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# Global differences and risk factors influencing drug hypersensitivity quality of life: A multicenter, multiethnic study of drug allergy across 3 continents



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**Background:** Penicillin allergy labels are associated with many adverse outcomes. Fear and restriction of future medication use also have an impact on health-related quality of life (HR-QoL). However, the impact of a drug allergy on HR-QoL and its associated factors remains unknown.

**Objective:** We sought to investigate the impact of penicillin allergy labels and compare the factors associated with HR-QoL impairment among patients in an international multicenter, multiethnic cohort.

**Methods:** HR-QoL was measured using the 6-item Drug Hypersensitivity Quality of Life Questionnaire (DrHy-Q) and compared among patients labeled with penicillin allergy, before their allergy evaluation, from 8 adult allergy/immunology clinics across Asia, Australia, and North America.

**Results:** We recruited 643 patients labeled with penicillin allergy (median age, 56 years [interquartile range, 39-67]; male:female ratio, 1:2.2), with 273 (42.5%), 186 (28.9%), and 184 (28.6%) from Asia, North America, and Australia, respectively. The median DrHy-Q score was 8.3 (interquartile range, 0.0-29.2). All patients underwent penicillin allergy evaluation, and 96% (617 of 643) were delabeled following negative provocation test results. Female patients (8.3 vs 4.2;  $P = .003$ ), those with other concomitant antimicrobial allergy labels (20.8 vs 4.2;  $P = .004$ ), and patients from Asia (33.3 vs 4.2 [North America] vs 0 [Australia];  $P < .001$ ) had significantly higher DrHy-Q scores, reflecting a reduced HR-QoL. Ethnicity

as well as other allergy variables were not significant in the multivariate analysis.

**Conclusions:** Regional differences, ethnicity, and other risk factors influence HR-QoL impairment among patients labeled with penicillin allergy. Future studies are needed to understand the contributions of regional sociodemographic factors and identify interventions to improve HR-QoL. (J Allergy Clin Immunol Global 2025;4:100354.)

**Key words:** Drug allergy, penicillin, quality of life, health-related quality of life (HR-QoL), delabeling

Penicillin “allergy” labels are highly prevalent and associated with inferior patient and health service outcomes.<sup>1-3</sup> Despite the high prevalence of penicillin allergy labels, most of the labels are proven to be incorrect after negative drug provocation test results.<sup>4-7</sup> Reported and (mis)labeled penicillin allergies result in a myriad of adverse health outcomes for patients and can significantly affect a patient’s health-related quality of life (HR-QoL).<sup>8,9</sup> Even beyond situations with an imminent need for medications, drug allergy labels can independently contribute to impaired HR-QoL.<sup>10</sup> Despite emerging recognition of its importance, tools for measuring drug allergy HR-QoL have been underused and have scarcely been described in the literature.<sup>8</sup>

The Drug Hypersensitivity Quality of Life Questionnaire (DrHy-Q), initially published in 2011,<sup>11</sup> has been validated in various country-specific settings such as Spain,<sup>12</sup> Portugal,<sup>13</sup> the Netherlands,<sup>14</sup> Turkey,<sup>15</sup> Thailand,<sup>16</sup> and China.<sup>10</sup> More recently, the original DrHy-Q was optimized into a more concise and precise 6-item optimized version,<sup>17</sup> enhanced for easier everyday clinical use. This streamlined version, which can be completed within 3 minutes, has been validated and easily converted into a total score ranging from 0 to 100 (best to worst possible HR-QoL) for serial and interindividual comparison.<sup>17</sup>

Individual HR-QoL varies significantly and can be influenced by various disease, environmental, and sociodemographic factors.<sup>18</sup> For example, a previous study among Chinese patients labeled with penicillin allergy identified significantly impaired HR-QoL among female patients and those with other concomitant drug allergy labels.<sup>10</sup> Especially, as HR-QoL among drug allergy patients will likely be influenced by medication use and prescription practices, we also postulate significant differences in HR-QoL across different cultures and health care infrastructures.<sup>19,20</sup> However, we are unaware of any previous studies comparing or investigating differences in drug allergy HR-QoL between different regions or ethnicities.

This international, multicenter, multiethnic study aimed to compare and identify factors associated with HR-QoL impairment

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**Abbreviations used**

DrHy-Q: Drug Hypersensitivity Quality of Life Questionnaire  
 HR-QoL: Health-related quality of life  
 QoL: Quality of life

among diverse patients labeled with penicillin drug allergy undergoing allergy evaluation.

**METHODS****Participants**

Adult patients ( $\geq 18$  years) with a history of suspected or confirmed penicillin allergy were prospectively recruited from 8 allergy/immunology clinics across Asia (Queen Mary Hospital and Grantham Hospital, Hong Kong), Australia (Austin Health, Peter MacCallum Cancer Centre, and Royal Melbourne Hospital, Melbourne), and North America (Duke University Medical Center, Durham, NC, Vanderbilt University Medical Center, Nashville, Tenn, and McGill University Health Centre, Montreal, Quebec, Canada) between June 2021 and January 2024. All patients had their suspected penicillin allergies evaluated by their consulting allergists/infectious disease physician and were offered allergy testing (*in vivo* skin tests or provocation tests).

The patients' sociodemographic and clinical characteristics, including pertinent drug allergy history and PEN-FAST scores,<sup>21</sup> were recorded. The patients completed the DrHy-Q before any allergy investigations.

**Statistical analysis**

Statistical analysis was done using SPSS Statistics version 28.0 (IBM, Armonk, NY) and R version 4.3.1 (R Foundation, Vienna, Austria). A univariable association analysis was performed by comparing the normalized DrHy-Q scores (scale of 0-100) of patients with different clinical characteristics using the Mann-Whitney *U* test or the Kruskal-Wallis test, as appropriate. All variables with a univariable *P* value less than .1 were included in a general linear model for multivariable analysis. A 2-sided *P* value of less than .05 indicated statistical significance. A subgroup analysis was conducted by repeating the analyses by continent (North America, Australia, or Asia).

For the patients recruited in North America and Australia, the protocol was approved by an institutional review board at Austin Health Hospital and subsequently by the independent institutional review board at each site.<sup>7</sup> For the Asian cohort, the research project was approved by the institutional review board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster. All participating patients gave written informed consent.

**TABLE I.** Patient demographic and clinical characteristics by geographical region

Characteristics	All (N = 643)	Asia (n = 273)	North America (n = 186)	Australia (n = 184)
Age (y), median (IQR)	56 (39-67)	61 (48-70)	52 (36-66)	50 (34-64)
Sex: female, n (%)	440 (68)	198 (73)	127 (68)	115 (63)
Ethnicity, n (%)				
White	345 (54)	2 (1)	168 (90)	175 (95)
East Asian	276 (43)	269 (99)	4 (2)	3 (2)
Black	6 (1)	0	6 (3)	0
Indo-Asian	5 (1)	1 (1)	1 (1)	3 (2)
Hispanic or Latino	5 (1)	1 (1)	4 (2)	0
Other	6 (1)	0	3 (2)	3 (2)
Labeled (culprit) penicillin, n (%)				
Unspecified penicillin	406 (63)	109 (40)	164 (88)	133 (72)
Penicillin VK and G	24 (4)	11 (4)	6 (3)	7 (4)
Aminopenicillins*	190 (30)	131 (48)	16 (9)	43 (23)
Piperacillin/tazobactam	7 (1)	7 (3)	0	0
Antistaphylococcal penicillin†	16 (2)	15 (5)	0	1 (1)
Duration of penicillin allergy label, n (%)				
$\leq 5$ y	91 (14)	85 (31)	4 (2)	2 (1)
$> 5$ y	552 (86)	188 (69)	182 (98)	182 (99)
Characteristic of penicillin allergy, n (%)				
Immediate reactions	138 (22)	95 (35)	21 (12)	22 (13)
Concomitant antimicrobial allergy labels, n (%)	184 (29)	107 (39)	49 (26)	28 (15)
PEN-FAST score, n (%)				
0	206 (32)	57 (21)	68 (37)	81 (44)
1	233 (36)	28 (10)	110 (59)	95 (52)
2	204 (32)	188 (69)	8 (4)	8 (4)
Positive allergy test results,‡ n (%)				
Skin test	26 (4)	20 (7)	5 (3)	1 (1)
Oral challenge	11 (2)	7 (3)	4 (2)	0
Oral challenge	15 (2)	13 (5)	1 (1)	1 (1)
DrHy-Q score, median (IQR)	8.3 (0.0-29.2)	33.3 (16.7-58.3)	4.2 (0-8.3)	0 (0-4.2)

IQR, Interquartile range; PALACE, Penicillin Allergy CLinicAL deCision rule.

\*Aminopenicillins include amoxicillin, ampicillin, amoxicillin/clavulanate, ampicillin/sulbactam, and unspecified aminopenicillins.

†Antistaphylococcal penicillins include cloxacillin, cloxacillin/ampicillin, and flucloxacillin.

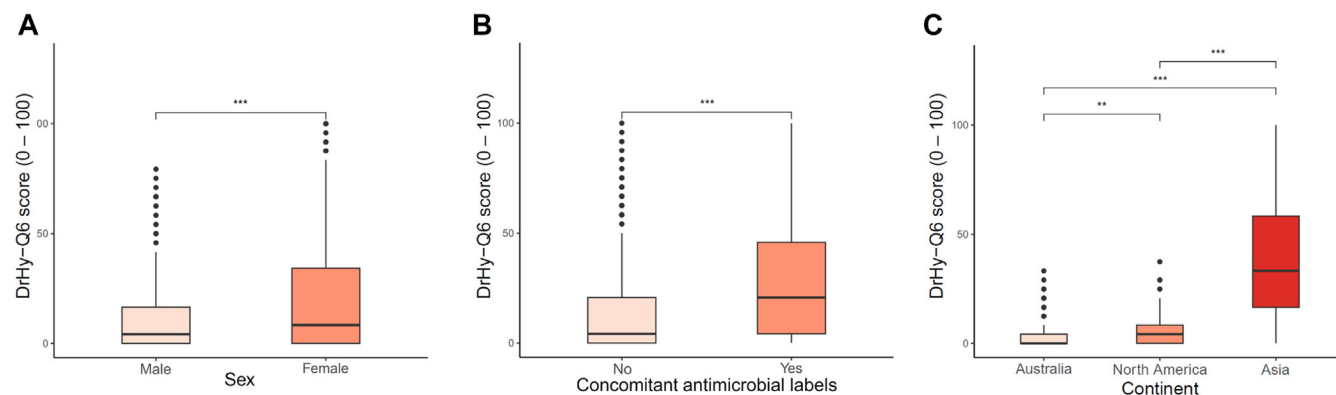
‡As per the PALACE study protocol, 50% of the PALACE cohort did not undergo skin testing.

**TABLE II.** Multivariable association analysis of DrHy-Q by demographic and clinical characteristics

Characteristics	n (%)	DrHy-Q score, median (IQR)	P value	
			Univariable	Multivariable
Total	643 (100)	8.3 (0.0-29.2)		
Age			.139	—
≥65 y	190 (30)	8.3 (0.0-41.7)		
<65 y	453 (70)	8.3 (0.0-25.0)		
Sex			<.001*	<b>.003*</b>
Female	440 (68)	8.3 (0.0-36.5)		
Male	203 (32)	4.2 (0.0-16.7)		
Ethnicity			<.001*	.511
White	345 (54)	0.0 (0.0-8.3)		
Non-White	298 (46)	29.2 (8.3-58.3)		
Geographical region			<.001*	<b>&lt;.001*</b>
North America	186 (29)	4.2 (0.0-8.3)		
Australia	184 (29)	0.0 (0.0-4.2)		
Asia	273 (43)	33.3 (16.7-58.3)		
Duration of allergy label			<.001*	.599
≤5 y	91 (14)	29.2 (8.3-58.3)		
>5 y	552 (86)	4.2 (0.0-25.0)		
Immediate reactions			<.001*	.314
Yes	138 (22)	22.9 (4.2-55.2)		
No	505 (78)	4.2 (0.0-22.9)		
Other antimicrobial allergy labels			<.001*	<b>.004*</b>
Yes	184 (29)	20.8 (4.2-45.8)		
No	459 (71)	4.2 (0.0-20.8)		
PEN-FAST score			<.001*	.676
0	206 (32)	4.2 (0.0-16.7)		
1	233 (36)	4.2 (0.0-8.3)		
2	204 (32)	33.3 (16.7-58.3)		
Provocation result			.044*	.906
Positive	15 (2)	33.3 (0.0-62.5)		
Negative	628 (98)	8.3 (0.0-29.2)		

IQR, Interquartile range. Bolded numbers represent the significant variables in the multivariable analysis.

\*P < .05.



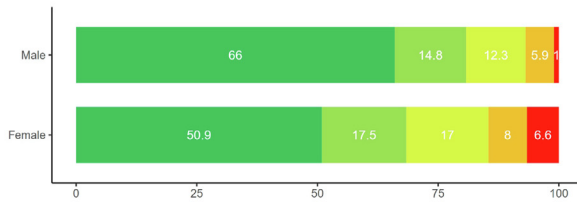
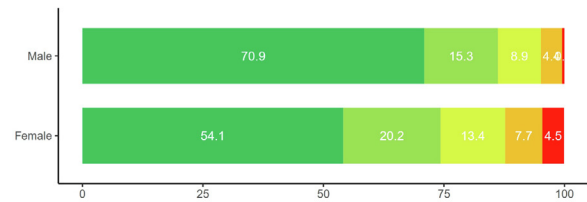
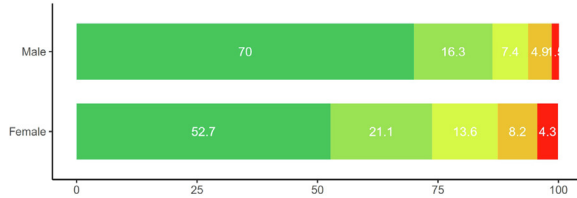
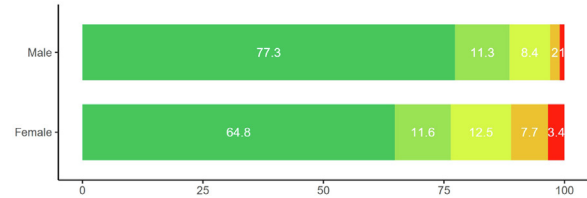
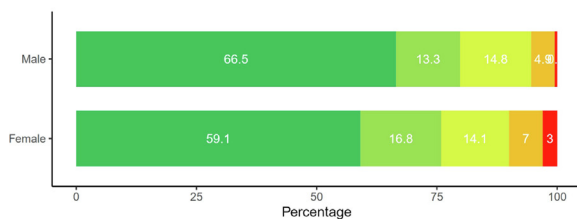
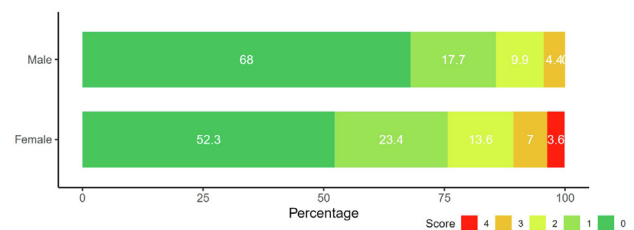
**FIG 1. A-C.** 6-Item DrHy-Q scores stratified by sex (Fig 1, A), concomitant antimicrobial labels (Fig 1, B), and geographical region (Fig 1, C). \*P < .05; \*\*P < .01; \*\*\*P < .001.

**RESULTS**

We recruited 643 patients labeled with penicillin allergy, with 273 (42.5%), 186 (28.9%), and 184 (28.6%) patients from Asia, North America, and Australia, respectively. Their demographic and clinical characteristics are provided in Table I. The median age was 56 years (interquartile range, 39-67) and the male-to-female ratio was 1:2.2. Most of the patients were White (345 of 643 [54%]) and East Asian (273 of 643 [43%]), with the

remaining patients being Black (6 of 643 [1%]), Indo-Asian (5 of 643 [1%]), and Hispanic/Latino (5 of 643 [1%]).

Most patients (405 of 643 [63%]) could not recall the exact name of the penicillin they had reacted to, and 29% (190 of 643) reported aminopenicillin-associated reactions. Regarding the duration of the penicillin allergy label, this was reported as a childhood reaction in 40% (255 of 643) and occurred more than 5 years ago for most (552 of 643 [86%]). Concomitant drug

**Q1 Do you feel frightened because of your drug allergy problem?****Q4 Do you feel anxious due to your drug allergy problem?****Q2 Does your drug allergy problem affect your life?****Q5 Are you in a bad mood due to your drug allergy problem?****Q3 Do you feel different from others?****Q6 Does the idea of taking a medicine make you feel anxious?**

**FIG 2.** Responses to individual DrHy-Q questions stratified by sex. The scores 0 to 4 correspond to “not at all” for score 0, “slightly” for score 1, “moderately” for score 2, “very” for score 3, and “extremely” for score 4.

allergies (nonpenicillin) were reported in 29% (184 of 643) of patients (Table I). Compared with the North American and Australian cohorts, the Asian cohort had patients with a shorter duration of penicillin allergy labels, more history of immediate reactions, and higher PEN-FAST scores. Skin tests were performed in 100% (273 of 273), 50% (93 of 186), and 49.5% (91 of 184) of patients before consideration of provocation tests in the Asian, North American, and Australian cohorts, respectively. The patients in North America and Australia were recruited for a randomized clinical trial, and this explains that half of the cohort had skin testing performed before their oral challenge. All patients underwent penicillin allergy evaluation, and 96% (617 of 643) were delabeled by negative provocation test results.

The median DrHy-Q score, on a scale of 0 to 100 (best to worst possible HR-QoL), before penicillin allergy evaluation was 8.3 (interquartile range, 0.0-29.2). Multivariable association analysis was performed to identify independent factors influencing drug allergy HR-QoL as reflected by DrHy-Q scores (Table II; Fig 1). Female patients (8.3 vs 4.2;  $P = .003$ ) had other concomitant antimicrobial allergy labels (20.8 vs 4.2;  $P = .004$ ), and patients from Asia (33.3 vs 4.2 [North America] vs 0 [Australia];  $P < .001$ ) had significantly higher DrHy-Q scores, reflecting reduced HR-QoL (Fig 1). Ethnicity, PEN-FAST scores, or other studied clinical-demographic variables were not significant in the multivariable analysis. Responses to individual DrHy-Q questions stratified by sex, presence of concomitant antimicrobial labels, and geographical region are shown in Figs 2, 3, and 4, respectively.

Subgroup analysis and multivariable analysis of DrHy-Q scores by geographical region are provided in Table III. The female sex remained significant in the Asian cohort (41.7 vs 25.0;

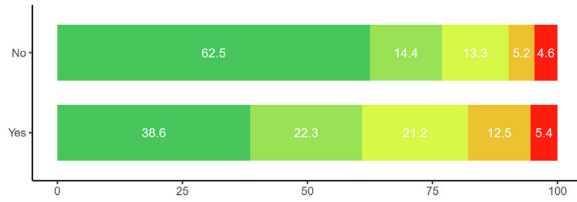
$P = .004$ ), and concomitant antimicrobial allergy labels remained significant in the Australian cohort ( $P = .045$ ). No independent variables were associated with DrHy-Q scores in the North American cohort. Specifically looking at potential differences in DrHy-Q with PEN-FAST scores, no significant differences were seen in subgroup analysis of individual regions (Fig 5).

## DISCUSSION

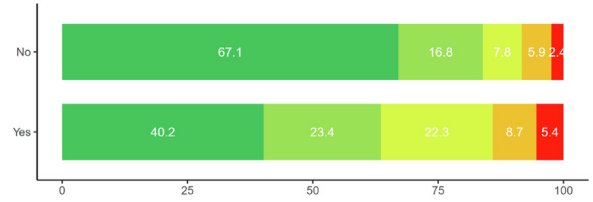
In this first-of-its-kind international drug allergy HR-QoL study, we identify factors and global differences among a large, geographically and ethnically diverse cohort of patients labeled with penicillin allergy. Because drug hypersensitivity reactions can be unpredictable in terms of their disease severity and short- and long-term morbidity, patients carrying the burden of a drug allergy label can easily feel helpless and overwhelmed, leading to a decreased quality of life (QoL).<sup>8</sup> For example, drug-anaphylaxis survivors seem to have an impaired QoL that can be linked with possible mental health distress and anxiety.<sup>8</sup> As we mentioned, the impact of this drug allergy label is underappreciated in the medical literature and difficult to measure in the clinical setting with few optimized tools.

Although previous reports have suggested various factors associated with higher DrHy-Q scores, these may have been limited by relatively small cohorts from single-center experiences.<sup>13,14,16</sup> In this study, we identified the female sex, the presence of concomitant antimicrobial allergy labels, and geographical regions as variables independently associated with higher DrHy-Q scores, translating into a decreased HR-QoL. Other factors that have been previously reported to be associated with DrHy-Q scores, such as immediate reactions, duration of the

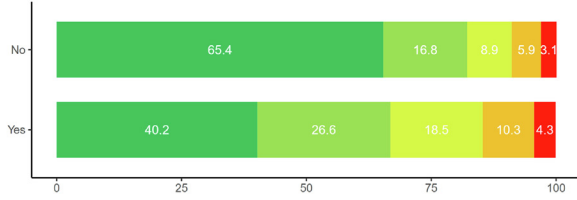
**Q1 Do you feel frightened because of your drug allergy problem?**



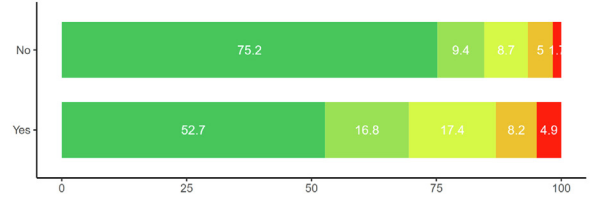
**Q4 Do you feel anxious due to your drug allergy problem?**



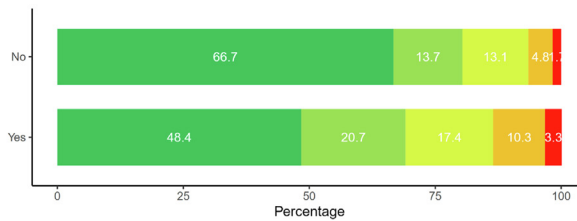
**Q2 Does your drug allergy problem affect your life?**



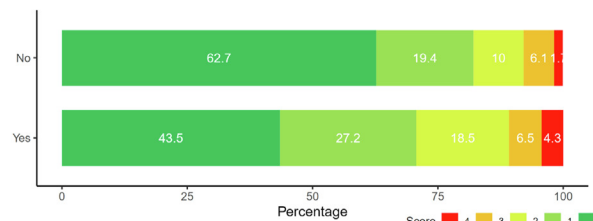
**Q5 Are you in a bad mood due to your drug allergy problem?**



**Q3 Do you feel different from others?**

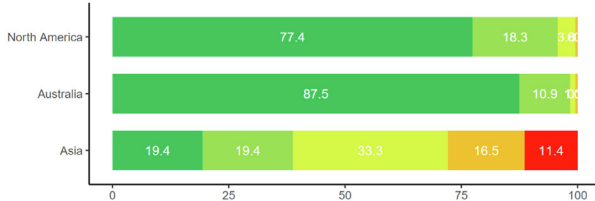


**Q6 Does the idea of taking a medicine make you feel anxious?**

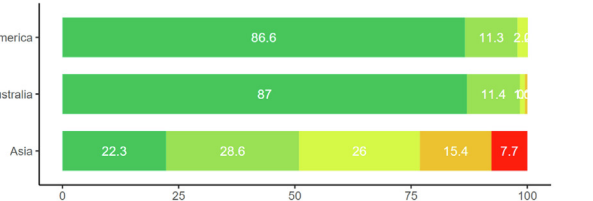


**FIG 3.** Responses to individual DrHy-Q questions stratified by presence of concomitant antimicrobial labels. The scores 0 to 4 correspond to “not at all” for score 0, “slightly” for score 1, “moderately” for score 2, “very” for score 3, and “extremely” for score 4.

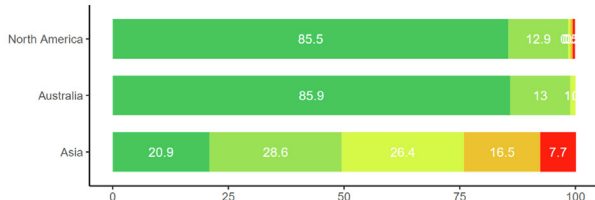
**Q1 Do you feel frightened because of your drug allergy problem?**



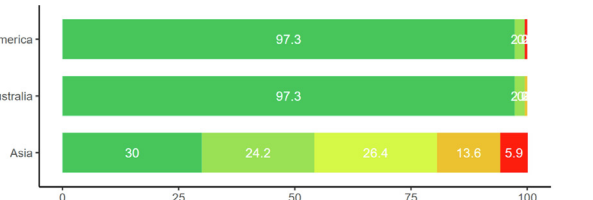
**Q4 Do you feel anxious due to your drug allergy problem?**



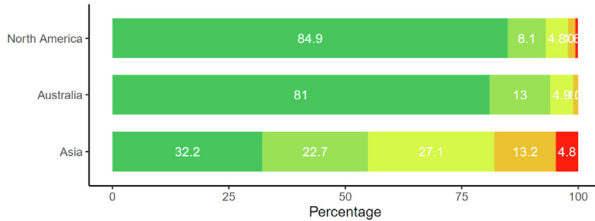
**Q2 Does your drug allergy problem affect your life?**



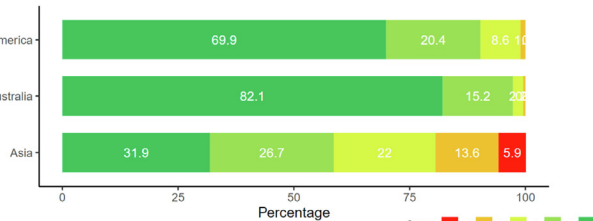
**Q5 Are you in a bad mood due to your drug allergy problem?**



**Q3 Do you feel different from others?**



**Q6 Does the idea of taking a medicine make you feel anxious?**



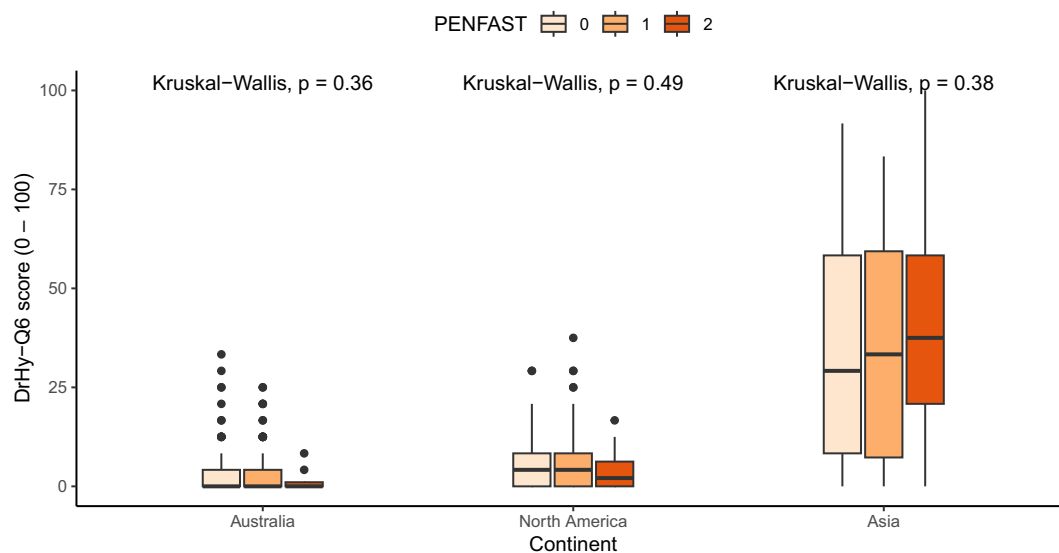
**FIG 4.** Responses to individual DrHy-Q questions stratified by geographical region. The scores 0 to 4 correspond to “not at all” for score 0, “slightly” for score 1, “moderately” for score 2, “very” for score 3, and “extremely” for score 4.

**TABLE III.** Multivariable association analysis of DrHy-Q scores stratified by geographical region

Characteristics	North America			Australia			Asia		
	DrHy-Q score, median (IQR)	P value		DrHy-Q score, median (IQR)	P value		DrHy-Q score, median (IQR)	P value	
		Univariable	Multivariable		Univariable	Multivariable		Univariable	Multivariable
Total	4.2 (0.0-8.3)			0.0 (0.0-4.2)			33.3 (16.7-58.3)		
Age		.635	—		.497	—		.695	—
≥65 y	4.2 (0.0-8.3)			0.0 (0.0-4.2)			33.3 (12.5-58.3)		
<65 y	4.2 (0.0-8.3)			0.0 (0.0-5.2)			33.3 (16.7-59.4)		
Sex		.196	—		.476	—		<.001*	<b>.004*</b>
Female	4.2 (0.0-8.3)			0.0 (0.0-4.2)			41.7 (20.8-62.5)		
Male	0.0 (0.0-8.3)			0.0 (0.0-8.3)			25.0 (4.2-50.0)		
Ethnicity		.119	—		.491	—		.190	—
White	4.2 (0.0-8.3)			0.0 (0.0-4.2)			14.6 (0.0-14.6)		
Non-White	0.0 (0.0-8.3)			0.0 (0.0-4.2)			33.3 (16.7-58.3)		
Timing of the index reaction		.728	—		.799	—		.203	—
≤5 y	4.2 (1.0-10.4)			0.0 (0.0-4.2)			33.3 (8.3-58.3)		
>5 y	4.2 (0.0-8.3)			0.0 (0.0-4.2)			37.5 (20.8-58.3)		
Immediate reactions		.653	—		.353	—		.096	.082
Yes	0.0 (0.0-8.3)			2.1 (0.0-8.3)			41.7 (20.8-62.5)		
No	4.2 (0.0-8.3)			0.0 (0.0-4.2)			33.3 (16.7-58.3)		
Other antimicrobial allergy labels		.195	—		<b>.045*</b>	<b>.045*</b>		<b>.043*</b>	.079
Yes	4.2 (0.0-8.3)			4.2 (0.0-12.5)			41.7 (25.0-58.3)		
No	4.2 (0.0-8.3)			0.0 (0.0-4.2)			29.2 (8.3-58.3)		
PEN-FAST score		.489	—		.359	—		.381	—
0	4.2 (0.0-8.3)			0.0 (0.0-4.2)			29.2 (8.3-58.3)		
1	4.2 (0.0-8.3)			0.0 (0.0-4.2)			33.3 (5.2-61.5)		
2	2.1 (0.0-10.4)			0.0 (0.0-3.1)			37.5 (20.8-58.3)		
Provocation result		.452	—		.609	—		.334	—
Positive	0.0 (0.0-0.0)			0.0 (0.0-0.0)			56.3 (10.4-62.5)		
Negative	4.2 (0.0-8.3)			0.0 (0.0-4.2)			33.3 (16.7-58.3)		

Bolded numbers represent the significant variables in the multivariable analysis.

\* $P < .05$ .



**FIG 5.** 6-Item DrHy-Q scores stratified by PEN-FAST scores and geographical region. The color code corresponds to PEN-FAST 0, 1, and 2 (from light orange to dark orange). No significant differences were seen in subgroup analysis of individual regions.

allergy label and penicillin allergy label, and PEN-FAST scores, were significant only in univariable analysis (and did not remain significant in multivariable analysis). This may indicate a possible

confounding effect unmasked by more diverse and comprehensive cohorts such as the one presented in this study. Furthermore, we also saw disparities in these individual factors during

subgroup analysis (eg, the female sex remained significant only in the Asian cohort), which may indicate further complexity with region- or culture-specific interactions. Alternatively, because there were also baseline clinical-demographic differences between patients of these 3 regions (more patients and a larger proportion of female patients in the Asian cohort), it may just be a limitation of sample sizes during subgroup analysis. Certain variables were also unavailable for all cohorts and could not be studied. For example, it has been reported that patients presenting anaphylaxis and urticaria/angioedema are more likely to have higher DrHy-Q scores compared with those presenting other reactions.<sup>11-13,22</sup> Similarly, in a meta-analysis of 45 observational studies, drug-induced anaphylaxis significantly affected HR-QoL and mental health.<sup>8</sup> In this present study, PEN-FAST scores were used as a marker of disease severity, and this tool was not associated with DrHy-Q, even in dedicated subgroup analysis. However, this is an expected finding because most included patients were considered low-risk with a PEN-FAST score of 2 or less. This highlights the need for more multinational and dedicated studies on drug allergy HR-QoL in the future.

As previously reported in the literature, there was also a significant association between multiple drug allergy labels and higher DrHy-Q scores. In the initial Chinese validation cohort, patients reporting multiple drug allergy labels had an impaired QoL compared with patients with a single drug allergy label.<sup>10</sup> The importance of multiple drug allergy labels has also been described in the country-specific validation studies from Thailand<sup>16</sup> and the Netherlands.<sup>14</sup> Because patients with labeled penicillin allergy already have severe restrictions in future antimicrobial use, we postulate that the presence of additional concomitant (especially antimicrobial) allergy labels would further worsen HR-QoL. With the knowledge of these risk factors, future penicillin delabeling initiatives could consider prioritizing such patients who are at a higher risk of impaired HR-QoL.

Although drug allergy HR-QoL within individual regional or country-specific cohorts has been reported, no studies have compared different geographical regions. Interestingly, the multivariable analysis revealed that only the geographical region, rather than ethnicity background, independently contributed to differences in DrHy-Q scores. Further studies are needed to confirm the external validity of our findings, but in the meantime, we postulate that this may be due to the possible effect of prescribing practices in particular regions. It has been reported in the literature that Asian practitioners prescribe a large number of antibiotics, and this could increase the patient's perceived importance of drug restrictions for those with penicillin drug allergy labels.<sup>23-25</sup> In this context, poor antimicrobial stewardship could not only lead to multidrug-resistant organisms but also affect HR-QoL. Furthermore, differences in socioeconomic background (eg, language barrier, health literacy, and absence of access to health information and services)<sup>26</sup> and not cultural or ethnic differences can help explain the reported differences in DrHy-Q scores and the impact on HR-QoL.<sup>27</sup> This underlines the need for dedicated and practical interventional studies to help decrease these important population barriers. Finally, another factor explaining these differences could be related to available policies, awareness, and barriers to drug allergy testing. For instance, long waiting lists and wait times for allergy tests and reduced access to specialist allergy support can all have an impact on patients' perceived HR-QoL.<sup>28-30</sup> There is a global need to improve overall drug allergy awareness and patient advocacy.

Several limitations can be underlined for this study. The included population is predominantly Chinese and White, and subgroup analysis to explain population differences could not be performed. However, within each cohort, the populations were quite homogeneous. Similarly, although 3 continents were included, patients were recruited from 4 countries, which led to a decreased external validity that could influence the presented results. The collected demographic data did not include socio-demographic data such as education or health literacy, which could have further explained the differences in the DrHy-Q scores. Patients with a high pretest probability and a genuine penicillin allergy are not presented in this cohort, and most of the included patients had a PEN-FAST score of 2 or less. The absence of severity criteria could have directly influenced the DrHy-Q scores.

Furthermore, this cohort focused on penicillin allergy labels; however, up to 29% had concomitant nonpenicillin drug allergy labels, and we cannot generalize the finding to a larger cohort affected by isolated penicillin drug allergy or other types of drug hypersensitivity reactions. Also, there is a clinical heterogeneity among the included cohorts. The patients from the Asian cohort had higher PEN-FAST scores, whereas those from the North American/Australian cohorts were mostly represented by low-risk drug allergies. This also illustrates the different penicillin delabeling initiatives in different regions and can influence the perception of HR-QoL. Finally, the DrHy-Q score was administered before the allergy testing, limiting our understanding of removing an allergy label on the HR-QoL. Further studies are needed to better understand the use and validity of the DrHy-Q score.

The regional difference among the included patients is interesting to explore further. The patients from the Asian cohort seemed to have the greatest QoL impairment regarding their drug allergy labels. Also, the North American cohort had higher QoL scores compared with the Australian cohort. This is beyond the scope of the present research, but psychosocial and socio-economical aspects, such as the impact of education, social status, and revenue and the access to health care services, could be further explored. Further studies are required to understand these factors and their impact on persistent drug allergy labels.

## DISCLOSURE STATEMENT

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