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Retrospective cross-sectional study on bronchiectasis in adult Aboriginal Australians: disease characteristics and comparison with ethnically diverse global bronchiectasis registry cohorts

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ABSTRACT

Background Globally, adult Indigenous people, including Aboriginal Australians, have a high burden of chronic respiratory disorders, and bronchiectasis is no exception. However, literature detailing bronchiectasis disease characteristics among adult Indigenous people is sparse. This study assessed the clinical profile of bronchiectasis among adult Aboriginal Australians and compared against previously published international bronchiectasis registry reports.

Methods Aboriginal Australians aged >18 years with chest CT confirmed bronchiectasis between 2011 and 2020 in the Top End Northern Territory of Australia were included. Demographics, chest CT findings, pulmonary function results, sputum microbiology, coexistent medical comorbidities, and pharmacotherapy use were assessed and compared against five published international bronchiectasis registry reports (Australian (ABR), European (European Multicentre Bronchiectasis Audit and Research Collaboration (EMBARC)-Europe), Indian (EMBARC-India), Korean (KMBARC) and the USA (USBRR)).

Results A total of 459 patients were assessed. In comparison with international and non-Aboriginal Australian national cohorts, Aboriginal Australians were younger (median 56 years (IQR (48, 65)); however, sex distribution (55% female) and body mass index (23 kg/m^2 (IQR 19.4–27)) were comparable . Smoking rates were higher at 85% compared with other registry cohorts (22–46%) as was the prevalence of comorbidities (97%): cardiovascular diseases (73%), diabetes mellitus (50%) and chronic obstructive pulmonary disease (83%) compared with other registry cohorts (4–32%; 6–14%; and 14–37%, respectively). Spirometry demonstrated forced expiratory volume in 1 s of 38% predicted in comparison with 61–77% in other cohorts. Sputum microbiology showed *Haemophilus influenzae* (57%) isolated at 3.4 to 6 times the rate of other registry cohorts and *Pseudomonas aeruginosa* in 31%. Chest CT demonstrated multilobar and lower lobes involvement in 73% and inhaled pharmacotherapy use was recorded in up to 62% and long-term antibiotics in 5%.

Conclusion The overall bronchiectasis disease burden is higher in Aboriginal Australian adults in comparison with global ethnically diverse non-Indigenous populations. Further efforts are required to address this disparity secondary to bronchiectasis among Indigenous people.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Bronchiectasis disease profiles and related outcomes across global geographic regions and among non-Indigenous populations are well documented in the literature. However, despite evidence to suggest Indigenous people suffer from a higher prevalence of chronic respiratory conditions, comprehensive evidence surrounding bronchiectasis disease characteristics is sparse.

WHAT THIS STUDY ADDS

⇒ This study for the first time examined the disease characteristics of adult Aboriginal Australians and compared them against published ethnically diverse global bronchiectasis registry cohorts. It illustrates that the overall bronchiectasis disease burden is significantly higher and, moreover, how divergently bronchiectasis manifests in an adult Indigenous/Aboriginal Australian population compared with other non-Indigenous global populations.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results of this study may be of use to inform clinical protocols and practice in the future to reduce the respiratory health disparity among adult Aboriginal Australians and among Indigenous people globally.

INTRODUCTION

Bronchiectasis is a chronic respiratory condition that clinically manifests as chronic productive cough secondary to recurrent respiratory tract infection/inflammation and radiologically characterised by dilation

of bronchial airways.[1] Bronchiectasis, once thought to be a rare disorder, is progressively gaining attention and being recognised as one of the major causes for chronic ill health among diverse ethnic populations.[2 3] Moreover, evidence in the literature suggests that there is substantial heterogeneity and geographic variation in the prevalence and in the clinical manifestations of bronchiectasis across various ethnic and socioeconomic groups.[3]

In line with what is being observed globally among cohorts of various ethnicities, there is growing evidence to suggest that bronchiectasis is not only common in the paediatric Indigenous population, but also prevalent among adult Indigenous people.[4] Prevalences among both groups are higher compared with non-Indigenous populations, including among Aboriginal Australians[4] (from here on 'Indigenous' is used to refer to global First Nations populations, while 'Aboriginal Australian' is used to specifically refer to Australia's First Nations population). Moreover, adult Aboriginal Australians are also reported to have a higher prevalence of multimorbidity, 2.6 times higher than that for non-Aboriginal people.[5] Complex and advanced respiratory disorders are also highly prevalent in this population, giving rise to higher hospital admission rates and mortality.[6–8] Previous studies in other global cohorts have illustrated higher overall morbidity and worse outcomes when bronchiectasis is coupled with multimorbidity, more specifically in the presence of concurrent respiratory disorders, such as chronic obstructive pulmonary disease (COPD) and with reduced lung function parameters.[9] In the adult Aboriginal Australian population, multimorbidity, particularly of concurrent respiratory diseases, alongside reduced lung function parameters is highly prevalent.[6 10 11] Furthermore, significant sex differences in the clinical manifestation of respiratory diseases have been noted in this population.[12]

Nevertheless, in recent years, there have been collaborative efforts from several countries and across continents to establish bronchiectasis registries in order to address the disease burden among adult populations.[13] These registries have reported valuable clinical data, including health-related outcomes secondary to bronchiectasis across various global geographic regions and diverse ethnic populations.[14–18] However, representation of Indigenous people in these bronchiectasis registries remains sparse, including in the first report from the Australian bronchiectasis registry (1 (0.2%)).[15] This is despite the high prevalence of chronic respiratory comorbidities, and socio-economic barriers to healthcare experienced by Indigenous populations.[19] Hence, in light of recent literature on international cohorts with bronchiectasis, it is timely for an insight to describe and compare the bronchiectasis disease profile among an Indigenous cohort against the global cohorts.[14–18] Therefore, this study aims to comprehensively assess various clinical parameters among an adult Aboriginal Australian cohort diagnosed to have bronchiectasis over a 10-year period (2011–2020) from the Top End Health Service (TEHS) region of the Northern Territory (NT) of Australia and compare against other published bronchiectasis registry data.

METHODS

Study population

Approximately 3.3% of Australians self-identify as Aboriginal and/or Torres Strait Islanders. The NT is an Australian federal territory occupying the central-northern region of Australia. The TEHS region within the NT covers approximately 35% or 475 338 km^2 of the total area of the NT and contains an estimated adult population (>18 years) of 129 000 people, representing almost 80% of the total NT adult population (figure 1).[20 21] In the TEHS region, 22% of the adult population are Aboriginal Australians, of whom approximately 77% reside in remote or very remote communities as defined by the Australian Statistical Geographic Standard Level 4 or Level 5.[22]

Ethics

This study was approved by the Human Research Ethics Committee (HREC) of the NT, Department of Health and Menzies School of Health Research (Reference: HREC; 2019–3547). Individual consent for patients entry into the study was waived by the ethics research committee due to the retrospective nature of the study and the difficulty in obtaining individual consent. The authors acknowledge the rights of Australian Aboriginal people involved in this study, and as such conducted and reported according to strengthening and reporting of health research involving Aboriginal people, including consultations, advice and direction from the institute's Aboriginal representatives.[23]

Patient and public involvement

Due to the retrospective nature of the study, patients and/or public were not involved in this study.

Study patients

This study is a part of a larger research project examining various aspects of bronchiectasis disease profiles among the adult Aboriginal population residing in the TEHS health districts of the NT of Australia, which is inclusive of all adult Australian Aboriginal patients aged≥18 years identified to have bronchiectasis via chest CT scan between 2011 and 2020.

Clinical data assessed

Baseline demographics, including smoking status (self-reported as current, former or never smoker, with current or former status combined into a binary 'smoking history' for the purposes of this report) and body mass index (BMI) when available were recorded. Presence of respiratory conditions alongside bronchiectasis and other concurrent medical comorbidities, details of chest

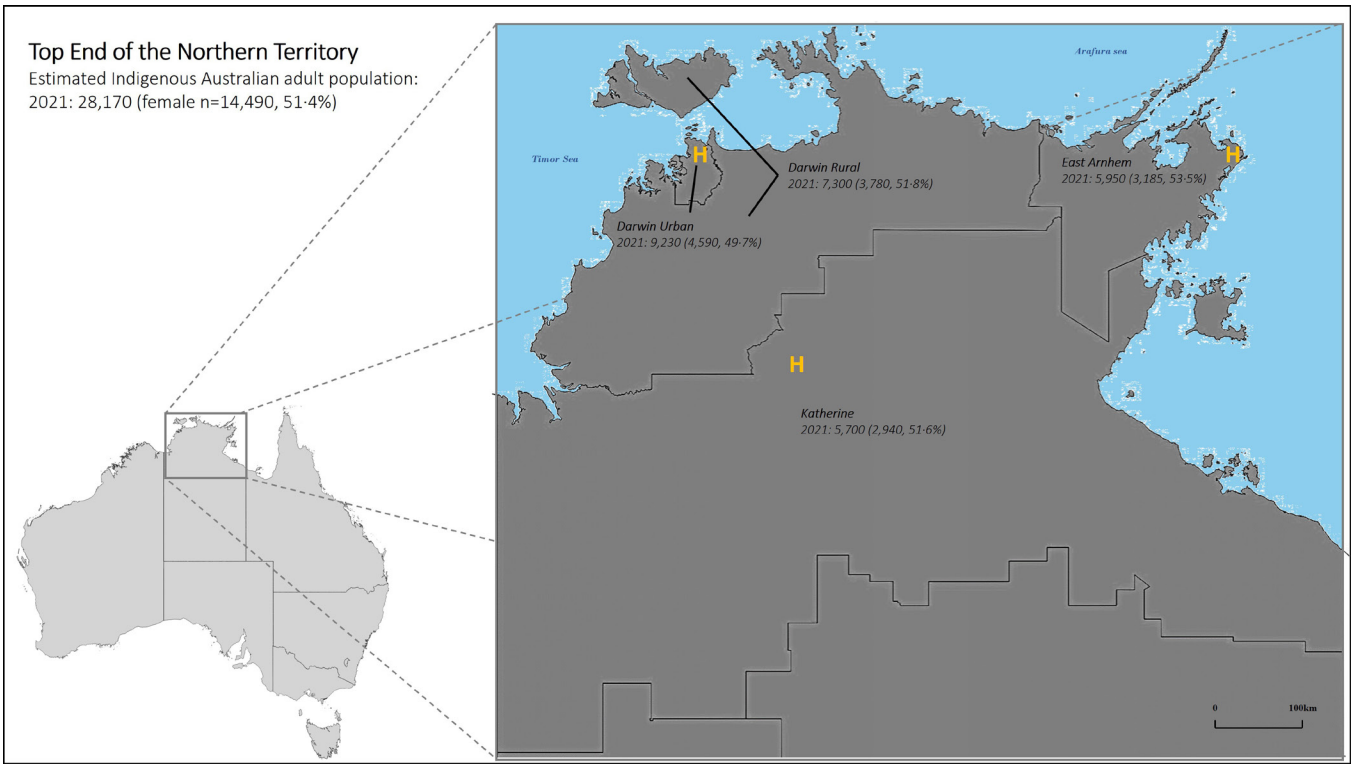

Figure 1 Map showcasing the four health regions in the TEHS, NT, Australia, alongside the total Aboriginal Australian population and number (%) of females for each region as per 2021 ABS census data. Approximate location of hospitals is notated with 'H'. ABS, Australian Bureau of Statistics; H, Hospital; NT, Northern Territory; TEHS, Top End Health Service.

CT scan findings, spirometry results (the predicted values calculated using the Third National Health and Nutrition Examination Survey reference sets), sputum microbiology and pharmacotherapy were collected from patients electronic medical records. In addition, bronchiectasis severity index (BSI) (age, BMI, FEV_1, hospitalisation in past 2 years, exacerbations in past year, Pseudomonas colonisation, other sputum culture colonisation and radiological extent) was also assessed. Further details on clinical data and methods are available from a recent report from our centre.[24]

National and international comparison data

To compare the clinical outcomes for our study cohort against other bronchiectasis registry reports, five published bronchiectasis registry reports were used. The European Multicentre Bronchiectasis Audit and Research Collaboration (EMBARC),[14] the Australian Bronchiectasis Registry (ABR),[15] the Korean Multicentre Bronchiectasis Audit and Research Collaboration (KMBARC),[16] the Respiratory Research Network of India Registry (EMBARC-India)[17] and the US Bronchiectasis Research Registry (USBRR).[18]

Statistical analysis

Continuous data were presented as median and IQR and categorical data as frequency (percentage). In cases where data were missing for patients, the denominator used was noted in the leftmost column of affected tables or table footnotes. Statistically significant differences in comorbidities, spirometry values, sputum cultures and chest CT findings between females and males were tested via Kruskal-Wallis rank sum test if continuous variables and two-tailed χ^2 test for categorical variables, using Fishers exact test if cells contained <10. Post hoc power analysis of significant results was conducted for each test independently and reported in brackets following the p value. All analyses were conducted in STATA IC 15 (StataCorp, College station, Texas), and alpha set to 0.05 throughout.

RESULTS

Patient demographics

A total of 459 patients (one (0.2%) self-reported Torres Strait Islander but not Aboriginal descent, three (0.7%) Aboriginal and Torres Strait Islander descent and the remaining 455 (99.1%) Aboriginal but not Torres Strait Islander descent—thus hereafter combined and reported as Aboriginal Australian) with bronchiectasis were identified and were included for analysis. More patients were female (55%), resided in rural and remote communities (66%), with a median age of 56 years (IQR 48, 65).

Medical comorbidities

The prevalence of comorbidities was significant, with only 12 (2.6%) patients not having any comorbidity

Table 1 Comorbidities in Aboriginal patients with bronchiectasis split by sex

Medical comorbidities	Total (n=459)	Female (n=254)	*Male (n=205)*	P Value
Concurrent respiratory comorbidities	405 (88.2%)	226 (89%)	179 (87.3%)	0.583
► COPD	380 (82.8%)	208 (81.9%)	172 (83.9%)	0.570
► Asthma	117 (25.5%)	90 (35.4%)	27 (13.2%)	<0.001* (0.999)
► NTM	41 (8.9%)	21 (8.3%)	20 (9.8%)	0.578
► Melioidosis	30 (6.5%)	17 (6.7%)	13 (6.3%)	0.880
► Tuberculosis	7 (1.5%)	2 (0.8%)	5 (2.4%)	0.251
► ILD	3 (0.7%)	2 (0.8%)	1 (0.5%)	0.999
► Sarcoidosis	2 (0.4%)	2 (0.8%)	0 (0%)	0.505
Cardiovascular comorbidities	333 (72.5%)	186 (73.2%)	147 (71.7%)	0.717
► HTN	289 (63%)	160 (63%)	129 (62.9%)	0.989
► CAD	160 (34.9%)	76 (29.9%)	84 (41%)	0.013* (0.699)
► AF	49 (10.7%)	20 (7.9%)	29 (14.1%)	0.031* (0.570)
► RHD	42 (9.2%)	32 (12.6%)	10 (4.9%)	0.004* (0.824)
► Cardiomyopathy	8 (1.7%)	2 (0.8%)	6 (2.9%)	0.147
Connective tissue diseases	23 (5%)	20 (7.9%)	3 (1.5%)	0.002* (0.886)
► SLE	13 (2.8%)	12 (4.7%)	1 (0.5%)	0.008* (0.778)
► RA	7 (1.5%)	6 (2.4%)	1 (0.5%)	0.137
► Undifferentiated connective tissue disease	4 (0.9%)	3 (1.2%)	1 (0.5%)	0.632
► Sjogren's syndrome	2 (0.4%)	1 (0.4%)	1 (0.5%)	0.999
Diabetes mellitus	228 (49.7%)	134 (52.8%)	94 (45.9%)	0.141
► T2DM	224 (48.8%)	132 (52%)	92 (44.9%)	0.131
► T1DM	4 (0.9%)	2 (0.8%)	2 (1%)	0.999
Kidney diseases: CKD	184 (40.1%)	111 (43.7%)	73 (35.6%)	0.079
Liver diseases	83 (18.1%)	46 (18.1%)	37 (18%)	0.986
► Hepatitis B	55 (12%)	29 (11.4%)	26 (12.7%)	0.678
► Cirrhosis	37 (8.1%)	22 (8.7%)	15 (7.3%)	0.599
► Hepatitis C	1 (0.2%)	0 (0%)	1 (0.5%)	0.447
Gastrointestinal diseases	2 (0.4%)	1 (0.4%)	1 (0.5%)	0.999
► Crohn's	1 (0.2%)	1 (0.4%)	0 (0%)	0.999
► Ulcerative colitis	1 (0.2%)	0 (0%)	1 (0.5%)	0.447

p Values obtained via χ^2 test or Fishers exact test in cases where cells were <10.
*Indicates statistical significance at p<0.05. Power of test noted in brackets.
AF, atrial fibrillation; CAD, coronary artery disease; CKD, chronic kidney diseases; COPD, chronic obstructive pulmonary disease; HTN, arterial hypertension; ILD, interstitial lung disease; NTM, non-tuberculous mycobacterium; RA, rheumatoid arthritis; RHD, rheumatic heart disease; SLE, systemic lupus erythematosus; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus.

recorded. Respiratory comorbidities were the most common (88.2%), though multiple differences in the comorbidity burden between sexes were noted (table 1). Females recorded a significantly higher prevalence of asthma (35 vs 13%, p<0.001), rheumatic heart disease (13 vs 5%, p=0.004) and systemic lupus erythematosus (5 vs 0.5%, p=0.008), while males recorded a significantly higher prevalence of ischaemic heart disease (41 vs 30%, p=0.013) and atrial fibrillation (14 vs 8%, p=0.031). Smoking prevalence also differed between sexes, with 23.8% of females reporting having never smoked compared with 4.3% of males (p=0.002, power=1.000).

Lung function parameters

A total of 169 (37%) spirometry results were available for assessment (online supplemental table 1). There were significant lung function impairments observed among the study patients, with a median forced vital capacity (FVC) prebronchodilator of 50% predicted (IQR 40, 64), a median forced expiratory volume in 1s (FEV_1) pre-bronchodilator of 38% predicted (IQR 28, 52) and median FEV_1/FVC of 0.66 (IQR 0.5, 0.77). Females displayed significantly lower absolute values for FVC and higher values for FEV_1/FVC.

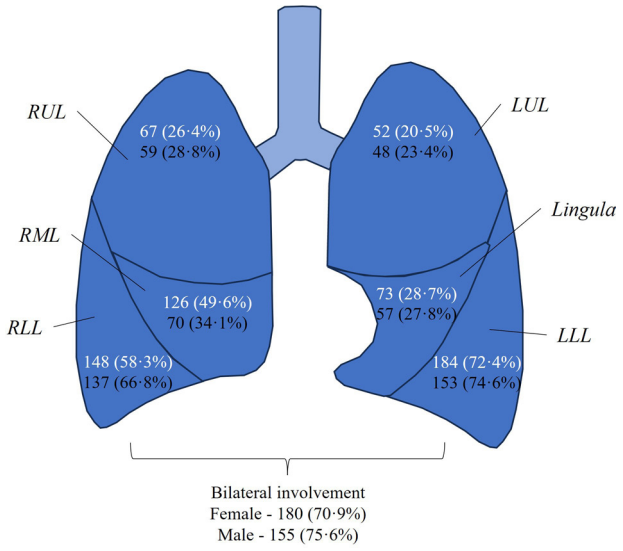

Figure 2 CT scan data for females (white numerals) and males (black numerals). LLL, left lower lobe; LUL, left upper lobe; RLL, right lower lobe; RML, right middle lobe; RUL, right upper lobe.

Chest CT scan data

The most common location of bronchiectasis was noted to involve the left lower lobe (73%) followed by the right lower lobe (62%), with the left upper lobe the least commonly affected (22%) (figure 2). Females were recorded to have the right middle lobe affected significantly more often than males (50 vs 34%, p=0.001, power=0.935). Bilateral involvement was observed in 73% of patients with no significant difference between sexes. Most patients (73%) had two or more lobes affected, and 36% of patients had three or more lobes affected.

Sputum microbiology results

Sputum cultures results were available for 425 (93%) study patients during the study window (figure 3). *Haemophilus influenzae* was the most common pathogen, isolated in 58%. *Pseudomonas aeruginosa* was identified in almost one-third (31%) of patients and *Moraxella* species in one quarter (26%). Minor non-significant sex differences were noted for the sputum microbiology; however, *non-tuberculous mycobacterium* were isolated in a significantly greater proportion of males than females (17% vs 8%, p=0.011 power=0.713).

Treatment details

Of the available data in relation to inhaled pharmacotherapy, short-acting β-agonists were the most common medication prescribed (62%); however, more than half of the cohort also had an inhaled corticosteroid (ICS) prescribed (55%). ICS prescription was more common among those with comorbid COPD (243/380, 64%) than those without (9/79, 11%). Long-acting β-agonists and long-acting muscarinic antagonists were noted to be prescribed in 61% and 46%, respectively. Long-term antibiotics (azithromycin) were prescribed in a minority (5%) of patients. No significant differences were noted in medication prescriptions between sexes (online supplemental table 2).

International and non-Aboriginal comparison data

Although the sex distribution and BMI was comparable to that of the international cohorts, the Australian Aboriginal cohort was approximately 10 years younger than those in the international datasets, aside from

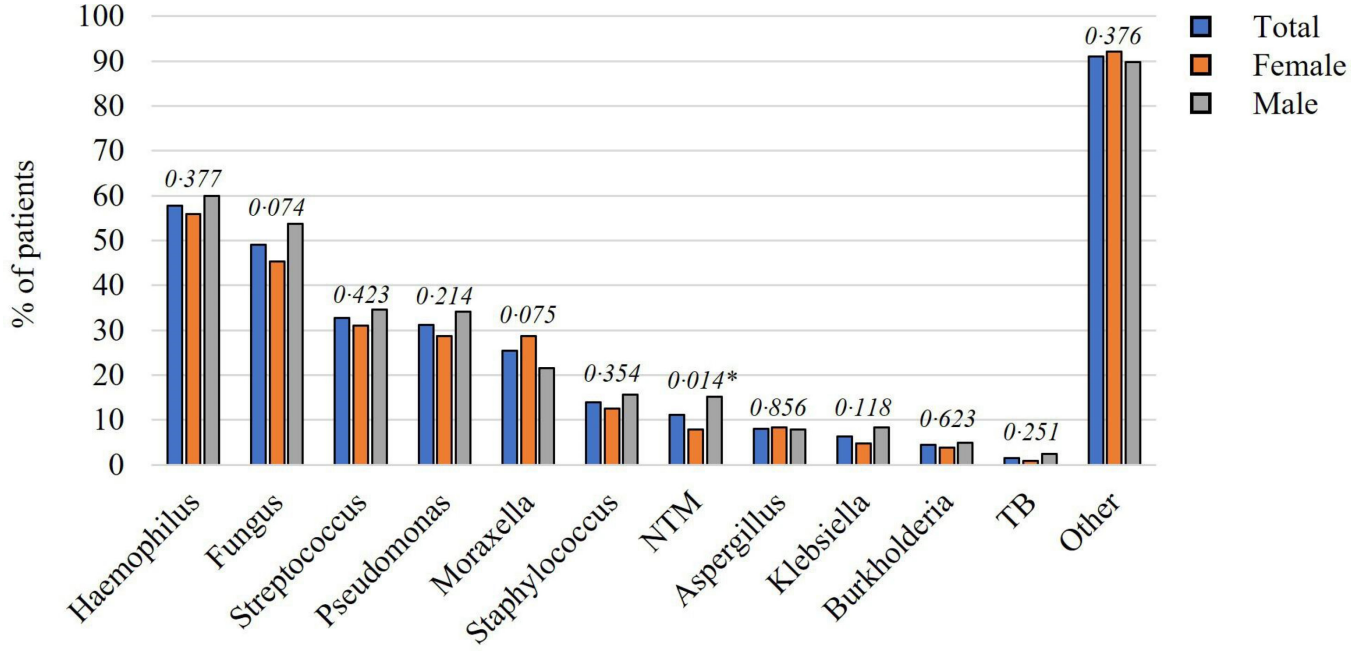

Figure 3 Sputum results for bronchiectasis patients split by sex with p values for differences between sexes (via χ^2 test or Fishers exact test) noted above each column. NTM, non-tuberculous mycobacterium; TB, tuberculosis.

EMBARC-India (56 years (IQR 41, 66)) (Australian ABR cohort (median 71 years), the EMBARC cohort (median 67 years), the KMBARC cohort (median 66 years) and the USBRR cohort (mean 64 years)). The prevalence of comorbidities was higher among the Aboriginal Australian cohort than any other cohorts. Cardiovascular disease prevalence was 2.7 times higher in comparison to EMBARC-India and 1.3 times higher than EMBARC-Europe. Ischaemic heart disease specifically was 5 times higher than the ABR cohort and 7.8 times higher than the KMBARC cohort. Similarly, diabetes mellitus prevalence was 2.5 times to 7.8 times higher than any other cohort. Asthma prevalence however was in a comparable range to what was reported internationally, at 25.5%. In contrast, comorbid COPD prevalence was significant, at 83% within the Aboriginal Australian cohort—5.7 times higher than the non-Indigenous ABR cohort and 2.2 times higher than the next highest prevalence in the KMBARC cohort. Smoking status was only recorded for 150 (33%) of the Aboriginal Australian cohort; however, among those, 85% recorded a history of smoking compared with 46% in EMBARC-Europe, 40% in USBRR, 35% in KMBARC, 28% in EMBARC-India and 22% in the ABR. Similarly, spirometry was only recorded for 169 (37%) of the Aboriginal Australian cohort, yet percent predicted FEV_1 was significantly lower than any other cohort with a median 38% (IQR 28, 52)—almost half that of the EMBARC-Europe (median 77 (IQR 59, 97)) and ABR (median 75 (IQR 57, 91)) cohorts. Positive sputum cultures were more prevalent among the Aboriginal Australian cohort than any other. *P. aeruginosa* was isolated at a comparable rate to the USBRR (33%), yet significantly higher compared with other cohorts (14–19%), while *H. influenzae* was 3.4 times more prevalent in the Aboriginal Australian cohort than in EMBARC-Europe and six times more prevalent than in the ABR cohort (table 2). In relation to long-term antibiotics, 22 (4.8%) Aboriginal Australians were noted to be prescribed with azithromycin, a much lower proportion in comparison to other reports (EMBARC-Europe, EMBARC-India, ABR) which ranged between 12% and 31%.

DISCUSSION

To the best of the authors' knowledge, this is the first comprehensive study detailing clinical and laboratory parameters, including sex differences among an adult Aboriginal Australian population with bronchiectasis from the Top End, NT of Australia. This study demonstrates that the Aboriginal Australian population with bronchiectasis is significantly younger than the non-Aboriginal Australian cohort and most other international cohorts. However, the proportion of females is comparable as found among other reports, as is the median BMI. In our study, patients with bronchiectasis were a median 56 years of age, with only a slight (55%) female predominance. In contrast, the ABR data which predominantly consisted of a non-Aboriginal Australians reported a median age of 71 years with 71% female,[15] and the European EMBARC cohort reported a median age of 67 years with 61% female.[14]

Earlier literature has demonstrated differences in the way bronchiectasis manifests between male and females which has been attributed to the effects of sex hormone and lung microbiomes.[25 26] Previous registry data have not elaborated on disease manifestations between sexes in detail. Although in our study we observed differences between sexes on some clinical parameters, there was no substantial clinically relevant differences, other than lower absolute lung function values among females compared with males. Overall, spirometry parameters showed significantly reduced values, with a median FEV_1 of 38% predicted, compared with 61 to 77% predicted in other registry cohorts.[14–17] In the TEHS, NT region, adult Aboriginal Australians with respiratory disorders are observed to have substantially lower lung function values in comparisons to their non-Indigenous counterparts.[27–32] Previous studies have shown that presence of reduced lung function parameters is associated with long-term poor outcomes among patients with bronchiectasis.[33–36] Whether this is also the case for Indigenous patients is currently not known, particularly in the absence of any published longitudinal data.

Presence of multimorbidity alongside bronchiectasis is associated with greater risk of adverse outcomes.[37] Indeed, presence of multimorbidity has been reported to be highly prevalent among Aboriginal Australians.[38–50] This study mirrored these previous reports, as presence of multimorbidity was significantly higher among the Aboriginal Australian cohort, with almost half reporting cardiovascular disease or diabetes mellitus, and four in five reporting COPD, which is significantly higher than reported in both international cohorts,[14 16–18] and the Australian non-Aboriginal cohort.[15] Similarly, the presence of a smoking history was significantly greater, with 85% of the Aboriginal cohort reporting a smoking history compared with 22–46% among other registry reports.[14–18] A more recent follow-up study from the EMBARC-Indian registry data has shown worse outcomes and mortality among bronchiectasis patients with a smoking history and comorbid COPD.[51] It is highly plausible this could be similar among Aboriginal Australians with a high prevalence of smoking and concurrent presence of COPD and bronchiectasis.[52–55] However, further prospective studies will be needed to investigate this association in this population.

In relation to sputum microbiology, in contrast to each of the other registry cohorts, where *P. aeruginosa* was the most commonly cultured bacterial pathogen, within our study, *H. influenzae* was the most common pathogen cultured (58%), followed by *Streptococcus pneumoniae* (32%). Although *P. aeruginosa* was not the most commonly cultured, it was still cultured significantly more commonly within this cohort (31%) compared with the ABR (19%), EMBARC-Europe (18%), EMBARC-India

Table 2 Bronchiectasis summary data for global cohorts

	EMBARC Europe (n=16 963)	ABR* (n=589)	KMBARC (n=598)	EMBARC India (n=2195)	USBRR (n=1826)	AA-TEHS (n=459)
Age, years	67 (57–74)	71 (64–77)	66 (60–72)	56 (41–66)	64±14	56 (48, 65)
Female	10 335 (60.9%)	420 (71%)	334 (55.9%)	946 (43.1%)	1439 (79%)	254 (55%)
BMI, kg/m^2	24.9 (21.7–28.7)	25 (22–29)	22.9 (20.7–25.4)	21.5 (18.5–24.5)	23.2±5.7	23.1 (19.4–27)
Comorbidities†						
Cardiovascular diseases	5509 (32.5%)	46 (7%)	27 (4.5%)	355 (16.2%)	–	198 (43.1%)
IHD‡	–	*46 (7%)*	*27 (4.5%)*	–	–	*160 (34.9%)*
Diabetes	1724 (10.2%)	42 (6.4%)	73 (12.2%)	315 (14.4%)	–	228 (49.7%)
Asthma	5267 (31.0%)	94 (14.4%)	134 (22.4%)	485 (22.1%)	515 (29%)	117 (25.5%)
COPD	4324 (25.5%)	95 (14.5%)	226 (37.8%)	512 (23.3%)	350 (20%)	380 (82.8%)
Smoking						
Never	9096 (53.6%)	451 (78%)	387 (64.7%)	1576 (71.8%)	1094 (60%)	22 (14.7%)
Ex-smoker	6785 (40.0%)	123 (21%)	211 (35.3%)	506 (23.1%)	693 (38%)	64 (42.7%)
Current	1082 (6.4%)	7 (1%)	–	113 (5.1%)	28 (2%)	64 (42.7%)
Spirometry						
FEV_1 (% predicted)	76.9 (56–96.7)	75 (57–91)	65.4 (52–78.7)	61.4 (41.9–80.5)	–	38 (28–52)
Cultures						
Pseudomonas aeruginosa	3047 (18%)	122 (18.7%)	66 (11%)	301 (13.7%)	470 (33%)	141 (30.7%)
Haemophilus influenzae	2866 (16.9%)	63 (9.7%)	9 (1.5%)	11 (0.5%)	116 (8%)	265 (57.7%)
Moraxella catarrhalis	652 (3.8%)	14 (2.1%)	3 (0.5%)	22 (1%)	20 (1%)	117 (25.5%)
Streptococcus pneumoniae	1032 (6.1%)	–	–	18 (0.8%)	49 (3%)	145 (31.6%)
Staphylococcus aureus	1044 (6.2%)	17 (2.6%)	4 (0.7%)	50 (2.3%)	170 (12%)	62 (13.5%)
BSI						
Mild	4960 (29.2%)	46 (16%)	171 (29.4%)	728 (33.2%)	–	210 (45.8%)
Moderate	6054 (35.7%)	81 (28%)	257 (44.1%)	674 (30.7%)	–	184 (40.1%)
Severe	5949 (35.1%)	162 (56%)	154 (26.5%)	793 (36.1%)	–	65 (14.2%)

Data reported as median (IQR) or number (%), aside from the USBRR which reported as mean ± standard deviation.
The BSI for the Aboriginal cohort is calculated without MRC dyspnoea data. Furthermore, only 169 patients had both FEV1 and BMI data available for these severity calculations.
Spirometry reference values used: EMBARC Europe, European Community of Coal and Steel equations ABR, Global Lung function Initiative (GLI), 2012 EMBARC India, South Asian AA-TEHS, NHANES-III.
*ABR comorbidity and cultures data comes from the KMBARC study correspondence as comorbidity data is not present in the First Report of the ABR, and the cultures data differs between what is reported in the KMBARC correspondence, and the ABR First Report.
†Cardiovascular disease was defined differently between cohorts. Among the Aboriginal Australian cohort, it includes: coronary artery disease, cardiomyopathy, atrial fibrillation, heart failure and rheumatic heart disease. Among the ABR and KMBARC cohorts, however, it is limited to IHD.
‡IHD (in italics) is reported as a subset under the umbrella term of 'cardiovascular diseases'.
AA-TEHS, Aboriginal Australian top end health service; ABR, Australian bronchiectasis registry; BMI, Body mass index; BSI, Bronchiectasis severity index; COPD, Chronic obstructive pulmonary disease; EMBARC, European Multicentre Bronchiectasis Audit and Research Collaboration; FEV1, Forced expiratory volume in 1 one second; IHD, Ischaemic heart disease; KMBARC, Korean multicentre bronchiectasis audit and research collaboration; MRC, Medical Research Council; NHANES-III, Third National Health and Nutrition Examination Survey; USBRR, United states bronchiectasis research registry.

(14%) and KMBARC (11%).[14–17] Nonetheless, there are limited data in relation to sputum microbiology among adult Aboriginal Australian patients with bronchiectasis and its relationship with other health related outcomes.[4] However, studies from Central Australian region where human T-lymphotropic virus infection is reported to have strong association with bronchiectasis among Aboriginal patients,.[56–58] This may indicate that there may be several differing geographical factors either intrinsic or extrinsic that may be influencing the occurrence and progression of bronchiectasis among Indigenous people.

To assess the severity and prognosis among patients with bronchiectasis, two well established tools are often used: the FACED tool (F, forced expiratory volume in 1 s;

A, age; C, chronic colonisation by *P. aeruginosa*; E, radiological extension; D, dyspnoea) and the BSI tool.[59 60] Due to our study being retrospective in nature and lacking some of the required parameters, especially the Modified Medical Research Council Dyspnoea Scale[61] to accurately assess the severity and prognosis using either the FACED or BSI tools, we were unable to compare our data to assess the bronchiectasis severity to other registry cohorts in more detail. However, the applicability of these tools for an Indigenous population is questionable, as these tools were developed from non-Indigenous population data sets. For example, age, which is the single highest scoring contributor to the BSI, presents a problem for the Indigenous population, which is significantly younger, in our study cohort—31% of the study patients would scores '0' due to being <50 years and a further 56% score '2' due to being aged 50–69 years—hence, Indigenous people may spuriously demonstrate lower BSI scores. This is despite higher prevalence of comorbidities, higher smoking rates, significantly reduced lung function, greater array of organisms cultured and higher hospital admissions. Moreover, impaired access to radiology (CT) and comprehensive lung function testing among Indigenous patients residing in remote and rural communities further limit the utilisation of the BSI and FACED tools, and more broadly, substantial chest radiology (CT) data is lacking among the Aboriginal Australian populations.[7 62] As observed in this study, only 169 patients (37%) had both FEV_1 and BMI data available. Hence, it is reasonable to speculate that use of these tools would potentially lead to inappropriate classification of disease severity and may also give way for inappropriate therapeutic interventions as well.[63 64] Therefore, there is a need for developing bronchiectasis severity tool using differing clinical parameters specific for Indigenous populations, in addition to considering realistic limitations of remoteness and cultural factors.[65 66]

Although current literature portrays a high bronchiectasis disease burden and associated adverse health outcomes globally,[67] innovative preventative or therapeutic interventions are negligible, other than the proven benefits of chest physiotherapy/airway clearance techniques.[68] Indeed, a recent study from Taiwan has demonstrated that the only factor that reduced mortality risk was airway clearance therapy.[69] Ironically, implementation of chest physiotherapy/airway clearance interventions and availability of such dedicated services for Aboriginal Australian people is sparse currently, especially among those residing in remote and rural communities.[70] However, use of inhaled pharmacotherapy was noted to be substantial, especially prescription of ICS in our study patients, similar as observed in the ABR report among non-Aboriginal Australians.[71] This is despite guidelines advocating cautious use of ICS among patients with bronchiectasis.[72 73] The risk of pneumonia associated with ICS use and the unknown potential effects ICS may have on the microbiome in Aboriginal patients with bronchiectasis is of concern.

In the previously published registry reports,[14–18] other than the ABR data which has clearly represented inclusion of Aboriginal Australians (although with far lesser numbers (1 (0.2%, (not inclusive of or overlapping with our current study data)), in comparison to non-Aboriginal patients), it is unclear if the other international reports from the USA, Europe, Korea and India included any Indigenous patients. Yet, Indigenous people reside in these aforementioned geographic regions, such as the Yukon Kuskokwin delta in Alaska, USA; in northern Europe the "Sámi' People; in the Korean Peninsula the 'Jeju' people; and in India the tribal people 'Adivasis' among other diverse cultural groups.[4] It is estimated that over 476 million Indigenous peoples live worldwide and make up approximately six per cent of the global population. There is also significant disparity in several social determinants, and Indigenous peoples' life expectancy is up to 20 years lower than that of non-Indigenous people.[74] It is a matter of speculation how much of this heightened mortality and reduced life expectancy experienced by underprivileged global Indigenous people would be secondary to respiratory disorders such as bronchiectasis.

Nevertheless, this study has demonstrated that the bronchiectasis disease burden is substantial as is its impact on overall health and well-being among adult Aboriginal Australians, much higher than International and non-Aboriginal cohorts. Moreover, unlike among non-Indigenous populations where bronchiectasis is predominantly noted to occur in adulthood and with advancing age, among Aboriginal Australians, there is a significant incidence of bronchiectasis in childhood.[75] It may be reasonable to speculate that Indigenous children transiting into adulthood with ongoing recurrent exacerbations which perpetuate airway inflammation contributes to the deterioration in airway function, hence the aftermath of the disease course in the adulthood.[76 77] Therefore, further dedicated efforts are needed to address this disparity to reduce the morbidity and mortality secondary to bronchiectasis, including implementing educational programmes and facilitating transition of care from paediatric care to adulthood.[78 79] To this vein, it is paramount for health organisations and stakeholders to consider establishing a national and international task force consisting of adult respiratory and paediatric physicians, researchers, primary health medical practitioners, physiotherapists, community Aboriginal health workers and Aboriginal controlled community organisations to address the respiratory health burden among Aboriginal Australians and Indigenous people globally. This will not only enable Aboriginal Australian and global Indigenous people to lead a better quality of life, but also reduce the economic cost and healthcare utilisation related to the significant bronchiectasis burden.

Limitations

This study's outcomes pertain to Aboriginal Australian people residing in the TEHS region of the NT of

Australia, and the results represented in this study cannot be generalised to the wider Aboriginal populations in Australia or for Indigenous people globally. As the Aboriginal Australian population is heterogenous socially and geographically, there could be numerous factors such as environmental, infections, smoking rates, housing and access to healthcare that may be contributing to differing disease manifestations. Due to the study being retrospective in nature, some clinical parameters, such as the lung function data, were not available for all of the study patients. This may have created biases within our results, as it may be, for example, that only those patients with symptomatic or advanced lung disease underwent spirometry, while those who did not experience significant symptoms or signs did not. Additionally, for these reasons, the BSI could not be assessed and compared. Moreover, we did not have data related to parity in our female cohort. As such, there is relationship between parity and its impact on health outcomes, which would have been useful. It is unclear if some of the international datasets were inclusive of Indigenous people. Furthermore, during this study, we did not dwell extensively on the differences in how bronchiectasis diagnoses were established between countries/registry cohorts, including how associated comorbidities were assessed/defined in different countries and other registry cohorts. In our study, we used only chest CT confirmed patients; hence, it is reasonable to speculate that there could be several adult patients with bronchiectasis in regional and remote communities who were not included due to not having an opportunity to undergo a chest CT secondary to geographical isolation and access to specialist healthcare. Therefore, what is represented in this study may be only the tip of the iceberg of the bronchiectasis burden which exists among Aboriginal peoples. This also could be the case for global underprivileged Indigenous populations as well. Nonetheless, this is the first study to illustrate the unprecedented bronchiectasis disease burden within the adult Aboriginal Australian population in the NT compared with other diverse ethnic groups and could be considered a steppingstone forward to implement strategies, including establishing specific diagnostic and management pathways to reduce the morbidity and mortality secondary to bronchiectasis among Indigenous peoples globally.

CONCLUSION

The Aboriginal Australian bronchiectasis cohort in our study had more multimorbidity, including concurrent respiratory comorbidities, alongside reduced lung function parameters, differing sputum microbiology, including demonstrating multilobe and bilateral disease burden on chest CT in comparison to ethnically diverse national and international comparison cohorts. Further dedicated efforts are needed to address this disparity and to close the respiratory health gap not only among the Aboriginal Australians, but also Indigenous populations globally.

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