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Abstract

Objective: To investigate actual and perceived disease control in Australians with asthma, and identify factors associated with overestimation of asthma control.

Methods: This was a cross-sectional study of Australian adults with asthma, who were recruited via Facebook to complete an online survey. The survey included basic demographic questions, and validated tools assessing asthma knowledge, medication adherence, medicine beliefs, illness perception and asthma control. Items that measured symptoms and frequency of reliever medication use were compared to respondents' self-rating of their own asthma control. Predictors of overestimation of asthma control were determined using multivariate logistic regression.

Results: Of 2971 survey responses, 1950 (65.6%) were complete and eligible for inclusion. Overestimation of control was apparent in 45.9% of respondents. Factors independently associated with overestimation of asthma control included education level (OR = 0.755, 95% CI: 0.612-0.931, $P = 0.009$), asthma knowledge (OR = 0.942, 95% CI: 0.892-0.994, $P = 0.029$), total asthma control, (OR = 0.842, 95% CI: 0.818-0.867, $P < 0.001$), agreement that most medications

are addictive (OR = 1.144, 95% CI: 1.017-1.287, P = 0.025), and increased feelings of control over asthma (OR = 1.261, 95% CI: 1.191-1.335), P < 0.001).

Conclusions: Overestimation of asthma control remains a significant issue in Australians with asthma. The study highlights the importance of encouraging patients to express their feelings about asthma control and beliefs about medicines, and to be more forthcoming with their asthma symptoms. This would help to reveal any discrepancies between perceived and actual asthma control.

Introduction

Asthma imposes a significant burden on individuals, families and communities around the globe. It is estimated that asthma affects over 300 million people worldwide [1]. While there is currently no cure for asthma, it is accepted that effective management can reduce the burden of asthma [2].

A well-documented barrier to the attainment of optimal asthma management is patients overestimating their level of disease control [3-8]. Worldwide, there is a tendency for patients to overestimate control and underestimate severity of asthma, suggesting a willingness to accept symptoms, exacerbations and lifestyle limitations as unavoidable consequences of their disease [3]. Patients who overestimate their asthma control commonly have partially or poorly controlled asthma that they have failed to recognize; this may result in an increased burden of asthma on the individual and society due to greater variability in asthma symptoms, increased exacerbations and associated healthcare costs [5].

To our knowledge, the factors that affect patients' overestimation if their asthma control have not been explored. This is a significant gap because previous research has suggested that the main limitation to the uptake and effectiveness of asthma interventions may be patients' acceptance of their asthma symptoms, because those who consider their symptoms controlled, even mistakenly, are unlikely to seek further education or advice [9,10]. Until we know how to target the

discrepancy between perceived and actual asthma control, this overestimation will continue to be a barrier the effectiveness of costly interventions, as well as overall asthma management.

The prevalence of asthma in Australia is one of the highest in the world; asthma affects 1 in 10 Australians [11], making it an ideal location for this study. As it is around the globe, over-estimation of asthma control is common in Australia – up to 50% of patients with daily asthma symptoms incorrectly define their asthma as 'well controlled' [4]. The aim of this study was to investigate actual and perceived disease control in Australians adults with asthma, and identify factors associated with overestimation of asthma control.

Methods

Study design and participants

We undertook a cross-sectional web-based survey performed on a sample of patients recruited via social media. To be eligible for inclusion, patients needed to be living in Australia, aged 18 years or over and have a current diagnosis of asthma (not including exercise-induced asthma). The eligibility check for a current diagnosis of asthma was consistent with the survey question tested by the Australian Centre of Asthma Monitoring, used in National Health Surveys to monitor national asthma indicators [12].

The online survey was active from April to August 2015. Patients were recruited to the survey using Facebook, and a paid advertisement ran throughout the duration of survey activity. A prize draw of an iPad mini was used as a recruitment incentive (to maintain anonymity, prize draw details could not be linked to survey responses).

Responses to a least 385 surveys were needed, in order to ensure the results were generalizable to Australians with asthma. This recruitment target was calculated using the Australian prevalence of asthma (approximately 2 million people), with a 95% confidence interval and a 5% margin of error [11,13].

Online survey

The survey contained basic demographic questions, asking for patients' age, gender and level of education.

Asthma control was assessed using the Asthma Control Test, a validated 5-item questionnaire [14,15]. The first four items of the test assessed recent asthma symptoms and reliever medication usage. The final question assessed the patients' perception of control, asking how they would rate their control. Each item had five response options that corresponded to a 5-point scale. The Asthma Control Test was used to determine overestimation of asthma control. We did this by averaging the responses to the first four items to give a symptom score and comparing this with the score of the last item (perception score). Overestimation was classified as someone whose perception score was higher than their symptom score.

Knowledge of asthma management and medications was assessed using a modified version of the Consumer Asthma Knowledge Questionnaire [16]. The questionnaire contained true or false questions, with points given for each correct answer. The original questionnaire contained 12 items; two of the questions were removed in this study, as they were not applicable to Australian adults with asthma.

Medication beliefs were examined using the Beliefs about Medicines Questionnaire, a validated questionnaire used to assess the cognitive representation of medications [17]. Items assessed beliefs about the necessity of prescribed medication, concerns about prescribed medication based on the danger of dependence and toxicity, beliefs that medications are harmful addictive poisons, and beliefs that medications are overused by doctors. Items were rated on a continuous scale based on how strongly the patient agreed or disagreed with the statements.

Illness perception was assessed using the Brief Illness Perception Questionnaire, a validated eight-item questionnaire, assessing cognitive and emotional representations of illness, as well as illness comprehensibility [18]. Items were rated using a zero-to-ten response scale based on the patients' views about their asthma. As the Brief Illness Perception Questionnaire is not disease-specific, the authors recommended replacing the word 'illness' with the name of the particular illness being examined [18]. In this case 'asthma' was used.

Medication adherence was assessed in patients taking preventative medication, using the Morisky Medication Adherence Scale, a validated four item questionnaire that measured self-reported adherence [19]. The items evaluated adherence behaviors using 'yes' and 'no' responses to examples of non-adherent behavior; a patient was considered adherent if there was a lack of a 'yes' response [20].

Statistical analyses

All variables were collated and entered into a statistical software package, SPSS version 21 (IBM, Armonk, New York, US). Age, gender, level of education, asthma knowledge, medication

beliefs, illness perception and medication adherence were all tested against overestimation of asthma control. Categorical variables were analyzed using the Chi Square test for independence (with Yates' Correction for Continuity for 2 by 2 tables). Continuous variables were analyzed using independent sample t-tests. Multivariate logistic regression analysis was performed on univariate predicators, with $P < 0.1$ used as the threshold for entry into the model. A significance level of $P < 0.05$ was used for all statistical procedures.

Ethics and consent

This study was approved by the Tasmanian Social Science Human Research Ethics Committee (Tasmania) Network on 24th January 2015 (reference number H0014636). By submitting the survey, patients provided their implied consent.

Results

A total of 2971 patients completed the online survey, of which 1950 (65.6%) responses were complete and eligible for inclusion (Figure 1). The cost of Facebook advertising averaged $3.11 per response. The average age of respondents was 38.6 ± 16.6, the majority (83.5%) being female. Of the 1950 respondents, 896 (45.9%) were reported as overestimating their asthma control.

Table 1 displays patients' demographics as compared to overestimation of asthma control. Compared to patients who did not overestimate control, those who overestimated their asthma control were significantly more likely to be older, ($t = 2.3$, $P = 0.021$) and have lower total scores for asthma control ($t = 11.5$, $P < 0.001$). Patients who overestimated their asthma control were

also more likely to have lower levels of education than those who did not overestimate their control (36.3% versus 28.5%, respectively; $\chi^2 = 13.2$, df = 1, $P < 0.001$)

Patients who overestimated their asthma control had higher perception scores, and lower symptom scores than those who did not overestimate control, although the scores were not compared statistically as they were used to define overestimation.

Patients' beliefs about medicines are shown in Table 2. Compared to patients who did not overestimate control, those who overestimated their asthma control were significantly more likely to believe that most medications are addictive ($t = 4.0$, $P < 0.001$), that their health depends on their asthma medications ($t = 2.9$, $P = 0.004$), that their life would be impossible without their asthma medications ($t = 3.6$, $P < 0.001$), that without their asthma medication they would be very ill ($t = 4.1$, $P < 0.0001$), that their health in the future would depend on their asthma medications ($t = 2.5$, $P = 0.013$) and that they were significantly more likely to worry about becoming too dependent on their asthma medications ($t = 1.6$, $P = 0.025$).

Table 3 shows the component scores for illness perception. Compared to patients who did not overestimate control, those who overestimated their asthma control were significantly more likely to perceive that asthma had a greater effect on their life ($t = 4.2$, $P < 0.0001$), that they experienced more asthma symptoms ($t = 5.3$, $P < 0.0001$), that they were more concerned about their asthma ($t = 3.5$, $P < 0.0001$) and that their asthma affected them more emotionally ($t = 3.7$, $P < 0.0001$).

The multiple variable logistic regression model for overestimation of asthma control contained 16 independent variables and was statistically significant ($\chi^2 = 86.0$, df $= 16$, $P < 0.001$). As shown in Table 4, lower education level, reduced asthma knowledge, decreased total asthma control, agreement that most medications are addictive and increased feelings of control over asthma were identified as significant independent predictors of overestimation of asthma control.

Discussion

Previous research has shown that overestimation of asthma control is common, and is a barrier to optimal asthma management, yet the factors associated with overestimation of asthma control have, up until now, remained understudied and poorly defined. The current study revealed that the overestimation of asthma control is still a significant problem in Australia and provides insight into the factors associated with this overestimation. The results indicate that level of education, asthma knowledge, overall asthma control, beliefs about the addictive of nature medications and feelings of control over asthma were independently associated with overestimation of asthma control.

The prevalence of overestimation amongst patients was similar to other studies involving Australia [4,7], with just under half of the respondents overestimating their level of control. Patients who overestimate asthma control commonly have partially or poorly controlled asthma that they have failed to recognize [4,7]. Overestimation of control is a barrier to the attainment of optimal asthma control, as those who mistakenly consider that their asthma is controlled are unlikely to seek the advice they require from health professionals or to become involved in integral asthma interventions [9,10].

There has been limited research to date on the factors that are associated with the overestimation of asthma control. The present found that patients with lower levels of education (year 12 or below) were significantly more likely to overestimate their asthma control, compared to those with high levels of education (Certificate / Diploma / Bachelor / Masters / PhD). Previous research has not yet shown a significant association between education level and perception of asthma control [21]. However, it has previously been demonstrated that patients with inadequate health literacy were more likely to hold several potentially detrimental beliefs about asthma, including the 'no symptoms-no asthma' belief, the belief that asthma can be cured and the belief that medications work better when not used all the time [22]. While inadequate health literacy has been linked to poorer asthma knowledge and self care [23], it is a surmountable barrier to learning and remembering key asthma self-management skills [24].

Lower education level has been observed as being associated with lower healthy literacy, which in turn may lead to a decreased ability to take control of and to optimize health outcomes [25]. It is plausible that people with lower education levels may have a different understanding the constituents of well-controlled asthma when compared to guideline definitions. Control, when used in lay-terms, refers to having restraint over; to dominate; or to hold in check, as opposed to being in the context of asthma where it means 'the suppression of asthma manifestations' [26]. This may lead to some patients believing that asthma control is the knowledge of what to do in an asthma flare-up or how quickly symptoms resolve when reliever medications are used, rather than the suppression of their asthma symptoms all together. Further qualitative research is needed to identify patients' understanding of the term 'asthma control'.

This study provides new insight into the modifiable predictors of overestimation of asthma control, including asthma knowledge, overall asthma control, and patient's beliefs about medicines and perceptions about asthma.

Patients with lower asthma knowledge were at a significantly increased risk of overestimating their asthma control. A number of studies have demonstrated that patients' knowledge and understanding of asthma and its management is often suboptimal [27-30]. Reduced asthma knowledge may result in patients having low expectations of what can be achieved by asthma management and not realizing their condition can be improved. In fact, it has been shown that patients' satisfaction with asthma care falls by almost half when they are shown asthma symptom management goals as defined in international guidelines [26], supporting the observation that asthma patients may not realize they could be better [28]. While improving patients' asthma knowledge may change their perceptions and expectations of treatment, previous studies have found that improving patient knowledge alone does not seem to reduce hospitalizations, doctor visits or medication use for asthma, but may play a role in improving patients perceptions of their symptoms [31].

Patients who overestimated their asthma control had lower scores for total asthma control. The Asthma Control Test consists of four questions relating to recent asthma symptoms (daytime and night-time symptoms, limitation of activities and use of reliever medication) and one question asking patients how they perceive their own asthma control. Interestingly and perhaps somewhat worryingly, patients who over-estimated their asthma control (those whose perception score was higher than their symptom score) had significantly lower scores for overall asthma control. These

results suggest that patients often rate their asthma as more controlled than it actually is, despite the present of asthma symptoms and use of reliever medication. Patients often have symptoms that they accept as unavoidable consequences of having asthma [9]. Failure to recognize symptoms as indicators of poor control may be due to a lack of awareness of the level of control that is achievable [6,28]. This lack of awareness may lead to patients believing that they have optimal control despite their current symptoms, resulting in an overestimation of asthma control. Providing education in regards to guideline definitions of control that focuses on symptom presentation and the achievability of optimal asthma control may help to improve the discrepancy between perceived and actual control.

This study demonstrated that the belief that 'most medications are addictive' was an independent predictor for overestimation of asthma control. Previous research has shown that patients believe that inhaled corticosteroid medications are addictive, or may stop working or have harmful effects working when used regularly [32-34]. This perception can result in poor adherence to regular preventive medications and the underestimation of the beneficial effects of medications in attaining disease control. When this erroneous belief is combined with the overestimation of asthma control, patients may be at high risk of exacerbations due to poor adherence to therapy and under-recognition of asthma symptoms [34]. This finding can be used to develop future interventions to modify or acknowledge this belief with the goal of reducing the overestimation of asthma control.

Patients who overestimated their asthma control had higher scores for how much control they felt they had over their condition. In order for overestimation of control to occur, one's perceived

level of control must be higher than the control indicated by their current symptoms. It is therefore reasonable to expect that overestimation of control would be associated with feelings of having more control over one's own asthma. The Health Belief Model highlights how health motivation to take preventative action is related to the perceived severity of the condition [35]. Those patients who perceive they have greater asthma control are less likely to become involved in health interventions targeted at improving asthma management due to their low perceived consequences. This is an important consideration for the development of interventions targeting those who overestimate asthma control, as patients' current perception may be a barrier to involvement.

There are some potential limitations to this study. The evaluation of patients' perception of asthma control was based on the final question of the Asthma Control Test, which asks patients to rate their recent asthma control. While the isolation of this question has not been validated for this purpose, a number of other studies investigating perception of control have used similar style questions comparing patients' self-rating of asthma control to symptom frequency and use of reliever medication [4,5,21,36]. There may have been a degree of self-selection bias, as patients' current perception of their asthma control may have influenced their likelihood of participating. Recruitment through Facebook may have led to a select population within the sample; the age range of respondents was wide (ages 18-83), but more than 80% were female, perhaps indicative of the demographics of social media users [37]. Then again, Facebook recruitment may be a strength in this particular study as it was not biased by factors associated with recruitment through health care facilities, allowing for inclusion of those who have limited or no contact with healthcare professionals in the study sample.

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Limitations relating to the nature of the survey may have had an impact on the data collected. Patients' self-reported diagnosis of asthma could not be confirmed, a common limitation associated with asthma surveys. However, while the Asthma Control Test was originally validated in patients with confirmed asthma, it has since been used to describe asthma control in patients with self-reported asthma around the world [38-40]. Self-reported symptoms and medication adherence relied on patient recall, and may have been under- or over-stated by patients, again a limitation associated with any asthma survey. Finally, some of the differences between patients who did and did not overestimate their asthma control, while statistically significant, were quite small and the clinical relevance of these differences is not yet known.

Despite these limitations the results of this study provide valuable information regarding the overestimation of asthma control in Australia and its predictors. The study was strengthened by its large sample size, and therefore should be generalizable to Australians with asthma.

Conclusions

To our knowledge, this is the first study that has identified modifiable predictors of overestimation of asthma control. We now have the necessary knowledge to try and reduce the discrepancy between perceived and actual asthma control, which is not just useful in Australia, but also promising for other countries, as overestimation of asthma control has been reported in many areas around the world [3-8]. The results of this study highlight the importance of encouraging patients to express their feelings about asthma control and beliefs about medicines, and to be more forthcoming with their asthma symptoms. This would help to reveal any

discrepancies between perceived and actual asthma control. Looking for and identifying these discrepancies can be an initial step towards normalizing perceived control of asthma control.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Table 1. Patient demographics, asthma control, asthma knowledge and medication adherence

Parameter	All patients (n = 1950)	Overestimation		P
		Yes (n = 896)	No (n= 1054)	
Age	38.6 ± 16.6	39.5 ± 17.4	37.7 ± 15.8	0.021
Gender				
Male	321 (16.5%)	149 (16.6%)	172 (16.3%)	0.902
Female	1629 (83.5%)	747 (83.4%)	882 (83.6%)	
Highest level of education				
Year 12 or below	625 (32.1%)	325 (36.3%)	300 (28.5%)	< 0.001
Certificate / Diploma / Bachelor / Masters / PhD	1325 (67.9%)	571 (63.7%)	754 (71.5%)	
Asthma control				
Total asthma control score (/25)	17.3 ± 4.8	16.0 ± 5.0	18.4 ± 4.4	< 0.001
Perception score (/5)	3.5 ± 1.0	3.9 ± 0.9	3.3 ± 1.0	
Symptom score (/5)	3.4 ±1.0	3.0 ± 1.0	3.7 ± 0.9	
Asthma knowledge	6.6 ± 1.9	6.5 ± 1.9	6.7 ± 1.9	0.080
Morisky classification	*n = 1541*	*n = 752*	*n = 789*	
Adherent	299 (19.4%)	159 (21.1%)	140 (17.7%)	0.105
Non-adherent	1242 (80.6%)	593 (78.9%)	649 (82.3%)	

Figures represent number (percent) of patients or mean ± SD.

Table 2. Beliefs about medicines

Questionnaire item[a]	All patients (n = 1950)	Overestimation		P
		Yes (n = 896)	No (n = 1054)	
Overuse items				
Doctors prescribe too many medications	2.8 ± 1.1	2.8 ± 1.1	2.8 ± 1.1	0.616
Natural remedies are safer than medications	2.2 ± 0.9	2.3 ± 0.9	2.2 ± 1.0	0.234
Doctors place too much trust on medications	2.5 ± 1.1	2.6 ± 1.1	2.5 ± 1.1	0.094
If doctors had more time with patients they would prescribe fewer medications	2.9 ± 1.1	2.9 ± 1.1	2.9 ± 1.1	0.831
Harm items				
People who take medications should stop their treatment for a while every now and again	2.1 ± 0.9	2.1 ± 0.9	2.1 ± 0.9	0.240
Most medications are addictive	2.4 ± 0.9	2.4 ± 0.9	2.3 ± 0.9	< 0.001
Medications do more harm than good	1.9 ± 0.8	2.0 ± 0.8	1.9 ± 0.8	0.100
All medications are poisons	1.9 ± 0.9	2.0 ± 1.0	1.9 ± 0.9	0.094
Necessity items				
My health, at present, depends on my asthma medications	3.0 ± 1.2	3.1 ± 1.2	2.9 ± 1.2	0.004
My life would be impossible without my asthma medications	3.3 ± 1.2	3.5 ± 1.2	3.3 ± 1.2	< 0.001
Without my asthma medications I would be	3.3 ± 1.2	3.4 ±	3.2 ± 1.2	< 0.001

very ill		1.2		
My health in the future will depend on my asthma medications	3.4 ± 1.1	3.4 ± 1.1	3.3 ± 1.1	0.013
My asthma medications protect me from becoming worse	4.0 ± 0.9	4.1 ± 0.8	4.0 ± 0.9	0.113
Concerns item				
Having to take asthma medications worries me	2.3 ± 1.1	2.3 ± 1.1	2.3 ± 1.1	0.386
I sometimes worry about long-term effects of my asthma medications	2.8 ± 1.3	2.9 ± 1.3	2.8 ± 1.3	0.119
My asthma medications are a mystery to me	2.2 ± 1.0	2.2 ± 1.0	2.2 ± 1.0	0.490
My asthma medications disrupt my life	2.0 ± 0.9	2.0 ± 1.0	2.0 ± 0.9	0.262
I sometimes worry about becoming too dependent on my asthma medications	2.4 ±1.2	2.5 ± 1.2	2.4 ± 1.2	0.025

Figures represent mean ± SD.

[a]1 = Strongly disagree; 5 = Strongly agree.

Table 3. Illness perception

Questionnaire item	All patients (n = 1950)	Overestimation		P
		Yes (n = 896)	No (n = 1054)	
How much does your asthma affect your life?[a]	4.6 ± 2.3	4.8 ± 2.3	4.4 ± 2.3	< 0.001
How long do you think your asthma will continue?[b]	8.7 ± 2.3	8.7 ± 2.2	8.6 ± 2.3	0.277
How much control do you feel you have over your asthma?[c]	6.6 ± 2.2	6.7 ± 2.2	6.5 ± 2.2	0.075
How much do you think your treatment can help your asthma?[d]	7.7 ± 2.0	7.8 ± 1.9	7.7 ± 2.1	0.124
How much do you experience symptoms from your asthma?[e]	5.1 ± 2.2	5.4 ± 2.2	4.9 ± 2.1	< 0.001
How concerned are you about your asthma?[f]	4.7 ± 2.7	5.0 ± 2.8	4.5 ± 2.7	< 0.001
How well do you feel you understand your asthma?[g]	7.0 ± 2.4	7.1 ± 2.4	6.9 ± 2.4	0.112
How much does your asthma affect you emotionally? (e.g. does it make you angry, scared, upset or depressed?)[h]	3.4 ± 2.9	3.7 ± 2.9	3.2 ± 2.8	< 0.001

Figures represent mean ± SD.

[a] 0 = no affect at all; 10 = severely affects my life.

[b] 0 = a very short time; 10 = forever.

[c] 0 = absolutely no control; 10 = extreme amount of control.

[d] 0= not at all; 10 = extremely helpful.

[e] 0 = no symptoms at all; 10 = many severe symptoms.

[f]0 = not at all concerned; 10 = extremely concerned.

[g]0 = don't understand at all; 10 = understand very clearly.

[h]0 = not at all affected emotionally; 10 = extremely effected emotionally.

Table 4. Multivariate analysis of factors affecting overestimation of asthma control

Questionnaire items	Odds ratio (95% CI)	*P*
Age	1.005 (0.999-1.012)	0.100
Level of education	0.755 (0.612-0.931)	0.009
Asthma control	0.842 (0.818-0.867)	< 0.001
Asthma knowledge	0.942 (0.892-0.994)	0.029
Doctors place too much trust on medications	1.023 (0.926-1.130)	0.657
Most medications are addictive	1.144 (1.017-1.287)	0.025
All medications are poisons	1.020 (0.912-1.141)	0.725
My health, at present, depends on my asthma medications	0.994 (0.897-1.102)	0.913
My life would be impossible without my asthma medications	0.973 (0.846-1.120)	0.705
Without my asthma medications I would be very ill	1.033 (0.898-1.189)	0.651
My health in the future will depend on my asthma medications	1.042 (0.917-1.184)	0.529
I sometimes worry about becoming too dependent on my asthma medications	0.978 (0.890-1.075)	0.645
How much does your asthma affect your life?	0.962 (0.897-1.031)	0.274
How much control do you feel you have over your asthma?	1.261 (1.191-1.335)	< 0.001
How much do you experience symptoms from your asthma?	0.998 (0.929-1.071)	0.945
How concerned are you about your asthma?	0.980 (0.930-1.032)	0.448
How much does your asthma affect you emotionally? (e.g. does it make you angry, scared, upset or depressed?)	1.025 (0.981-1.071)	0.267
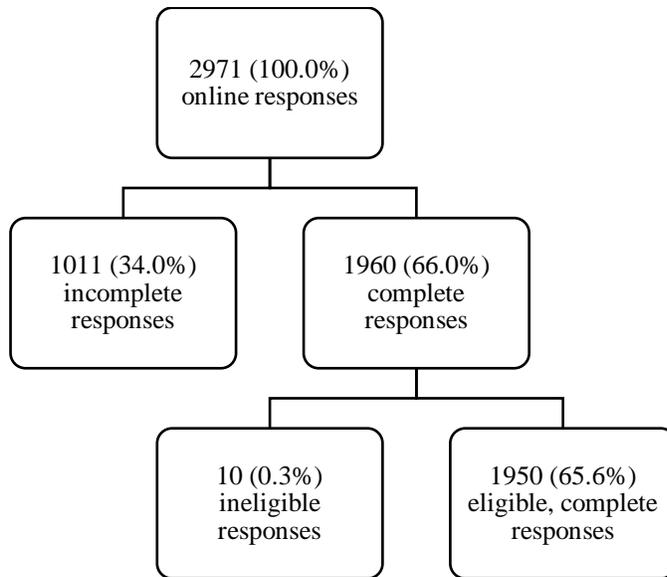
Figure 1. Overview of responses