b = – 0.77; 95% CI, – 1.43 to – 0.11).

Conclusions:

Greater Indigenous participation in caring for country activities is associated with significantly better health. Although the causal direction of these associations requires clarification, our findings suggest that investment in caring for country may be a means to foster sustainable economic development and gains for both ecological and Indigenous peoples' health.

In Australia's Northern Territory, 49% of the landmass and 85% of the coastline is owned by Indigenous peoples.[1] More than 70% of the NT Indigenous population live on Indigenous land, predominantly in remote townships.[2] Nationally, Indigenous life expectancy is well below the Australian average.[3] In the NT, this lower life expectancy is underpinned by a disproportionate burden of disease linked to inactivity, malnutrition, social disorders and socioeconomic disadvantage.[4] Type 2 diabetes and cardiovascular disease account

for 40% of excess Indigenous mortality and over 21 800 preventable Indigenous hospital admissions annually.[3]

Pressure to centralise remote Indigenous populations and services into townships has increased[5] despite evidence suggesting this would lead to worse health outcomes.[6-8] Depopulation of remote areas has contributed to ecological degradation through the decline of Indigenous land management; introduced weeds, animals and wildfires now damage landscapes unchecked by the dislocated owners.[1] Indigenous Australians have long asserted the importance of their enduring relationship to ancestral lands and seas. This is acknowledged in the national strategic framework for Indigenous health:

> *For Aboriginal and Torres Strait Islander peoples health does not just entail the freedom of the individual from sickness but requires support for healthy and interdependent relationships between families, communities, land, sea and spirit. The focus must be on spiritual, cultural, emotional and social well-being as well as physical health.*[9]

Traditional land owners aspire to maintain links with ancestral estates and have evolved innovative natural resource management programs, undertaking both customary and contemporary ecological services to "care for country"[10] (Box 1 and Box 2). In addition to environmental health gains,[14] caring for country has the potential to positively influence health behaviours and the social determinants of health.[15] This has not been systematically investigated, despite Indigenous demands for a shift in the focus of health research to "what works", in particular, the social and cultural determinants of health and resilience, coupled with an an awareness that effective interventions may arise from outside the health sector.[16]

Our objective was to investigate the associations between participation in caring for country and health outcomes relevant to excess Indigenous morbidity and mortality.

Methods

Participants were Indigenous residents aged 15–54 years, recruited from March to September 2005 through an outreach program of preventive health checks in a remote Arnhem Land community. We purposively recruited volunteers with different levels of involvement in caring for country activities; they were recruited from homelands, township residences, workplaces (Indigenous rangers and non-rangers) and public spaces (outside the community store and community council buildings).

Measures

A 2-year collaboration with a remote Arnhem Land township and network of surrounding homelands[11] identified six core activities in caring for country: time on country; burning of annual grasses; gathering of food and medicinal resources; ceremony; protecting sacred areas; and producing artwork. Participation in these activities was quantified on a four-point ordinal response format by means of an interviewer-administered questionnaire that has been rigorously and systematically validated in this population.[11] Accurate weighted caring-for-country composite scale scores were subsequently derived.

Participants wore light clothing and no shoes while their weight was recorded on digital scales to the nearest 100 g, their height was measured to the nearest centimetre with a mounted stadiometer, and waist circumference was measured to the nearest millimetre with an inelastic tape by standard techniques.[17] Body mass index (BMI) was derived from participants' weight and height. Abdominal obesity was defined as ≥ 90 cm for men and ≥ 80 cm for women.[18]

Blood pressure readings were taken with an automated sphygmomanometer (Spot Vital Signs 420TB-E1, Welch-Allyn, Skaneateles Falls, NY, USA) and correct cuff size for the upper arm

circumference at 1-minute intervals while participants were seated; the average of the second and third readings was calculated. Morning urine samples and non-fasting blood samples were obtained. Serum samples were centrifuged within 4 hours of collection and all samples were transported on the day of collection to an accredited laboratory. Urinary albumin to creatinine ratio (ACR), levels of glycated haemaglobin (HbA_{1c}; by the haematin immunoturbidimetric method), blood glucose (by the hexokinase method), and high-density lipoprotein (HDL) cholesterol, and total cholesterol to HDL cholesterol ratio (lipid ratio; by the colorimetric method) were measured on a Cobas Integra 800 analyser (Roche Diagnostics, Sydney, NSW).

Participants' type 2 diabetes status was determined by review of medical records or an indicative blood glucose level, confirmed by a subsequent oral glucose tolerance test. We calculated 10-year absolute coronary heart disease (CHD) risk for participants aged 30–54 years using the Framingham equations,[19] excluding adjustment for left ventricular hypertrophy, because an electrocardiogram was not part of the preventive health check. We estimated the cardiovascular disease (CVD) risk category using the New Zealand Guidelines Group's handheld chart in conjunction with review of the participants' medical history and adjustments for isolated extreme risk factors and ethnicity.[20] Psychological distress was measured by a modified five-item version of the Kessler Psychological Distress Scale (K5) using the same interviewer-administered questions and cue card as the National Aboriginal and Torres Strait Islander Health Survey.[21]

We used an interviewer-administered questionnaire[11] to collect self-reported data on primary place of residence, education, income, diet, physical activity and smoking status. To avoid confounding associations between health outcomes and caring for country, we controlled for residence in our analysis because: (i) township residents' caring for country activities may be constrained by decreased access to customary estates; (ii) caring for country is more

common on homelands, though not all homelands residents participate;[11] and (iii) homelands residents may have less access to vehicles, takeaway food, cigarettes and processed foods.

Ethics approval for this study was obtained from Charles Darwin University (H04053) and the NT Department of Health and Community Services (04/35).

Statistical analysis

Participants were stratified by their residence in either the township or homelands. Differences between these groups were tested by *t* test (continuous variables), Wilcoxon–Mann–Whitney test (ordinal variables) and by χ^2 analyses (categorical outcomes).

We began our analysis by calculating Pearson Product Moment correlation coefficients for all pairs of variables in the dataset. Variables demonstrating significant correlation either (i) with other grouped sociodemographic characteristics or health behaviours, or (ii) between sociodemographic characteristics, health behaviours or with clinical outcomes, were included in regression analyses.

We investigated multivariate relationships between health behaviours and caring for country using backwards stepwise logistic and ordinal logistic regression analyses. Sociodemographic variables (age, sex, income, education and residence) and health behaviours (except consumption of bush foods, which is part of the construct definition of caring for country) were included, along with the weighted composite caring-for-country scale score divided by its interquartile range (to provide a conservative estimate of effect size for a participant engaged in caring for country versus participants who did not engage in caring for country). Non-significant predictors were eliminated one by one, starting with the variable with the lowest standardised β value.

Regression models were re-evaluated after each deletion until only significant predictors remained.

We tested the associations between caring for country and clinical outcomes by backwards stepwise multivariate regression using logistic regression for binary outcomes, linear regression for continuous outcomes and ordinal logistic regression for CVD risk. Sociodemographic variables and clinically significant health behaviours (smoking, alcohol consumption and exercise) were included alongside the weighted composite caring-for-country scale score divided by its interquartile range. Non-significant predictors were deleted one by one, as described above. Five women were excluded from the BMI and abdominal obesity regression models because they were pregnant.

Evaluation criteria for the clinical outcome models were: (i) clinical plausibility; (ii) satisfactory diagnostic plot of standardised residuals versus fitted values for continuous variables; and (iii) satisfactory Hosmer–Lemeshow goodness-of-fit statistic for binary outcomes.

All statistical analyses were performed with Stata software, version 9.2 (StataCorp, College Station, Tex, USA).

Results

Of the eligible population of 1284 adults aged 15–54 years in the remote Arnhem Land community, 298 people (23.2%) participated in this study. Most (196) were township residents while the remainder (102) were residents of 16 Aboriginal homelands. Participants ranged in age from 15 to 54 years (mean age, 30.96 years; SD, 10.15 years), and 59% (175) were men. The cross-sectional age structure of the sample was similar to the census profile ($\chi_2 = 9.63$; $P = 0.2$).[2]

The range of raw scores for participation in caring for country activities was 6 – 24 (mean score, 14.63; SD, 4.87). Accurate weighted caring-

for-country composite scale scores ranged from 0.76 to 3.06 (mean score, 1.93; SD, 0.68). There were 153 participants who were aged 30 – 54 years and had their CHD risk calculated.

Ten participants were unable to have their weight and height measured on standardised equipment, and several questionnaire items were incomplete (Box 3). One participant declined a blood test and 17 additional HbA_{1c} samples were incorrectly processed by the pathology laboratory. Seventeen urine samples were of insufficient volume to perform an ACR or had leaked during transport. Measurement of psychological distress with the K5 scale was discontinued halfway through the study period because of workforce shortages in the study team; the response rate for the period when it was measured was 90%.

Homelands residence was significantly associated with marginally higher income, lower educational attainment, less consumption of takeaway foods, more frequent consumption of bush foods, more frequent exercise and greater participation in caring for country activities (Box 3).

Correlation coefficients showed significant associations between sociodemographic characteristics and health behaviours within groups, and between these and the clinical outcomes. Correlation coefficients were generally small to moderate, ranging from 0.13 to 0.73 (*P* range, 0.05 to < 0.001), and all were included in the regression modelling. The directions of the relationships were as expected in all cases (eg, greater age correlated with more clinical outcomes). Detailed results are available from the corresponding author.

Box 4 and Box 5 show that after adjusting for sociodemographic factors, place of residence and health behaviours, an interquartile range rise in the weighted composite caring-for-country scale score was significantly associated with more frequent exercise and bush

food consumption, and with better health on most clinical outcomes (lower BMI, less abdominal obesity, less diabetes, lower blood pressure, lower HbA_{1c} level, higher HDL cholesterol level, normal ACR, lower psychological distress and lower CVD risk). Caring for country was not associated with smoking, alcohol use or the frequency of consumption of store produce or takeaway foods. Caring for country demonstrated inverse trends for lipid ratio and CHD risk, but these were not statistically significant. All significant clinical outcome models met our evaluation criteria.

Discussion

Using a systematically developed and validated measure of Indigenous participation in caring for country,[11] we have shown several significant and substantial associations with health outcomes relevant to excess Indigenous morbidity and mortality. Consistent with previous work[15] and international models of Indigenous health promotion,[22] caring for country was associated with better nutrition, more frequent physical activity and fewer chronic disease risk factors and diagnoses. Our findings are consistent with other reports of better health outcomes among homelands residents;[6-8] in addition, we offer an explanation (caring for country) for these associations from an Indigenous viewpoint.[11]

Unexpectedly, homelands residence was associated with worse clinical outcomes when controlling for caring for country (Box 5), perhaps because: (i) more homelands people with chronic disease participated in the study, having less access to medical care than township residents; (ii) unwell Indigenous patients often return to homelands to “make themselves well”; or (iii) caring for country explains the superior health outcomes found in the homelands. This last possibility indicates a strength of our study, as it identifies a potential mechanism for how improved health outcomes associated with homelands residence may come about.

Even within a small sample, we have shown statistically significant associations between participation in caring for country and positive health outcomes. Non-significant findings also showed trends consistent with our expectations. Our findings contribute preliminary empirical epidemiological support for: (i) the Indigenous assertion that caring for country may deliver health gains through social, cultural and behavioural pathways;[15] and (ii) Indigenous requests to conduct research on workable solutions based on social and cultural determinants of health.[16]

Study limitations

We are unable to determine the causal direction of the associations between caring for country and health outcomes. We have previously identified plausible pathways[15] and, given our findings in this study, a longitudinal and/or intervention study is now merited to elucidate the causal direction of these associations.

The lower than expected cohort prevalence of type 2 diabetes in our study suggests that volunteers for a preventive health check may not be representative in terms of population morbidity. However, our sampling strategy to include participants with varying participation in caring for country was reliable, and involved just under a quarter of the eligible population. Given this, and that the age structure of this sample did not differ significantly from the most recent census,[2] significant bias is unlikely. Moreover, if those with established disease or poor health were self-excluded, our findings may constitute: (i) a conservative estimate of health benefit; and (ii) an implied causal-link to better health because unwell people (physically unable to care for country) were (self-)excluded.

Several of our measures were crude and reliant on self-report. Although self-reported smoking status appears to be reliable,[23] nutritional assessment is notoriously inaccurate.[24] By contrast, our

caring for country measure was robust and was validated using test–retest validity, proxy respondent completion and rigorous statistical analysis.[11] Our items, piloted and refined with Indigenous health workers in preparation for the study, were considered comprehensible and in a suitable format for this population. Plausible associations between caring for country, health behaviours and clinical outcomes support this assessment.

Neither of our cardiovascular risk measures has been validated for use in this population. The Framingham equations can be used to estimate absolute CHD risk in people aged 30 years and older, and are known to underestimate risk,[25] whereas the New Zealand Guidelines Group's CVD risk chart requires all men and women aged 44 years or younger to be allocated the same age-specific risk. In both cases, however, we believe our findings are a conservative estimate of risk. Other risk factors, such as abdominal obesity and elevated ACR (both of which showed significant inverse associations with caring for country), are proposed to contribute, independently of traditional risk factors, to cardiovascular risk.[25] To improve clinical assessment and interventions for cardiovascular risk for Indigenous Australians, we now require cardiovascular risk calculators that incorporate these risk factors, and that are extended to younger age groups.

Finally, the generalisability of our findings to other Indigenous contexts is uncertain, given the diversity in language, land tenure and cultural expression among Indigenous Australians. Further studies are required to explore this possibility.

Conclusion and implications

We conclude that there are significant and substantial associations between caring for country (which Indigenous people assert is a health

promotion activity) and health outcomes relevant to excess morbidity and mortality in this Arnhem Land community.

We propose three main implications of our findings. First, our results provide preliminary empirical support for long-standing Indigenous demands for government investment supporting Indigenous peoples to manage their country.[10] This strategy appears likely to deliver ecological health gains,[14] sustainable economic development and, possibly, human health gains through social, physical and cultural mechanisms.[15]

Second, our findings suggest careful reconsideration of conflicting Indigenous affairs policies that are simultaneously discouraging connections with country[5] and promoting Indigenous natural resource management.[26] Our findings indicate that homelands foster important health-promoting activities that appear to deliver both ecological and human health gains.[27]

Finally, our research demonstrates the potential importance of collaborative engagement with activities that Indigenous people assert promote good health to identify appropriate interventions with which to tackle seemingly intractable disadvantage in remote Australia.

1 Indigenous concepts of "country" and the importance of caring for country

For Indigenous peoples, "country" encompasses an interdependent relationship between Indigenous peoples and their ancestral lands and seas.[11] "Country is multi-dimensional — it consists of people, animals, plants, Dreamings; underground, earth, soils, minerals and waters, air . . . People talk about country in the same way that they would talk about a person: they speak to country, sing to country, visit country, worry about country, feel sorry for country, and long for country."[12]

"Caring for country" means participating in interrelated activities on Aboriginal lands and seas with the objective of promoting ecological, spiritual and human health. It is also a community-driven movement towards long-term social, cultural, physical and sustainable

economic development in rural and remote locations, simultaneously contributing to the conservation of globally valued environmental and cultural assets.[13]

By combining customary and contemporary knowledge, Aboriginal landowners deliver a broad suite of environmental services of national and global significance, including:

- Border protection
- Biodiversity conservation, fisheries management
- Quarantine services
- Water resource management
- Wildfire abatement/carbon sequestration
- Sustainable commercial use of wildlife
- Control of invasive weeds and feral animals
- Cultural maintenance activities

2 Indigenous rangers caring for country

Photographs courtesy of Djelk Rangers.

3 Overall cohort characteristics and comparison by place of residence (values are mean [SD] unless otherwise specified)

	All participants		Township residents		Homelands residents		
	Value	No. of respondents	Value	No. of respondents	Value	No. of respondents	*P***
Sociodemographic characteristics		298		196		102	

Men (%)	59%		60%		56%		ns
Age in years	31.0 (10.1)		31.1 (10.2)		30.8 (10.1)		ns
Income level score*	1.74 (0.47)		1.63 (0.52)		1.95 (0.22)		< 0.001
Education level score†	2.91 (0.99)	275	3.07 (1.04)	186	2.56 (0.8)	89	< 0.001
Health behaviours							
Current smoker (%)	73%		75%		71%		ns
Consumes alcohol (%)	30%	285	31%	195	28%	90	ns
Exercise frequency score‡	3.08 (0.87)	286	2.89 (0.90)	196	3.48 (0.64)	90	< 0.001
Score for consumption§ of:							
Takeaway food	2.08 (0.64)	280	2.16 (0.66)	191	1.91 (0.56)	89	< 0.001
Store-bought fruit	2.41 (0.73)	280	2.47 (0.79)	191	2.28 (0.54)	89	ns
Store-bought vegetables	2.41 (0.73)	280	2.48 (0.77)	191	2.28 (0.60)	89	ns
Bush meat	3.42 (0.75)	280	3.19 (0.79)	191	3.91 (0.32)	89	< 0.001
Bush fruit and	3.11 (0.94)	280	2.82 (0.93)	191	3.73 (0.58)	89	< 0.001

vegetables							
Caring for country							
Composite caring-for-country scale score	1.93 (0.68)		1.58 (0.49)		2.61 (0.41)		< 0.001
Clinical outcomes							
Body mass index in kg/m_2	22.9 (5.7)	288	23.2 (5.7)	195	22.4 (5.7)	93	ns
Prevalence of abdominal obesity (%)	43%	291	45%	190	38%	101	ns
Systolic blood pressure in mmHg	114 (16.4)	296	113 (17.2)	194	115 (15.0)	102	ns
Diastolic blood pressure in mmHg	70.4 (10.9)	296	69.7 (11.2)	194	71.8 (10.0)	102	ns
Prevalence of type 2 diabetes (%)	7.4%	297	7.7%	196	6.9%	101	ns
% HbA_{1c}	5.79 (1.15)	280	5.73 (0.91)	188	5.90 (1.52)	92	ns
HDL cholesterol in mmol/L	1.09 (0.27)	297	1.07 (0.27)	196	1.11 (0.26)	101	ns

Lipid ratio (levels of total to HDL cholesterol)	4.64 (1.42)	297	4.62 (1.40)	196	4.67 (1.46)	101	ns
Prevalence of ACR > 3.4 mg/mmol (%)	32%	281	32%	184	33%	97	ns
K5 psychological distress score	6.58 (2.12)	160	6.71 (2.24)	125	6.09 (1.56)	35	ns
% 10-year absolute CHD risk	5.88 (5.46)	153	5.94 (5.46)	107	5.72 (5.51)	46	ns
NZGG 5-year CVD risk category¶	3.00 (1.10)	295	3.04 (1.14)	194	2.93 (1.02)	101	ns

HbA_{1c} = glycated haemoglobin. HDL = high-density lipoprotein. ACR = urinary albumin to creatinine ratio. K5 = five-item version of the Kessler Psychological Distress Scale. CHD = coronary heart disease. NZGG = New Zealand Guidelines Group.[20] CVD = cardiovascular disease. ns = not significant.
* 1 = lowest income; 2 = medium income; 3 = highest income. † 1 = no formal education; 2 = primary school; 3 = lower secondary school; 4 = Year 10; 5 = Year 12; 6 = post-school qualification. ‡ 1 = none; 2 = one or two times a week; 3 = three or four times a week; 4 = more than four times a week. § 1 = never; 2 = sometimes; 3 = most days; 4 = every day. ¶ Each unit represents a change in CVD risk of 5% over 5 years. ** Comparison between township and homelands residents.

4 Significant associations between caring for country participation, health behaviours and clinical outcomes following multivariate regression

	Caring for country participation		
	Odds ratio	Regression	*P*

	(95% CI)	coefficient (95% CI)	
Health behaviours			
Greater exercise participation	2.90 (1.60–5.25)	—	< 0.001
Greater bush meat consumption	4.23 (2.05–8.74)	—	< 0.001
Greater bush fruit and vegetable consumption	3.36 (1.78–6.35)	—	< 0.001
Clinical outcomes			
Difference in body mass index	—	– 2.83 (– 4.56 to – 1.10)	0.001
Having abdominal obesity	0.43 (0.26–0.72)	—	0.001
Difference in systolic blood pressure	—	– 7.59 (– 12.01 to – 3.17)	0.001
Difference in diastolic blood pressure	—	– 3.15 (– 6.17 to – 0.14)	0.04
Having type 2 diabetes	0.12 (0.03–0.52)	—	0.001
Difference in HbA_{1c} level	—	– 0.45 (– 0.79 to – 0.11)	0.01
Difference in HDL cholesterol level	—	0.06 (0.01 to 0.12)	0.02
Difference in lipid ratio (levels of total to HDL	—	– 0.07 (– 0.35 to 0.21)	ns

cholesterol)			
Having ACR > 3.4 mg/mmol	0.28 (0.13–0.60)	—	0.001
Difference in K5 psychological distress score	—	– 0.97 (– 1.64 to – 0.31)	0.002
Difference in 10-year absolute CHD risk	—	– 0.72 (– 1.79 to 0.35)	ns
Difference in NZGG 5-year CVD risk category*	—	– 0.77 (– 1.43 to – 0.11)	0.023

HbA_{1c} = glycated haemoglobin. HDL = high-density lipoprotein. ACR = urinary albumin to creatinine ratio. K5 = five-item version of the Kessler Psychological Distress Scale. CHD = coronary heart disease. NZGG = New Zealand Guidelines Group.[20] CVD = cardiovascular disease. ns = not significant. * Each unit of change represents a change in CVD risk of 5% over 5 years.

5 Detailed estimates for the final New Zealand Guidelines Group cardiovascular disease risk category multivariate regression model

Final model variables	Regression coefficient* (95% CI)	*P*
Being female	– 1.18 (– 1.72 to – 0.65)	< 0.001
Age	0.16 (0.13 to 0.19)	< 0.001
Education level	0.32 (0.06 to 0.58)	0.017
Homelands resident	0.96 (0.17 to 1.74)	0.017
Exercise participation	– 0.47 (– 0.80 to – 0.14)	0.005

Being a current smoker	1.73 (0.99 to 2.47)	< 0.001
Participating in caring for country	– 0.77 (– 1.43 to – 0.11)	0.023

* Each unit of change represents a change in CVD risk of 5% over 5 years.

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Competing interests

None identified.

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