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Is higher population-level use of combination ICS/LABA associated with better asthma outcomes? Cross-sectional surveys of nationally-representative populations in New Zealand and Australia

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Summary at a glance

Poor asthma symptom control and urgent healthcare episodes remain common in NZ and Australia. More costly ICS/LABA use was strikingly higher in Australia, but NZ achieved similar outcomes with wider use of cheaper ICS monotherapy and better adherence. Pharmaceutical regulation, patient costs and patterns of clinical practice are likely influences.

ABSTRACT

Background and objective

New Zealand (NZ) and Australia have similarly high asthma prevalence; both have universal public health systems, but different criteria for subsidised medicines. We explored differences in asthma management and asthma-related outcomes between these countries.

Methods

A web-based survey was administered in Australia (2012) and NZ (2013) to people ≥ 16 years with current asthma, drawn randomly from web-based panels, stratified by national population proportions. Symptom control was assessed with the Asthma Control Test (ACT). Healthcare utilisation was assessed from reported urgent doctor/hospital visits in the previous year.

Results

NZ ($n=537$) and Australian ($n=2,686$) participants had similar age and gender distribution. More NZ than Australian participants used ICS-containing medication (68.8% vs 60.9%; $p=0.006$) but ICS/LABA constituted 44.4% of NZ and 81.5% of Australian total ICS use ($p<0.0001$). Adherence was higher with ICS/LABA than ICS-alone ($p<0.0001$), and higher in NZ than Australia ($p<0.0001$). ACT scores were similar ($p=0.41$), with symptoms well-controlled in 58.6% and 54.4% participants respectively. More NZ participants reported non-urgent asthma reviews (56.6% vs 50.4%; $p=0.009$). Similar proportions had urgent asthma visits (27.9% and 28.6% respectively, $p=0.75$).

Conclusion

This comparison, which included the first nationally-representative data for asthma control in NZ, showed that poorly-controlled asthma is common in both NZ and Australia, despite subsidised ICS-containing medications. The greater use of ICS-alone in NZ relative to ICS/LABA does not appear to have compromised population-level asthma outcomes, perhaps due to better adherence in NZ. Different ICS/LABA subsidy criteria and different patient co-payments may also have contributed to these findings.

Key words: Anti-Asthmatic Agents/therapeutic use, Asthma, Asthma/epidemiology*, Asthma/therapy*, Cross-Sectional Studies

Short title: Asthma control in NZ and Australia

INTRODUCTION

The burden of poorly-controlled asthma varies country-to-country,¹ ranging in Europe, for example, from 40.2% (Spain) to 65.3% (Germany).² Such variation may be due to genetic and environmental factors, as well as differences in health literacy, health care systems, and access to medication.

New Zealand and Australia are geographically proximate and highly urbanised, with comparable cost of living (2016 Big Mac index USD4.22 New Zealand [NZ], USD4.30 Australia [AU]).³ Both countries have universal public health schemes and a well-educated general practice and specialist workforce. Asthma prevalence is similar at 11.0% (NZ)⁴ and 10.2% (Australia)⁵ (Table 1). Current NZ⁶ and Australian asthma guidelines,⁷ like those in many other countries, recommend a stepwise approach to asthma treatment, starting with short-acting β_2 -agonist (SABA), moving to low-dose inhaled corticosteroid (ICS) for most patients, with long-acting β_2 -agonist (LABA) added if asthma remains poorly-controlled. In both countries, these medications are subsidised by government.

However, as outlined in Table 1, some key differences exist. For example, SABA is available over-the-counter without a prescription in Australia but not NZ; direct-to-consumer advertising of prescription medications is permitted in NZ but not Australia; patient co-payments are lower in NZ than Australia; and access to combination ICS/LABA has historically been more tightly restricted in NZ than Australia. Amongst Australian adults dispensed any ICS, 87.2% receive it as ICS/LABA.⁸ This includes asthma and COPD; no corresponding data are available for NZ.

Given these similarities and differences, we administered a standardised questionnaire to nationally-representative populations with asthma in NZ and Australia, with the aim of investigating whether

there were differences in asthma management and outcomes between these two neighbouring countries. In particular, we aimed to investigate whether there were differences in patient-reported use of ICS-containing preventer medications, or in asthma symptom control or asthma-related health care utilisation.

METHODS

Data were obtained by web-based surveys of representative populations of people with asthma in Australia (November 2012) and NZ (March 2013). Methodology is reported in detail elsewhere.⁹ In brief, a three-stage process was used to randomly identify potential participants from online panels in each country (Supplementary Information, Table S1). Inclusion criteria were age ≥ 16 years, self-reported health professional-diagnosed asthma, and asthma symptoms and/or treatment in the previous year. Recruitment was stratified by NZ census data for age, gender and ethnicity for people with asthma;¹⁰ and by Australian Health Survey data for age, gender and state of residence for people with asthma.¹¹

Asthma symptom control over the previous four weeks was assessed with the ACT, a validated five-item tool (used under licence from QualityMetric Incorporated), and classified as “well controlled” (ACT score 20-25), “not well controlled” (16-19) or “very poorly controlled” (5-15).¹² Overall health status was assessed from the question “*In general, would you say your health is?*”, with five response options ranging from “*excellent*” to “*poor*”. Participants identified asthma medications taken in the previous 12 months from images and tradenames; if they selected both ICS and ICS/LABA, data were analysed for the medication that they reported using most frequently. Healthcare utilisation (non-urgent and urgent GP review, emergency department (ED) visits, hospitalizations for ≥ 1 night) was assessed by specific questions. All analyses were undertaken using SAS version 9.4, SAS

Institute Inc. (Cary, NC, USA). Estimates of prevalence were calculated with survey weights applied. Chi-square test was used to check for differences in proportions between independent samples. Logistic regression was performed for comparison of self-reported adherence (≥5 days/week vs <5 days/week or none), adjusting for ICS type (ICS-alone or combination ICS/LABA) and country. P-values less than 0.05 were considered significant.

Ethics approval was obtained in Australia (CH62/6/2012-121; LNR/12/CRGH/153); in NZ, the study did not require ethics review as it satisfied national criteria for minimal risk observational studies. Some of the Australian data have been reported elsewhere.⁹

RESULTS

Demographics and health status

In NZ, 1,499 panel members agreed to complete a survey and reported ever having asthma; 767 (51.1%) satisfied criteria for 'current asthma' and entered the survey. Of these, 152 were excluded because their demographic quota was full, and 537/615 (87.3%) completed the survey (Supplementary Information, Figure S1). The completion rate for the Australian survey was similar (n=2,686, 89.0%).⁹

Table 2 shows demographic characteristics for NZ and Australian participants; age distributions were similar, and as expected, there were more females than males. Similar proportions had government concession cards (53.4% NZ vs 54.8% Australia (AU); p=0.54). Overall health status was rated higher in NZ than Australia (p=0.002).

ICS-containing preventer type and usage

Overall, more NZ than Australian participants had used any ICS-containing medication in the last year (68.8% vs 60.9%; $p=0.006$, Table 2). Many more NZ participants used ICS-alone inhalers (49.4% NZ vs 17.1% AU; $p<0.0001$), and fewer used ICS/LABA (30.5% NZ vs 50.0% AU; $p<0.0001$). Overall, of those using any ICS, the proportion prescribed it as combination ICS/LABA was 44.4% (NZ) and 81.5% (AU) (Figure 1). Use of LABA without ICS was low in both countries. Table 3 shows self-reported frequency of ICS-containing inhaler use in the last year. Of participants reporting any ICS, the same proportion in NZ and Australia reported taking it regularly (e 5 days/week: 56.7% for each). From logistic regression, those taking ICS/LABA were more likely to report taking it regularly compared to those taking ICS-alone, adjusted for country (60.9% vs 47.2% respectively, odds ratio (OR) 1.64 [95% CI 1.32-2.04], $p<0.0001$). However, the proportion of all participants using any ICS-containing medication regularly was significantly higher in NZ than Australia (43.2% vs 33.9%, OR 1.65 [1.29-2.11], adjusted for ICS type (ICS-alone vs ICS/LABA) (Table 3).

Asthma symptom control and healthcare utilisation

Mean ACT scores were similar (19.4 (NZ) vs 19.1 (Australia), $p=0.413$, Table 4). Furthermore, the distribution of symptom control categories was similar in both countries; asthma was classified as 'well-controlled' (ACT 20-25) for only 58.6% and 54.4% of participants respectively.

More participants in NZ than Australia reported having a non-urgent GP review of their asthma in the preceding year (56.6% vs 50.4%; $p=0.0094$, Table 4). However, there were no differences between NZ and Australia in the proportion of participants with e 1 urgent GP visits for asthma (22.6% vs 23.3%; $p=0.40$), e 1 hospital or ED visits (11.1% vs 10.0%; $p=0.41$) or e 1 nights'

admission to hospital for asthma (4.5% vs 3.6%; $p=0.38$) (Table 4). In both countries, participants with poorly-controlled symptoms were more likely to report urgent healthcare utilisation than those with well-controlled symptoms (total 44% vs 17%, $p<0.0001$).

Asthma control relative to ICS-containing preventer use

Participants were classified into four groups based on asthma symptom control category and self-reported regular (≥ 5 days/week) use of ICS-containing medication (Figure 1). For NZ participants, 37% participants had well-controlled asthma (ACT score 20-25) while using an ICS-containing preventer <5 days/week or not at all (Group A) and could be considered to have mild asthma.¹³ Group B (21%) had well-controlled asthma with self-reported ICS-containing preventer use ≥ 5 days/week. Conversely, group C (22%) had uncontrolled symptoms (ACT <20) despite self-reported use of ICS-containing preventer ≥ 5 days/week. Group D (20%) had uncontrolled symptoms, using no ICS-containing preventer at all, or using it <5 days/week. These proportions were similar in Australia (40%, 14%, 20% and 26% respectively),⁹ where fewer participants had taken any ICS, more had received it as ICS/LABA, but fewer took ICS-containing medication regularly compared with NZ (Figure 1).

DISCUSSION

This study provides an intriguing comparison of treatment and outcomes for adults with asthma in NZ and Australia. Uniquely, these countries have similar asthma prevalence, similar socioeconomic status, similar national health insurance schemes and a strong emphasis on implementation of asthma guidelines, but key differences around access to some subsidised asthma medicines. Using the same web-based survey tool, with rigorous methodology in nationally representative asthma populations,

we found that more participants in NZ reported using ICS-containing medications, and more had used them regularly. However, the proportion using ICS as combination ICS/LABA was strikingly different: 44% of ICS users in NZ and 82% in Australia. Despite this, asthma symptom control by ACT score was similar in the two countries, and a similar proportion of participants reported they required urgent health care for their asthma in the previous year.

Despite subsidised access to highly effective medications, both countries had a high burden of asthma: many participants reported poor asthma symptom control (41% in NZ, 46% in Australia), and almost 30% required urgent healthcare for asthma in the previous year (28% and 29%, respectively), with one in 10 requiring an asthma-related ED visit (11% and 10%, respectively). Urgent health care was more common amongst those with poorly-controlled symptoms.¹⁴

There are no previous population-based asthma control data for NZ. In 2001, Holt and colleagues surveyed 327 adult patients recruited from 29 randomly-selected general practices, reporting that 7% patients had an ED presentation in the previous year, and, using a study-specific classification, that asthma was not well controlled in 71%.¹⁵ In the present study, the prevalence of poor symptom control by ACT in both countries was similar to that from population-based surveys in the US (41.0%),¹⁶ Spain (40.2%)² and the United Kingdom (42.7%),² and lower than in Germany (65.3%).²

One of the most striking findings was the much higher usage of combination ICS/LABA in Australia than NZ (82% (Australia) vs 44% (NZ) of ICS users). In both countries, over time, ICS/LABA prescribing has increased and ICS-alone prescribing has decreased, but the time-course has been very different. In Australia, annual surveys show that by 2004, only four years after ICS/LABA was first subsidised, ICS/LABA prescribing by GPs had already outstripped ICS-alone prescribing;¹⁷ whereas in NZ, data from the Pharmaceutical Management Agency (PHARMAC) show that ICS/LABA

prescribing did not exceed ICS-alone prescribing until 2014, twelve years after ICS/LABA first became available.¹⁸ The contribution of physician-directed marketing to these trends is not known.

It is difficult to reconcile the predominance of ICS/LABA in Australia with national asthma guidelines that, at the time of the survey¹⁹ (as now⁷), recommended stepping up to ICS/LABA for adults only if asthma was uncontrolled with low-dose ICS-alone, after checking inhaler technique and adherence. It is also inconsistent with the Pharmaceutical Benefit Scheme (PBS) eligibility criteria for patient subsidy, that require prior treatment with optimal ICS doses. By contrast, at the time of the survey, NZ guidelines²⁰ recommended ICS/LABA only for patients whose asthma was uncontrolled on *moderate*-dose ICS. This was also required for PHARMAC subsidy. In 2003, Beasley and Masoli²¹ noted that 49% of patients with uncontrolled asthma in the above study by Holt *et al*¹⁵ were under-treated, mostly due to failure to add LABA, and they drew attention to then-current British guidelines which introduced add-on LABA after low-moderate dose ICS. In the 2016 NZ asthma guidelines,⁶ ICS/LABA is now recommended as step-up from low-dose ICS.²²

Important insight into these patterns can be gained from understanding the long-standing differences between NZ and Australia in prescriber requirements for subsidised ICS/LABA treatment. In Australia, no written confirmation of eligibility has been required. By contrast in NZ, for most of the 10 years prior to the survey, ICS/LABA could be obtained only after submission of a written Special Authority form, certifying the patient's eligibility, and with the clinician's signed acknowledgement that they may be audited.²² However, PHARMAC recently removed all restrictions (other than maximum daily doses) on subsidised ICS/LABA prescribing; prior treatment with ICS is no longer required, in contrast with clinical guidelines. It will be interesting to see whether this change has an effect on prescribing of ICS/LABA versus ICS-alone in NZ.

One advantage of combination ICS/LABA in asthma is that patients who might otherwise be poorly adherent with ICS-alone inhalers can obtain symptom relief when they take the medication, potentially encouraging their more frequent use. In the present study, while overall adherence with ICS-containing medications was poor, with regular use (≥ 5 days/week) reported by only 57% of those taking any ICS in the previous year in both countries, there was significantly greater regular use amongst those taking ICS/LABA than ICS-alone (61% vs 47%, Table 3). This is consistent with dispensing data from real-life observational studies,^{23,24} although the difference in adherence seen in studies providing medication free of charge to research volunteers is much smaller.²⁵

However, even after adjustment for ICS type (ICS/LABA vs ICS-alone), more New Zealanders than Australians took ICS-containing medications for asthma (OR 1.65 [1.29-2.11]). Factors contributing to higher adherence in NZ may include the higher proportion of participants reporting a routine (non-urgent) review of their asthma, and lower out-of-pocket cost to NZ patients. At the time of the surveys, NZ patients paid a dispensing fee of NZD3.00 for one month's supply of each prescription item, compared with the co-payment in Australia of NZD7.42 (AUD5.80) for concession card holders and NZD45.31 (AUD35.40) for the remaining one-third of participants. Higher patient co-payment is known to be a significant contributor to poor adherence, independent of socio-economic status.^{26,27}

In assessing the implications of these findings, the higher cost to payors of ICS/LABA than ICS-alone should also be considered. In a US study of mild asthma, direct asthma-related costs were 34% higher if treatment was initiated with ICS/LABA compared with ICS-alone.²⁸ Payors have sometimes introduced financial disincentives to reduce prescribing of high-cost medications. For example, during the global financial crisis, Iceland substantially increased patient co-payments for

ICS/LABA for asthma and COPD. However, more patients discontinued ICS-containing medication completely, and dispensing of relievers and oral corticosteroids increased; the decision was subsequently reversed.²⁹ Conversely, a population-based cohort linkage study in British Columbia, Canada found that between 2002-2007, despite a 178% increase in expenditure on ICS/LABA and an increase of 38.7% in overall direct medication costs for asthma, asthma control improved, and overall per-patient asthma costs decreased by 11% due to a concomitant decrease in hospitalisations and physician visits.³⁰ These examples emphasise the need to consider medicine costs as part of a complex system, rather than in isolation from health outcomes. In other words, a simplistic approach to drive down prescribing of ICS/LABA in Australia would not necessarily be desirable or safe unless accompanied by a strategy that broadened overall ICS usage to match that in NZ.

Strengths of this study include the random identification of participants through large web-based panels with stratification to obtain nationally-representative asthma populations, minimising the potential for sampling and selection bias. Other strengths are the use of the same questionnaire in both countries, use of a validated asthma control measure, and the high completion rates.

Generalisability of the findings was enhanced by high levels of home internet access in NZ and Australia (80.2% (2012) and 82.7% (2012-13) respectively). Methodology was rigorous, with reporting consistent with CHERRIES guidelines for internet-based surveys³¹ (Supplementary Information, Table S1).

Limitations of the study include those applying to any cross-sectional self-report survey: inability to confirm the diagnosis of asthma, accurately determine ICS dosage and adherence, adjust for propensity in prescribing, or assess external factors such as allergen exposure that may contribute to poorly-controlled asthma. Incorrect inhaler technique cannot be assessed from surveys; it is

extremely common³² and likely explains poor symptom control in many participants with good self-reported adherence (Group C in Figure 1). Finally, while we can comment on associations, causality cannot be attributed from cross-sectional surveys.

In conclusion, despite comprehensive public health systems and subsidised access to ICS-containing medicines in NZ and Australia, this cross-sectional study showed similarly high prevalence of poor symptom control and exacerbations requiring urgent healthcare utilisation. The proportion of participants using ICS/LABA, which is substantially more costly for payers, was strikingly higher in Australia than in NZ, potentially due to historical differences in clinical guidelines and in the regulatory requirements for subsidised treatment. However, self-reported adherence, although higher with ICS/LABA than with ICS-alone, was higher in NZ than Australia, perhaps enhanced by lower patient co-payments in NZ. Together, the results suggest that efforts to improve asthma control need to consider the complexity of relationships between regulatory requirements, physician prescribing and out-of-pocket costs incurred by patients, together with patients' beliefs and behaviours that ultimately drive their usage of asthma medicines.

Disclosure statement

The surveys, statistical analysis and logistical support for investigator meetings were funded by AstraZeneca. The surveys were hosted by Ultrafeedback and InSync Surveys. The investigators were independently responsible for the final methods, questionnaire design, analysis plan and interpretation, and had full access to all study data, including statistical reports and tables.

HR has provided independent medical education at symposia funded by AstraZeneca, Boehringer Ingelheim, GlaxoSmithKline, Merck, Mundipharma, Novartis, Teva and in advisory boards and/or safety monitoring boards for AstraZeneca, GlaxoSmithKline, Merck and Novartis; and has received independent research funding from AstraZeneca and GlaxoSmithKline. LB has participated on advisory boards for AstraZeneca, Boehringer Ingelheim and GlaxoSmithKline. LB has provided independent medical education at symposia funded by AstraZeneca, Boehringer Ingelheim and GlaxoSmithKline. MP has received honoraria from AstraZeneca for presentations of CME material and support for attendance at a major international congress, and has received honoraria for service on Advisory Boards and for CME lectures from GlaxoSmithKline. AM, TI, RA and SS have no relevant interests to declare.

Table 1. Key similarities and differences between New Zealand and Australia relevant to asthma management in adults, at the time of the surveys and now

	New Zealand 2013	Australia 2012
Asthma prevalence	11.0%	10.2%
Primary care services for asthma	<p>Asthma mainly managed by GPs. GP consultation costs subsidised by government through co-payment scheme. Patient co-payment lower if patient is enrolled with the GP.</p> <p>Additional funding for patients with chronic conditions.</p> <p>Many practice nurses provide asthma education.</p>	<p>Asthma mainly managed by GPs. GP consultation costs subsidised by government, with no patient co-payment for 81.1% of GP consultations in 2011-12. No financial incentive for patients to attend the same GP.</p> <p>Additional funding for patients with chronic conditions.</p> <p>Some practice nurses provide asthma education.</p>
Specialist services for asthma	Most specialist care is hospital-based, with no patient co-payment	Most specialist care is community-based, often with significant out of pocket costs for patients. Some specialist care is available in hospital outpatient clinics, generally without patient co-payment.
Other asthma services	<p>Government-funded pharmacist medicine reviews and adherence support for some patients with chronic conditions</p> <p>Asthma consumer organisations provide asthma education to patients including by face-to-face visits</p>	<p>Government-funded pharmacist home medicines reviews. Some pharmacists offer asthma education programs. Pharmacist required to provide advice when dispensing pharmacist-only medications e.g. salbutamol.</p> <p>Asthma consumer organisations provide asthma education to patients including by telephone.</p>

	New Zealand 2013	Australia 2012
<p>Asthma guidelines ... at time of survey</p> <p>... currently</p>	<p>Best practice evidence-based guideline: the diagnosis and treatment of adult asthma, 2002²⁰</p> <p>Asthma and Respiratory Foundation NZ adult asthma guidelines: A quick reference guide, 2016⁶</p>	<p>Asthma Management Handbook, 2006¹⁹</p> <p>Australian Asthma Handbook v1.2, 2016⁷</p>
Medicines agencies	<p>MedSafe is responsible for medicines regulation</p> <p>PHARMAC (Pharmaceutical Management Agency) is responsible for medicines funding and restrictions.</p>	<p>Therapeutic Goods Administration (TGA) is responsible for medicines regulation</p> <p>Pharmaceutical Benefits Advisory Committee (PBAC) is responsible for subsidised funding and restrictions under the Pharmaceutical Benefits Scheme (PBS).</p>
Subsidised asthma medicines, and prescribing restrictions*	<p><i>SABA</i>: fully subsidised, without restriction</p> <p><i>ICS</i>: fully subsidised, without restriction</p> <p><i>Combination ICS/LABA</i>: in 2013, fully subsidised (including maintenance and reliever regimen for budesonide/formoterol) for patients taking moderate dose ICS, and if the prescriber considered additional clinical benefit would be obtained. Until Feb 2012,³³ the patient was also required to be stabilised on separate ICS and LABA inhalers for 3 months. Until recently (Jan 2014 for fluticasone/salmeterol, April 2016 for budesonide/formoterol), the prescriber was required to submit a written Special Authority application, certifying</p>	<p><i>SABA</i>: subsidised, without restriction</p> <p><i>ICS</i>: subsidised, almost entirely without restriction</p> <p><i>ICS/LABA</i>: in 2012, subsidised (including maintenance and reliever regimen for budesonide/formoterol) for patients with frequent episodes of asthma despite OCS or optimal doses of ICS. Until 2015, patients were required to be stabilised on separate inhalers before prescribing combination ICS/LABA. Written confirmation by prescriber not required.</p>

	New Zealand 2013	Australia 2012
	<p>that the patient satisfied the specified criteria and agreeing that they may be audited.²²</p> <p><i>LTRA</i>: not generally funded for adults; written Special Authority required</p> <p><i>Omalizumab</i>: not funded in 2013</p>	<p><i>LTRA</i>: not subsidised for adults (automatic check of eligibility at time of dispensing, from date of birth)</p> <p><i>Omalizumab</i>: from 2011, subsidised for patients with severe allergic asthma satisfying multiple eligibility requirements; complex written application form</p>
Out-of-pocket costs for patients	Dispensing fee of NZD3.00 for one month's supply of each prescription item, increased to NZD5.00 in January 2013	Co-payment of AUD5.80 (NZD7.42) for participants with a concession card (two-thirds of participants in the present survey) and AUD35.40 (NZD45.31) for general beneficiaries. Annual cost-of-living increase.
Over-the-counter (OTC) medication	No OTC asthma medication	SABA available OTC without prescription, as a pharmacist-only medication
Advertising	Direct-to-consumer advertising permitted for prescription and non-prescription medications	No direct-to-consumer advertising for prescription medications, but permitted for non-prescription medications

GP: general practitioner; ICS: inhaled corticosteroid; LABA: long-acting β_2 -agonist; LTRA: leukotriene receptor antagonist; OCS: oral corticosteroid;

OTC: over the counter (without prescription); SABA: short-acting β_2 -agonist

*For current requirements, see www.pharmac.gov.nz and www.pbs.gov.au

Table 2. Demographic characteristics and treatment for New Zealand (n=537) and Australian (n=2,686) participants

Characteristic		NZ n (% of 537)	Australia n (% of 2,686)	Chi-square <i>p</i> value
Age-group	16-19 years	47 (8.8)	207 (7.7)	0.2620
	20-29 years	115 (21.3)	493 (18.4)	
	30-39 years	88 (16.5)	523 (19.5)	
	40-49 years	86 (16.0)	377 (14.0)	
	50-59 years	79 (14.8)	441 (16.4)	
	60-69 years	62 (11.5)	344 (12.8)	
	≥70 years	60 (11.1)	302 (11.2)	
Gender	Female	324 (60.4)	1,534 (57.1)	0.1619
Highest level of education	Year 10 or below	136 (25.3)	447 (16.6)	<0.0001
	Year 11 or 12	124 (23.1)	518 (19.3)	
	Certificate or diploma	150 (28.0)	908 (33.8)	
	University degree	124 (23.1)	802 (29.9)	
Government concession card		287 (53.4)	1,473 (54.8)	0.5401
Overall health status	Excellent	68 (12.6)	218 (8.1)	0.0020
	Very good	184 (34.2)	872 (32.5)	
	Good	174 (32.4)	1,050 (39.1)	
	Fair	86 (16.1)	402 (15.0)	
	Poor	25 (4.6)	145 (5.4)	
Medications used in the last 12 months*	SABA	493 (91.8)	2,475 (92.2)	0.7713
	Any ICS**	369 (68.8)	1,634 (60.9)	0.0006
	ICS-alone	265 (49.4)	459 (17.1)	<0.0001
	ICS/LABA	164 (30.5)	1,332 (49.6)	<0.0001
	LABA-alone with no ICS in last year#	8 (1.4)	17 (0.6)	0.0601

The sample sizes represented a similar proportion of the populations of the two countries at the time the surveys were completed (NZ 2013: 4.47 million; Australia 2012: 22.72 million).

ICS: inhaled corticosteroid; LABA: long-acting β_2 -agonist; SABA: short-acting β_2 -agonist

* Participants were asked which treatments they had used in the past 12 months, with the images and brand names of relevant medications shown on screen. **These totals are lower than the sum of ICS-alone and ICS/LABA, as some participants reported using both within the previous 12 months. # Use of LABA without concurrent ICS (in combination or as separate inhaler) is strongly discouraged by asthma treatment guidelines

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Table 3. Self-reported frequency of use of ICS-alone and ICS/LABA preventers in New Zealand and Australia

Frequency of use	ICS-alone inhalers		ICS/LABA inhalers	
	NZ	Australia	NZ	Australia
Every day	121 (46.5%)	160 (42.7%)	106 (65.5%)	711 (55.8%)
5 or 6 days a week	7 (2.7%)	12 (3.2%)	6 (4.0%)	52 (4.1%)
3 or 4 days a week	20 (7.6%)	25 (6.6%)	2 (1.3%)	66 (5.2%)
1 or 2 days a week	31 (11.8%)	26 (7.0%)	11 (6.9%)	85 (6.7%)
< 1 day a week	12 (4.4%)	34 (9.0%)	3 (2.1%)	77 (6.0%)
< 1 day a month	13 (5.0%)	21 (5.5%)	7 (4.2%)	76 (5.9%)
Only when I exercise	10 (3.9%)	5 (1.4%)	2 (1.5%)	12 (1.0%)
A few times a year	47 (18.0%)	93 (24.7%)	23 (14.5%)	194 (15.3%)
Total of those using any ICS	261 (100.0%)	375 (100.0%)	162 (100.0%)	1274 (100.0%)
Total of whole sample	261/531 [#] (49.2%)	375/2654 [#] (14.3%)	162/531 [#] (30.5%)	1274/2654 [#] (48.7%)
Of those using any ICS:				
Regular use (≥ 5 days/week) by ICS type and country	128/261 (49.0%)	172/375 (45.9%)	112/162 (69.1%)	763/1274 (59.9%)

Regular use (≥ 5 days/week) by ICS type	300/636 (47.2%)	875/1436 (60.9%)
Regular use (≥ 5 days/week) by country	New Zealand: 240/423 (56.7%) Australia: 935/1649 (56.7%)	
Of whole asthma population*:		
Regular use (≥ 5 days/week) of any ICS, by country	New Zealand: 232/537 (43.2%) Australia: 911/2686 (33.9%)	

For these analyses, participants who reported using both an ICS and an ICS/LABA within the last year (NZ: 52; Australia: 157) were classified according to the medication that they used most frequently; for example, if a participant reported using an ICS/LABA '3-4 days/week' and an ICS-only 'a few times a year', they were included within the ICS/LABA group. Any disparities between the sum of numbers of participants in subgroups and totals are the result of rounding weighted data to whole numbers.

#Participants who reported using both an ICS-containing and non-ICS containing preventer such as cromoglycate (NZ: 5; Australia: 32) were excluded from this table, as the questionnaire design did not permit the frequency of use of the ICS-containing preventer to be distinguished.

*For the whole asthma population, including those not using any ICS, logistic regression for self-reported good adherence with any ICS (≥ 5 days/week) vs no ICS or ICS < 5 days/week showed that both the ICS type (ICS/LABA vs ICS-alone) and country (NZ vs Australia) were significant. Regular use was more likely for those using ICS/LABA than ICS-alone (model estimate 0.4958, odds ratio (OR) 1.642 [95% confidence interval 1.323-2.038], $p < 0.0001$), and was more likely for New Zealanders vs Australians (model estimate 0.5009, OR 1.650 [1.289 – 2.112], $p < 0.0001$).

Table 4. Asthma control: symptom control and health care utilisation for asthma in the previous 12 months, New Zealand (n=537) vs Australia (n=2,686)

Variable	NZ n (% of 537)	Australia n (% of 2,686)	Chi-square <i>p</i> value
Asthma symptom control			
Mean ACT score (SD)	19.44 (4.6)	19.12 (4.6)	0.4132
Asthma symptom control category [*]			
Very poorly controlled	117 (21.8)	615 (22.9)	0.1664
Not well controlled	105 (19.6)	609 (22.7)	
Well controlled	315 (58.6)	1,461 (54.4)	
Urgent health care for asthma			
Urgent GP visit for asthma	121 (22.6)	627 (23.3)	0.3984
Hospital or ED visit for asthma	60 (11.1)	269 (10.0)	0.4127
Spent e 1 night in hospital for asthma	24 (4.5)	98 (3.7)	0.3838
Any of the above	150 (27.9)	769 (28.6)	0.7494
Non-urgent visit to GP for review of asthma	304 (56.6)	1,355 (50.4)	0.0094
Visit to nurse for asthma	83 (15.5)	(not asked)	-

ACT: Asthma Control Test; ED: emergency department; GP: general practitioner

[#] Asthma symptom control categories by ACT score¹²: Very poorly-controlled: 5-15; Not Well Controlled: 16-19; Well Controlled: 20-25

FIGURE LEGENDS

Figure 1. Asthma symptom control and self-reported medication use in last 12 months, New Zealand vs Australia

The figure shows, in the centre, the proportion of participants using any ICS-containing medicine in the previous 12 months, and the proportion of these who were receiving it as ICS/LABA. In the outer ring, participants are classified by their level of symptom control, i.e. good symptom control (ACT score 20-25, well-controlled asthma) or poor symptom control (ACT 5-19), and by their self-reported use of ICS-containing medications in the previous 12 months (regular : e 5 days/week vs little/no ICS', <5 days/week).

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