



Rape, asthma and dysfunctional breathing

To the Editor:

Functional breathing disorders are common, but poorly understood, causes of respiratory symptoms, and often co-exist with asthma and other respiratory diseases [1–3]. Hyperventilation syndrome is the most recognised form of dysfunctional breathing. It has long been suspected that dysfunctional breathing may have emotional origins, but there is little empirical evidence to support this [4].

Several studies have found that a history of adverse events and psychological trauma, including sexual assault, are associated with self-reported asthma [5–9]. Sexual assault is a particularly salient form of trauma and has been reported among patients with vocal cord dysfunction, another functional breathing disorder [10]. We hypothesised that non-consensual sexual intercourse would be a risk factor for developing dysfunctional breathing and asthma. We tested this hypothesis in the Dunedin Multidisciplinary Health and Development Study: a longitudinal investigation of health and behaviour in a population-based cohort of 1037 individuals born in 1972 or 1973 [11]. Ethical approval and written informed consent were obtained for each assessment.

Childhood asthma was defined as a parent-reported diagnosis with compatible symptoms or medication at 9, 11 or 13 years [11]. Current adult asthma was defined as a self-reported diagnosis with compatible symptoms or medication at age 38 years [11]. Wheeze included all episodes of reported wheeze in the previous year, excluding only one or two episodes lasting <1 h. At age 38 years, participants self-completed the Nijmegen questionnaire, which asks how often participants experience 16 symptoms (*e.g.* chest pain, fast or deep breathing, tingling in fingers and hands) on a scale of 0 (never) to 4 (very often). Responses sum to provide a score between 0 and 64. Scores ≥ 19 indicate dysfunctional breathing, but scores ≥ 23 may best discriminate between dysfunctional breathing and other respiratory disorders [3]. At age 38 years, the exhaled fraction of nitric oxide (F_{ENO}) was measured as an indicator of airway inflammation (Bedfont NObreath, Rochester, UK). Pre- and post-bronchodilator spirometry was measured (Vmax; SensorMedics, Yorba Linda, CA, USA).

Participants were asked about non-consensual sexual intercourse using computer-administered questionnaires on two occasions: At age 26 years, they were asked if they had had unwanted sexual intercourse before age 16 years and, if this had been forced [12]. For men, this included anal intercourse. This was considered to be rape before age 16 years. At age 38 years, participants were asked if they had “ever been raped”.

10% of women reported forced intercourse before age 16 years, and 14.9% ever being raped at age 38 years, with a combined lifetime prevalence of 18.9%. The corresponding figures for men were 2.3%, 2.1% and 3.9%, respectively. Median Nijmegen scores were higher among those reporting rape at either age (women 15 *versus* 11, men 19.5 *versus* 8, among those who did and did not report rape respectively; both $p < 0.001$). Participants of both sexes reporting rape at either age were more likely to have dysfunctional breathing at age 38 years (table 1). Findings were similar after adjustment for lifetime smoke exposure, childhood asthma, and childhood and adult socio-economic status. Associations with dysfunctional breathing were similar using a higher threshold of Nijmegen score ≥ 23 (not shown). Rape was also associated with asthma and wheeze among women, but not among men (table 1). Having asthma as a child did not predict reports of rape before age 16 or up to age 38 years. Excluding those reporting childhood asthma or wheeze made no material difference to the findings, except that the association between rape and adult asthma among women was stronger (OR 8.66, 95% CI 3.30–22.7; $p < 0.001$).

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A history of rape is a risk factor for dysfunctional breathing in adults of both sexes and for late-onset asthma diagnosis in women <http://bit.ly/2TFhdAH>

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TABLE 1 Unadjusted and adjusted associations between rape and asthma and dysfunctional breathing at age 38 years

	Unadjusted				Adjusted [#]			
	n	OR	95% CI	p-value	n	OR	95% CI	p-value
Women								
Asthma	466	3.10	1.83–5.25	<0.001	389	4.47	2.22–8.99	<0.001
Wheeze	466	2.83	1.74–4.59	<0.001	389	2.19	1.23–3.90	0.008
Dysfunctional breathing	457	2.68	1.59–4.52	<0.001	383	2.71	1.47–5.01	0.001
Men								
Asthma	472	1.04	0.29–3.70	0.947	417	1.77	0.32–9.93	0.514
Wheeze	472	0.82	0.27–2.55	0.736	417	0.59	0.16–2.17	0.430
Dysfunctional breathing	462	10.1	3.80–26.7	0.001	408	8.05	2.53–25.7	<0.001

[#]: adjusted for smoking history (pack-years) up to age 38 years, childhood and adult socio-economic status, and childhood asthma.

There were no associations between rape and the ratio of forced expiratory volume in 1 s (FEV₁) to forced vital capacity, or the percent FEV₁ improvement after salbutamol, at age 38 years (not shown). A history of rape was associated with lower log-transformed F_{ENO} levels, which was explained by a higher prevalence of smoking among those who had been raped.

In summary, we have found that a history of rape was strongly associated with symptoms of dysfunctional breathing in mid-adulthood in both women and men in this population-based cohort. Rape was also associated with self-reported diagnoses of asthma and symptoms of wheeze among women, but not men. These associations were independent of smoking and socio-economic status, and childhood asthma. There were no associations between a history of rape and objective evidence of airway disease in terms of airflow obstruction, bronchodilator responsiveness or exhaled nitric oxide levels. The findings support the hypothesis that rape is a risk factor for dysfunctional breathing in both men and women. Rape may also be a risk factor for symptoms of adult-onset asthma among women, although we did not find evidence of an association with objective airway disease.

As far as we are aware, this is the first epidemiological study to investigate the possible origins of hyperventilation syndrome. The findings indicate that dysfunctional breathing may be a consequence of severe psychological trauma and are consistent with case reports of sexual abuse in patients with vocal cord dysfunction [10]. Assuming that this is a causal association, population attributable fractions estimated from the adjusted analyses indicate that 17% of dysfunctional breathing among women and 14% among men in this cohort are attributable to being raped. We focused on rape because this is a particularly salient and traumatic experience that could be clearly defined. We have not analysed other forms of sexual and non-sexual abuse, but these may plausibly have a similar relationship with breathing pattern disorders and the attributable risks would probably be much higher if these other psychological traumas were included.

The experience of rape was very common, with nearly one in five women reporting forced intercourse before age 16 or being raped by age 38 years. This is similar to lifetime prevalence estimates for rape from the USA and lower than World Health Organization estimates for all forms of sexual assault in high income countries [13]. Although rape and the outcome of dysfunctional breathing were both much less common among men, there was no evidence that the association between rape and dysfunctional breathing symptoms was weaker in men than women.

The association between rape and self-reported asthma among women is consistent with previous findings [5–9]. Our analyses indicate that 23% of all asthma among women at age 38 years, or 32% of late-onset asthma could be attributed to rape. However, we did not find an association with objective airway dysfunction. We know of only one other study that used objective measures and this found no association between childhood maltreatment and lung function [9]. The difficulty in distinguishing between asthma and dysfunctional breathing raises the question of whether the association that we have observed between rape and late-onset asthma in women is due to misdiagnosis. Although we used self-reported asthma diagnoses, there was also an association between rape and prescribed asthma treatment, indicating that these diagnoses must have been made by medical doctors. We also found associations between rape and wheeze among women. Wheeze is a cardinal feature of asthma, but not usually regarded as a symptom of dysfunctional breathing and not part of the Nijmegen Questionnaire.

We did not find evidence of an association between rape and asthma among men. However, the confidence intervals were wide, because both rape and late-onset asthma were much less common among men than women, limiting our power to investigate these associations.

A causal association between rape and dysfunctional breathing is biologically plausible. Sexual assault can lead to anxiety and breathing control is influenced by acute and chronic anxiety [14]. Asthma is also associated with anxiety, but a biological mechanism for an association between rape and asthma is less clear [15]. While asthma may have been over-diagnosed among those with a history of rape, it is also possible that psychological stress has pathophysiological impacts that lead to asthma.

Strengths of this study include a high rate of follow-up from childhood to mid-adult life in a population-based cohort. Reports of asthma and respiratory symptoms were collected prospectively and information on rape was reported at two ages. We also have objectively measured lung function. Perhaps the biggest limitation is the use of the Nijmegen questionnaire to identify dysfunctional breathing, which was developed as a screening, rather than a diagnostic, tool [3]. However, there are no objective criteria for diagnosing dysfunctional breathing and the Nijmegen questionnaire is the most practical measure for identifying functional respiratory symptoms in epidemiological research. A Nijmegen score ≥ 23 discriminates between dysfunctional breathing and other respiratory conditions, whereas a score ≥ 19 distinguishes dysfunctional breathing from a general population sample. Our findings were similar regardless of the cut-off point used.

These findings have clear implications for research and practice. As the first study to report these associations, confirmation should be sought from other studies, and we need to investigate whether other forms of sexual, physical and psychological trauma are also associated with breathing pattern disorders. Further investigation into the apparent association between rape and late-onset asthma in women is also needed: is this due to genuine asthma or over-diagnosis? Clinicians should recognise the possibility of prior traumatic experiences triggering either dysfunctional breathing or late-onset asthma, and consider whether psychological counselling or other forms of therapy would help their patients.

In conclusion, a history of rape is associated with dysfunctional breathing in adults of both sexes, and with late-onset asthma diagnosis in women.

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