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Prevalence of functional limitations in older remote-living Aboriginal Australians

Kate Smith PhD[1,2] | Zoë Hyde PhD[1,2] | Leon Flicker PhD[1] | David Atkinson MBBS[3,4] | Roslyn Malay[1] | Dina LoGiudice PhD[5,6]

[1]Western Australian Centre for Health and Ageing, Medical School, University of Western Australia, Perth, Western Australia, Australia

[2]Centre for Aboriginal Medical and Dental Health, University of Western Australia, Perth, Western Australia, Australia

[3]Rural Clinical School of Western Australia, University of Western Australia, Broome, Western Australia, Australia

[4]The University of Notre Dame Australia, Fremantle, Western Australia, Australia

[5]Aged Care, Royal Melbourne Hospital, Melbourne, Victoria, Australia

[6]Department of Medicine, University of Melbourne, Melbourne, Victoria, Australia

Correspondence
Kate Smith, Centre for Aboriginal Medical and Dental Health (M303), University of Western Australia, 35 Stirling Highway, Perth, WA 6009, Australia.
Email: kate.smith@uwa.edu.au

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Abstract

Introduction: To better tailor prevention and care strategies, there is a need to identify modifiable factors associated with functional impairment in older Aboriginal people, and related service needs.

Objective: To investigate the prevalence and associated factors for functional impairment in older Aboriginal people, and related service needs.

Design: Cross-sectional survey of 289 Aboriginal people aged ≥45 years living in the remote Kimberley region of Western Australia. Factors associated with functional impairment were explored with logistic regression.

Findings: 41.2% (95% CI 35.6%–47.0%) of participants required assistance with at least one I/ADL, and 26.0% (95% CI 21.2%–31.3%) required assistance with two or more I/ADLs. A core activity limitation (required assistance with showering, dressing or cooking) was reported by 15.9% (95% CI 12.1%–20.6%). In multivariable logistic regression analyses, older age, diabetes, difficulty walking, head injury, higher depression score and worse cognition were associated with needing help with two or more I/ADLs, while older age, history of stroke, higher depression score and worse cognition were associated with the presence of a core activity limitation. The proportion of participants receiving support with I/ADLs ranged from 71.2% to 97.6%. Support was generally provided by family and friends rather than service providers.

Discussion: The key modifiable factors associated with functional impairment in older Aboriginal people living in remote regions are diabetes, depression and cognitive impairment. Services required are transport and socio-cultural activities, and ensuring support for family providing the majority of care.

Conclusions: This study highlights the need for holistic prevention strategies and care for older Aboriginal people with functional limitations and their families.

KEYWORDS

Aboriginal, activities of daily living, ageing, disability

1 | INTRODUCTION

The Aboriginal and Torres Strait Islander population is ageing. The proportion of people aged ≥65 years is expected to rise from 4.2% in 2016 to 8.0% by 2031.[1] Although life expectancy is steadily increasing, Aboriginal and Torres Strait Islander people experience increased rates of ill-health compared to the rest of the population,[2] resulting in an increased need to access appropriate support and healthcare services.

Obtaining accurate information about the prevalence of disability across populations can be difficult. Definitions of disability vary widely between surveys and countries, with a common disparity reflecting a 'medical' vs. 'functional' definition of impairment.[3] However, functional measures, such as difficulty performing activities of daily living (ADL), can take contextual factors such as culture and environment into account.[3] For example, a particular physical limitation may have different implications for someone living in a family household in a city location, compared to someone living remotely and/or on their own. Functional definitions may therefore be more appropriate to gauge the need for assistance, and to guide strategies to address the impact of a particular limitation.

As highlighted by King et al.[4] and Hollinsworth,[5] Aboriginal perspectives on disability are informed by the social implications of impairment. For example, if poor mobility prevents connection and participation in cultural and family activities, or impacts community and family well-being and fulfilling social obligations, then this may be viewed as a disability. Conversely, a medical condition that might typically be viewed as a disability from a biomedical perspective may not be seen as such by Aboriginal people if it does not prevent their ongoing participation in the community. As King et al.[4] write, '[w]hen Auntie Amelia could still go to the Elders' meeting, or the people on Mornington Island could be wheeled down to the beach to go fishing, they were participating and were therefore neither "unhealthy" nor "disabled".'

For collection of disability data, the Australian Bureau of Statistics (ABS) focuses on core activity limitations relating to mobility, self-care and communication. A 'profound' limitation exists if a person is unable to do, or always requires help with, a particular activity (including assistance from another person, or the use of aids and equipment). If assistance is *sometimes* required, the limitation is classified as 'severe'. The prevalence of profound or severe core activity limitations in Aboriginal Australians has been found to be substantially higher than in Australians overall. The 2015 Survey of Disability, Ageing and Carers reported a prevalence of profound or severe core activity limitations of 17.6% for Aboriginal and Torres Strait Islander Australians aged 55 years and older, compared to 10.8% among non-Indigenous Australians. A concerning disparity among younger adults was also evident. For those aged 35–54 years, the respective prevalence was 8.1% vs. 3.1%.[2]

A study by Gubhaju et al.[6] investigating functional limitations in older Aboriginal Australians living throughout New South Wales documented the prevalence of impairment for a range of activities, such as difficulty walking a specified distance, or carrying shopping. Twenty percent of Aboriginal participants aged >45 years had a minor physical functional limitation, 25% had a moderate limitation and 26% a severe one. The prevalence of severe physical functional limitations was twice that of non-Aboriginal participants. However, data for the study were collected via a self-administered postal questionnaire with only an 18% response rate, which may indicate a non-representative sample.[6]

For optimal allocation of aged care resources, it is important to identify both the prevalence of functional limitations in a given population, and the particular activities or tasks for which assistance needs are not being met.

What is already known on this subject

- The proportion of Aboriginal Australians aged ≥65 years is expected to roughly double over the next decade.
- Aboriginal people are more likely to report functional limitations than their non-Indigenous counterparts.

What this paper adds

- Diabetes, depression and cognitive impairment are potentially modifiable risk factors for functional limitations.
- The largest service gaps for older Aboriginal people with functional limitations are transport and support to take part in recreational and cultural activities that they enjoy.
- Family members are the primary sources of support for IADLs, with service providers providing the majority of assistance with showering and dressing ADLs.
- Remote communities need greater access to services, which must be informed by Aboriginal perspectives of disability.

This may be particularly relevant for remote populations, where health and aged care services are more difficult to access. It is also important to identify the activities/tasks which are valued by older Aboriginal Australians.[7] We therefore assessed the prevalence of limitations in instrumental and basic activities of daily living (I/ADLs) and valued socio-cultural activities, and whether support for these activities was available when needed, in older Aboriginal people living in the Kimberley region of Western Australia.

2 | METHODS

2.1 | Study design and setting

Data were collected as part of the second wave (2011–2013) of the Kimberley Healthy Adults Project. This longitudinal study investigated the incidence of, and risk factors for, geriatric conditions in Aboriginal Australians living in the remote Kimberley region of Western Australia.[8] Data were collected by an Aboriginal research officer and research nurse who had an established relationship with the communities.

2.2 | Study participants

We approached 387 Aboriginal people aged ≥45 years who were resident in one of six remote communities or the town of Derby, for at least 6 months of the year, of whom 289 participated in this study (response fraction: 75%). Communities were semi-purposefully selected based on the five Kimberley language families, ensuring a diverse representation of the region. The sampling strategy is described in detail elsewhere.[8,9] People who were acutely unwell were excluded from the study. Potential participants were identified by local health clinics and community councils with screening by Aboriginal community research assistants.

2.3 | Ethical approval

Community consultation and council approval were sought from each community involved in the study. Approval was granted by the Western Australian Aboriginal Health Information and Ethics Committee (281-04/10) and the University of Western Australia Human Research Ethics Committee (RA/4/1/5894). All participants provided written informed consent with assistance as required from paid interpreters or Aboriginal community research assistants.

2.4 | Procedures

Participants were administered the Kimberley Indigenous Cognitive Assessment Function Scale (KICA-Function), a subsection of the full KICA screening tool. The KICA is a culturally appropriate instrument which was developed for remote Aboriginal Australian populations.[10] This instrument was administered to participants and, where possible, to their family members or carers. The KICA-Function is adapted from the Barthel Index[11] and the Lawton-Brody Instrumental Activities of Daily Living Scale,[12] and assesses whether participants are fully independent, need some assistance, or are fully dependent with regard to 9 I/ADLs. These comprise showering, dressing, cooking, cleaning, managing medications, managing money, ability to do own work (paid or unpaid, e.g. caring for grandchildren or family obligations), participation in recreational activities important to the person, and ability to drive a car.

To permit comparisons between the sample and broader ABS population surveys,[2] we also assessed the prevalence of core activity limitations, defined in this study as requiring assistance with showering, dressing or cooking. To try to gauge disability in terms of Aboriginal perspectives of it,[4,5] we investigated whether participants were limited in their ability to perform their own work (e.g. looking after grandchildren/making fire) or their ability to engage in sociocultural and recreational activities that they enjoyed (e.g. fishing). An impairment in either of these domains was considered a disability. The KICA assessment tool also included items relating to medical history and socio-demographic characteristics. Participants self-reported known medical conditions or illnesses including diabetes, cardiovascular disease, incontinence, pain, difficulty walking and previous head injury. Depression and cognitive status were also assessed using the KICA, as previously described.[8,13]

2.5 | Statistical analyses

Data were analysed using the Stata SE statistical package, release 15.1 (StataCorp, College Station, Texas). Summary statistics are presented as the number and percent of participants who answered in the affirmative for categorical questions, and as medians and interquartile ranges for continuous variables. Associations between categorical variables were assessed with Chi-squared tests and Cuzick's non-parametric test for trend, while the Kruskal–Wallis test was used for continuous variables. We explored factors associated with having a core activity limitation, factors associated with requiring help for two or more I/ADLs and factors associated with the

domains most likely to reflect an Aboriginal view of disability with binary logistic regression. Participants with missing data were excluded from the regression analyses. We entered all variables which were significant in univariable analyses into multivariable models, and then removed non-significant variables in a manual, backwards manner, except where clinical judgement and measures of model fit (including the Akaike information criterion and Bayesian information criterion) indicated they should be retained. We used Hosmer and Lemeshow's goodness-of-fit test to assess model fit, and considered p values <0.05 statistically significant.

3 | RESULTS

Socio-demographic and clinical characteristics of the 289 participants in this study are shown in Table 1. The median age of participants was 59 years (range: 45–91; interquartile range [IQR] 52–69), and 55.7% were female. Male and female participants had a similar age distribution ($p = 0.901$). Forty-one percent (95% CI 35.6%–47.0%) of participants reported at least one functional limitation for which they required assistance, and one-quarter (26.0%; 95% CI 21.2%–31.3%) reported two or more. A core activity limitation was reported by 15.9% (95% CI 12.1%–20.6%) of participants. Nearly one-quarter of participants (23.5%; 95% CI 19.0%–28.8%) had some degree of limitation in at least one of the two domains reflecting the Aboriginal cultural view of disability (i.e. ability to complete one's own work, such as caring for grandchildren, or participating in other activities important to the older person). Approximately 1 in 10 (11.1%; 95% CI 7.9%–15.3%) had a profound limitation, being completely unable to perform at least one of these two activities.

TABLE 1 Lifestyle, demographic and clinical characteristics of participants.

Characteristics	*n* (%) or median (IQR)
Age (years)	
45–54	100 (34.6)
55–64	88 (30.5)
65–74	55 (19.0)
≥75	46 (15.9)
Sex	
Male	128 (44.3)
Female	161 (55.7)
Some formal schooling[5]	217 (75.1)
Drink alcohol[7]	109 (37.7)
Smoke tobacco[7]	96 (33.2)
Chew tobacco[8]	87 (30.1)
Poor vision[5]	129 (44.6)
Poor hearing[8]	52 (18.0)
Prior stroke[11]	37 (12.8)
Diabetes[20]	131 (45.3)
Hypertension[50]	111 (38.4)
Heart problem[21]	72 (24.9)
Kidney problem[27]	68 (23.5)
Incontinence[14]	71 (24.6)
Difficulty walking[9]	118 (40.8)
Pain[13]	154 (53.3)
Recent fall[15]	61 (21.1)
Head injury with loss of consciousness[15]	89 (30.8)
KICA-Dep[20]	3 (1–7)
Clinically relevant depressive symptoms (KICA-Dep ≥8)[20]	60 (20.8)
KICA-Cog[46]	37 (35–39)
Possible cognitive impairment (KICA-Cog ≤33)[46]	37 (12.8)

Note: Percentages calculated without excluding missing data (i.e. denominator is the entire sample). Column percentages are shown. Numerals in superscript denote the number of people (out of 289 participants in total) with missing data for that variable. Higher KICA-Dep scores indicate greater depressive symptoms; higher KICA-Cog scores indicate better cognition. Medical comorbidity items are not mutually exclusive.

Abbreviation: IQR, interquartile range.

3.1 | Prevalence of functional limitations by age and sex

Older participants were more likely to have functional limitations than younger participants (Table 2). Ability to drive (28.4%) and cleaning (26.0%) were the activities for which participants most reported limitations. Limitations were more prevalent for IADLs (cooking, cleaning, taking medicine, managing money) than basic ADLs (showering and dressing).

The number of activities for which participants required assistance was also higher with older age, ranging from a median of 0 activities at age 45–54 years, to a median of 2 (IQR 0–4) activities for those aged 75 years and over ($p < 0.001$). The proportion of participants requiring assistance with two or more I/ADLs by age group was as follows: 45–54 years, 13.0%; 55–64 years, 23.9%; 65–74 years, 29.1%; ≥75 years, 54.4%. Among participants aged ≥55 years, the proportion reporting a core activity limitation was 20.6% (95% CI 15.4%–27.0%).

In contrast to other activities, being unable to drive was commonly reported by all age groups (Table 2). A deficit

TABLE 2 Proportion of participants reporting limitations in activities of daily living.

	Overall	By age group (years)					
	All	45–54	55–64	65–74	≥75		
Activity	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*p* Value	*p* Value for trend
Cooking	41 (14.2)	8 (8.0)	9 (10.2)	8 (14.6)	16 (34.8)	<0.001	<0.001
Cleaning	75 (26.0)	13 (13.0)	18 (20.5)	19 (34.6)	25 (54.4)	<0.001	<0.001
Dressing	13 (4.5)	0 (0.0)	1 (1.1)	5 (9.1)	7 (15.2)	<0.001	<0.001
Showering	15 (5.2)	1 (1.0)	3 (3.4)	4 (7.3)	7 (15.2)	0.015	<0.001
Taking medicine	29 (10.0)	8 (8.0)	6 (6.8)	5 (9.1)	10 (21.7)	0.002	0.070
Managing money	32 (11.1)	4 (4.0)	11 (12.5)	6 (10.9)	11 (23.9)	0.005	0.001
Working	57 (19.7)	11 (11.0)	12 (13.6)	14 (25.5)	20 (43.5)	<0.001	<0.001
Recreation	46 (15.9)	8 (8.0)	13 (14.8)	8 (14.6)	17 (37.0)	<0.001	<0.001
Ability to drive†	59 (28.4)	15 (17.9)	25 (36.8)	8 (23.5)	11 (50.0)	0.001	0.003

Note: participants who never drove a car ($n = 81$) excluded from the item marked (†).

for this item might therefore not reflect deterioration, so we performed a sensitivity analysis to investigate this possibility. After excluding the driving item, the proportion of participants with at least one functional limitation requiring assistance fell from 41.2% to 32.9%, while the proportion with two or more functional limitations declined only slightly, from 26.0% to 24.6%.

Approximately one-third of men (35.2%) and almost half of women (46.0%) required assistance with one or more activity, and one-fifth of men (21.9%) and nearly one-third of women (29.2%) required assistance with two or more activities, although this did not reach statistical significance ($p = 0.064$, and $p = 0.159$, respectively).

3.2 | Factors associated with functional limitations

In a multivariable binary logistic regression model, older age (OR = 1.06; 95% CI 1.01–1.10), diabetes (OR = 2.59; 95% CI 1.08–6.20), difficulty walking (OR = 4.40; 95% CI 1.89–10.25), head injury (OR = 2.81; 95% CI 1.20–6.57) and higher depression score (OR = 1.10; 95% CI 1.02–1.18) were associated with requiring assistance with ≥2 I/ADLs. Better cognition was associated with reduced odds (OR = 0.74; 95% CI 0.65–0.85).

With regard to the presence of a core activity limitation, older age (OR = 1.07; 95% CI 1.02–1.12), history of stroke (OR = 2.72; 95% CI 0.97–7.68) and higher depression score (OR = 1.12; 95% CI 1.04–1.20) were associated with increased odds. Better cognition was associated with reduced odds (OR = 0.80; 95% CI 0.71–0.90).

With respect to the two domains reflecting the Aboriginal cultural view of disability, difficulty walking (OR = 12.48; 95% CI 2.98–52.35) and higher depression score (OR = 1.13; 95% CI 1.04–1.23) were associated with increased odds of having a profound limitation. Better cognition was associated with reduced odds (OR = 0.78; 95% CI 0.69–0.87).

3.3 | Assistance with activities

The majority of participants who reported functional limitations were receiving some form of assistance to help them with I/ADLs (Table 3). The proportion receiving assistance was generally high (≥86%), except for transport (71.2%) and recreational and cultural activities (73.9%). With the exception of dressing and/or showering, the majority of participants were helped by family members or friends; only about one-quarter to one-third of participants received assistance from a service provider for most activities. In contrast, about two-thirds of participants who needed help with showering and/or dressing were helped by a service provider.

4 | DISCUSSION

In this cross-sectional study conducted in the remote Kimberley region of Western Australia, 41.2% of older Aboriginal people reported having at least one functional limitation for which they required assistance. The proportion of participants aged ≥55 years who required help showering, dressing or cooking (20.6%) was slightly higher than the prevalence of core activity limitations (17.6%) reported by the ABS for Aboriginal and Torres Strait Islander Australians aged ≥55 years, but much higher than the 10.8% evident in the broader Australian population.[2] However, more than half of the participants in our study

TABLE 3 Proportion of participants with limitations that are receiving assistance.

	Receiving assistance	Who provides assistance		
Activity	***n* (%)**	**Family or friends *n* (%)**	**Service or organization *n* (%)**	**Unknown *n* (%)**
Cooking	40 (97.6)	27 (67.5)	13 (32.5)	0 (0.0)
Cleaning	70 (93.3)	53 (75.7)	16 (22.9)	1 (1.4)
Dressing or showering	14 (87.5)	5 (35.7)	9 (64.3)	0 (0.0)
Taking medicine	25 (86.2)	19 (76.0)	6 (24.0)	0 (0.0)
Managing money	31 (96.9)	21 (67.7)	10 (32.3)	0 (0.0)
Recreation	34 (73.9)	24 (70.6)	9 (26.5)	1 (2.9)
Transport	42 (71.2)	26 (61.9)	16 (38.1)	0 (0.0)

were younger than 60 years, and a much lower prevalence of core activity limitations is reported by the ABS for those aged ≤54 years.[2] In addition, we did not ask participants about limitations in communication or mobility, which is in contrast to the ABS definition. As such, the prevalence of core activity limitations may be underestimated in our study. It should also be noted that the ABS definition of a self-care core activity limitation includes feeding, whereas our study addressed cooking; hence only broad comparisons are appropriate. In general, our results suggest that the level of functional limitations in this remote population might be higher than that of the broader Aboriginal and Torres Strait Islander population, and is much higher than that of the wider community.[2]

Not surprisingly, and in accordance with previous research,[2,6] older participants were more likely to report functional limitations than younger participants. Given that the Aboriginal Australian population is shifting towards an older relative profile,[1] the prevalence of disability and the need for assistance is likely to increase over time. In contrast to the general age-related increase in functional limitations, the proportion of participants who were unable to drive was relatively high across all age groups. The high overall dependence on assisted transport is a concern, because lack of transport has been identified as a significant barrier to participation in health-related programs in previous studies.[14,15] Lack of assistance with pursuing recreational activities is also an area for potential improvement. It is appropriate that support for limitations relating to fundamental self-care have priority in resource allocation. However, social support and engagement are important for well-being, health and engaging in healthy behaviours such as meeting physical activity guidelines.[16–18] Furthermore, for Aboriginal people, the degree to which they are able to fulfil cultural obligations and socialise with kin may be the key factor in determining whether they have a disability.[5] Support strategies must be informed by Aboriginal perspectives of disability.[19,20] In this study, nearly one-quarter of participants had some degree of limitation in this regard, and 11% had a profound limitation. Interestingly, older age was not associated with the domains likely to reflect an Aboriginal view of disability in the multivariable regression models. Instead, poor mobility appeared to be associated with greatest risk.

The greater dependence apparent in women in this sample is similar to the prevalence of physical limitations in Aboriginal and Torres Strait Islander Australians of the same age[6] and also that for disability in the wider Aboriginal Australian population,[2] where women have a higher prevalence of disability. In the case of participants who reported one or more functional limitations, the proportion of people receiving assistance was generally high. An exception was transport, where 28.8% of those who were unable to drive did not receive assistance. Improvements in this area may be able to impact health outcomes, given that lack of transport is an established barrier in this respect.[14,15]

Diabetes and difficulty walking were both associated with requiring assistance with I/ADLs. People with diabetes have been reported to be twice as likely to have a disability and are almost three times as likely to have a severe or profound limitation.[21] A recent study of the prevalence of physical limitations in Aboriginal Australians also found a strong association with diabetes.[6] For the cohort in this study, we have previously reported an association between glycated haemoglobin (HbA1c; a measure of glucose control) and frailty.[22] The prevalence of diabetes in this cohort was 45%. Even in persons aged over 75 years in the broader community, the corresponding figure is much lower at 19%.[23] Diabetes prevention is likely to be an important component of an effective strategy for reducing the burden of disability.

Although most people with functional limitations were receiving support, this was predominantly provided by family members and friends, with potential implications for carers' health and well-being.[24,25] Our data were collected prior to the advent of Australia's National Disability Insurance Scheme (NDIS) and My Aged Care, which

provide funding to individuals with disability to access support and services. The impact of the NDIS and My Aged Care in the remote communities participating in this study is not yet known, but it is likely that significant challenges remain. Although funding may be available, access to services is limited. Additionally, the consumer-directed funding model of the NDIS and My Aged Care may not be the most appropriate one for a remote-living collectivist culture. More flexible models, in which individual support packages could be pooled at the community level, might work better. For example, these communities are not served by public transport, but the pooling of resources might enable the purchase of a vehicle for community use.

The Royal Commission into Aged Care Quality and Safety recently reported that Aboriginal and Torres Strait Islander people access aged care at lower than expected rates given their high level of need, and that access to culturally safe services is limited.[26] Aboriginal and Torres Strait Islander people living in remote areas have significantly reduced access to services.[27] Aboriginal and Torres Strait Islander people living in non-remote areas are 1.8 times more likely to receive home support services, and 2.4 times more likely to receive home care services than their remote-living counterparts.[27] This is reflected in recent research conducted in rural and remote South Australia. Thomas et al.[28] reported that 59% of older Aboriginal people with care needs were not receiving home care services. The majority of people who did receive care experienced long delays (≥12 months) before this was delivered. Participants stressed the need for better access to services, particularly culturally safe services.

Community-based disability and aged care models that embody a holistic rather than individual-focused approach can markedly improve care outcomes in remote settings. Best practice models, such as the Lungurra Ngoora collaborative service model[29] and the rehabilitation service developed by Cairns et al.,[30] share the following features: they are co-designed in genuine partnership with Aboriginal communities; support Indigenous leadership and delivery of services; are flexible and prioritise the needs of clients rather than service providers; and are guided by the principle of cultural safety.

Strengths of our study include the use of a culturally-specific questionnaire which has been developed and validated in remote Aboriginal communities, and a high response fraction (75%) from the participating communities.[10,13] To place this in context, the Australian Aboriginal Birth Cohort Study (one of the most successful cohort studies) has achieved response fractions between 59% and 85%.[31] Limitations include the relatively small sample size, the possibility of recall and response bias with data collected through face-to-face interview, and the inability to exclude reverse causality with this study design. An additional consideration is that only broad comparisons with previously published data are possible, owing to differing definitions of functional limitations.

The 9-item KICA-Function tool has only two questions encompassing the social components of disability. Two other existing tools better incorporate the holistic understandings of disability in the older Aboriginal Australian population. The recently developed Good Spirit, Good Life tool[7,32] is a culturally-valid strength-based quality of life assessment tool developed with older Aboriginal Australians, and includes items on ability to participate or connect in a range of social activities and the impact of other factors, such as respect. WHODAS 2.0[33] is an assessment tool that measures the medical and social components of disability, and is used by Australia's National Disability Insurance Scheme to determine the functional support needs of clients. It was developed to reflect the areas identified in the International Classification of Functioning, Disability and Health,[34] including health conditions, body function and structures, activities, participation, and environmental and personal factors. Future research could identify whether either or both of these tools better informs the holistic support and service requirements of older Aboriginal people with disabilities and their families.

5 | CONCLUSIONS

Many remote-living Aboriginal Australians report functional limitations, which are associated with older age, diabetes, history of stroke, depression, head injury, poorer cognition and difficulty walking. The prevalence of diabetes is very high compared to the general population. Programs which target diabetes and cardiovascular health might assist with the prevention of functional limitations, which will be of increasing importance as the population ages. Assistance with transport and participating in recreational and cultural activities are particular areas of unmet need, which will require flexibility in service delivery and funding to address to better support the health and well-being of older Aboriginal people. Innovative models of care, such as the Lungurra Ngoora collaborative service model, provide a template for success.

AUTHOR CONTRIBUTIONS

Kate Smith: Conceptualization; investigation; funding acquisition; writing – original draft; methodology; writing – review and editing; project administration. **Zoë Hyde:** Investigation; writing – original draft; methodology; writing – review and editing; formal analysis; data curation. **Leon Flicker:** Conceptualization; investigation; funding acquisition; writing – review and editing;

resources. **David Atkinson:** Conceptualization; investigation; funding acquisition; writing – review and editing. **Roslyn Malay:** Investigation; writing – review and editing. **Dina LoGiudice:** Conceptualization; investigation; funding acquisition; writing – review and editing; project administration.

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CONFLICT OF INTEREST STATEMENT

None declared.

DATA AVAILABILITY STATEMENT

Data are available from the authors upon reasonable request and after appropriate ethical approval is obtained.

ETHICS STATEMENT

Community consultation and council approval were sought from each community involved in the study. Approval was granted by the Western Australian Aboriginal Health Information and Ethics Committee (281-04/10) and the University of Western Australia Human Research Ethics Committee (RA/4/1/5894). All participants provided written informed consent with assistance as required from paid interpreters or Aboriginal community research assistants.

ORCID

Zoë Hyde https://orcid.org/0000-0002-5985-1729

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