

Title: Towards a new epidemiological definition of chronic rhinitis:
prevalence of nasal complaints in the general population

Short title: Definition of chronic rhinitis

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Abstract:

Background: Chronic rhinitis (CR) is currently defined as at least two nasal symptoms present for at least 1 hour per day for more than 12 weeks per year. Such definition lacks evidence-based foundation. Depending on the most troublesome symptom, CR patients are often divided into 'runners' and 'blockers', although the evidence supporting such subdivision is limited. The aim of the current study was to define CR, and to estimate its prevalence and the prevalence of the 'runners' and 'blockers' subtypes.

Methods: Cross-sectional, questionnaire-based study in a random sample of participants representing the general population of the Netherlands.

Results: The questionnaire was sent to 5000 residents; the response rate was 27%. CR was defined as at least 1 nasal complaint present for more than 3 weeks per year. The prevalence of CR in the general population was 40%. Participants who were excluded by the former CR definition (i.e. nasal complaints present for less than 1 hour per day, only one complaint, duration of complaints for 3-12 weeks per year) were shown to have a significantly higher VAS compared to the control group. The larger part of CR group was represented by non-allergic rhinitis (NAR): 70% vs 30%. There were 25% 'Blockers' and 22% 'Runners' in the CR group, whereas more than a half of the CR group could be classified in neither of these subgroups.

Conclusion: Based on our data, we propose a new definition of CR: at least one nasal complaint present for at least 3 weeks per year.

Keywords: allergic rhinitis, non-allergic rhinitis, chronic rhinitis

Introduction

Chronic rhinitis (CR) is one of the most common chronic diseases worldwide, affecting about 20-40% (1-3) of the adult Western population, significantly decreasing the quality of life (4) and having a substantial financial impact (5). The symptoms of CR include anterior and/or posterior rhinorrhea, blocked nose, sneezing and/or itchy nose (6). The current definition of CR states that the symptoms should be present for at least one hour per day for at least 12 weeks per year (7). To our knowledge, no epidemiological evidence supports such definition.

There are two major types of chronic rhinitis: allergic (AR) and non-allergic rhinitis (NAR). AR affects about 20-30% (8-11) of the Western population, whereas NAR affects about 10-19% (10, 12).

Depending on the most troublesome symptom, chronic (allergic) rhinitis patients are often divided into 'sneezers and runners' and 'blockers' (13), although the evidence of such subdivision is limited and somewhat contradictory. Some studies demonstrated that among AR patients there are significantly more 'sneezers and runners' than 'blockers' (14, 15), with the proportion around 2:1 (16). However, another study from India reported the prevalence of 'blockers' to be significantly higher than that of 'runners', with the reversed proportion (17). A South Korean study showed that the distribution of 'blockers' vs. 'runners' depends on disease duration and that a significant portion (about a third) of AR patients cannot be classified into either subtype (18).

The aim of the current study was to define CR and to describe the prevalence, duration and severity of nasal complaints in the general (adult) population, and to estimate the prevalence of CR. Additionally, we aimed to estimate the proportion of the 'runners' and 'blockers' subtypes.

Methods

We performed a cross-sectional, questionnaire-based study in a random sample of participants representing the general population of the Netherlands. The questionnaire (Attachment 1) consisted

66 of questions regarding general information (age and gender); nasal complaints; pulmonary
67 complaints, medication use, smoking status and allergy status.

68 *Relevant nasal complaints*

69 We collected information regarding the following nasal complaints: blocked nose, runny nose, post-
70 nasal drip, sneezing, itchy nose or throat, facial pain or pressure, reduced sense of smell or taste, and
71 itchy or teary eyes. We asked participants which of these complaints they had for at least one hour
72 per day on most days of the week (hereinafter termed “relevant nasal complaints”). Additionally, we
73 asked them which of the aforementioned complaints they were experiencing at the time of filling in
74 the questionnaire (hereinafter termed “current nasal complaints”). We asked them if they had these
75 complaints for at least one hour per day or less than one hour per day, and for how many days per
76 year in total. Moreover, we asked the participants to choose the most bothering nasal complaint
77 (only one answer allowed). According to ARIA guidelines (19), we have classified symptoms based on
78 duration (intermittent or persistent) and severity (mild or moderate/severe). Although ARIA
79 classification is intended for use in AR, we applied it to the whole CR group. Participants noted the
80 total burden of (all) nasal complaints at the moment of filling the survey on a Visual Analogue Scale
81 (VAS), from 0 to 100.

82 *Definitions used*

83 *Chronic rhinitis*

84 Chronic rhinitis (CR group) was defined as the presence of nasal complaints for at least 3 weeks (21
85 days) per year or a history of a positive allergy test and nasal medication use, irrespective of duration
86 of the nasal complaints.

87 *Allergic rhinitis*

88 When the participants fulfilled the CR criteria and answered affirmatively on the question whether
89 they had allergic rhinitis or hay fever, they were considered as having (self-reported) allergic rhinitis
90 (AR group). When the answer on aforementioned question was negative, they were considered as

having non-allergic rhinitis (NAR). Within the AR group, we defined the confirmed AR subgroup when participants reported having had a positive allergy test.

'Blockers' and 'Runners'

Based on the answer to the question 'From which of the nasal complaints do you suffer the most?', we extracted the 'Blockers' and 'Runners' subgroups from the CR population. 'Blockers' were defined as participants with CR who indicated that they suffer the most from blocked nose, and 'Runners' were defined as participants with CR who indicated that they suffer the most from anterior rhinorrhea.

Control group

The control group was defined as participants who did not report the duration of their nasal complaints (or had complaints for less than 21 days per year) and did not use nasal medications in the presence of confirmed allergies. The question regarding the duration was posed after asking if the participants had any relevant or current nasal complaints. Hence, we expected that participants who did not have any complaints, would leave this question blank.

Statistical analysis

We used SPSS version 26 for Windows (IBM) for statistical analysis. Data are summarized as frequencies, means and standard deviations, medians and interquartile ranges. To detect the differences between groups, we used an unpaired samples t-test for normally distributed numerical variables (such as age), and an independent samples Mann-Whitney U-test for non-normally distributed numerical variables (VAS score). For categorical variables (e.g. smoking status, presence of a particular complaint), we used a chi-squared test, odds ratio and/or relative risk.

Results

We have sent a survey to 5000 randomly selected subjects older than 15 years of age (full study population; representing the general adult population), registered in the same municipality in the

115 province North Holland, the Netherlands. The questionnaires were sent out once, in December 2019.
116 From December 2019 to April 2020, 1334 participants (response rate 27%) filled in the questionnaire.
117 Roughly 40% of the full study population had CR (Table 1). There was no gender difference. The CR
118 group was somewhat younger than the control group. Participants with CR were significantly more
119 likely to smoke, have asthma or other pulmonary complaints, and to regularly use nasal
120 decongestants.

121 *Prevalence of nasal complaints in chronic rhinitis group*

122 The characteristics of the CR group are summarized in Table 2. The median number of relevant nasal
123 complaints and current nasal complaints was two (IQR 1; 3 for both) (Table 2, Figure 1). The
124 prevalence of each complaint is presented in Figure 1; nasal obstruction, post nasal drip and runny
125 nose were the most prevalent. Fifteen percent of participants fulfilling the criteria for CR have not
126 reported any relevant nasal complaints (of those, 76% reported at least one current complaint) and
127 9% reported no current complaints. Twenty participants in the CR group reported no relevant and no
128 current nasal complaints. Of those, 11 were found to be allergic and use nasal medications (i.e. well-
129 controlled AR).

130 Twenty-seven percent (N=152) of CR group reported having one relevant nasal complaint, and 58%
131 (N=326) two or more. Participants with two or more nasal complaints had a higher VAS (45 mm (24;
132 65) vs. 30 mm (14; 61), $p=0.04$) and had significantly more moderate/severe cases (79% vs. 65%,
133 $p<0.05$). Participants with one nasal complaint had a significantly higher VAS compared to controls
134 (30 mm (14; 61) vs. 2 mm (0; 11), $p<0.01$).

135 Not only was nasal obstruction the most prevalent symptom, it was also the most bothering
136 complaint (25%), followed by runny nose (22%) and post-nasal drip (18%) (Figure 2A). Seventy
137 participants with CR failed to answer the question on the most bothering nasal complaint.

Duration of nasal complaints in chronic rhinitis group

Interestingly, 20 participants with nasal complaints present for less than 21 days per year (or unknown duration) were included to the CR group based on a positive allergy test and nasal medication use. The latter group most likely consists of participants with well-controlled AR. Regarding the daily duration, 310 (55%) reported having nasal complaints for 1 or more hours per day, 204 (36%) reported having nasal complaints for less than 1 hour per day. In 46 participants (9%), adequate data was missing. Participants with nasal complaints present for at least 1 hour per day had a significantly higher VAS compared to the participants with nasal complaints present for less than 1 hour per day (48 mm (25; 68) vs. 22 (10; 45), $p < 0.01$). There were significantly more moderate/severe cases in the former group compared to the latter (82% vs 61%, $p < 0.01$). Participants with nasal complaints present for less than 1 hour per day had a higher VAS compared to controls (22 mm (10; 45) vs. 2 mm (0; 11), $p < 0.01$).

ARIA classification of chronic rhinitis group

All participants with CR were classified according to the ARIA guidelines (19) (Table 2): 50% suffered from persistent and 44% from intermittent rhinitis. Regarding severity, 23% had mild rhinitis, while 71% had moderate/severe.

Allergic rhinitis

In the full study population, 19% (N=249) participants reported having allergic rhinitis or hay fever. Of those, 89 participants did not fulfill criteria to be included in the CR group due to short duration of their complaints (i.e. less than 21 days per year) or missing data on duration and no medication use. In this subgroup, 80% (N=70) did not report having any relevant nasal complaints, and 70% (N=62) did not report any current complaints.

Additionally, there were 79 participants in the full study population with a history of a positive allergy test who had missing data or short duration of their complaints. Of those, 20 were using nasal

medication and were included in the CR group. Of the 59 excluded, 35 had no nasal symptoms and 24 had very limited symptoms and did not report using any medication.

In the CR group, 30% (N=160) participants reported that they had allergic rhinitis or hay fever and were defined as AR group. Of those, 57% (N=91) reported to have a positive allergy test (confirmed AR group).

'Blockers' and 'Runners'

There were 121 'Blockers' (25%) and 109 'Runners' (22%) in the CR group. In the AR group, there were twice more 'Blockers' (N=42, 26%) than 'Runners' (N=20, 13%)($p=0.05$). In the NAR-group, 'Blockers' (N=73) and 'Runners' (N=84) were approximately equally distributed: 19% vs 22%.

The distribution of nasal complaints was indeed significantly different between 'Runners' and 'Blockers' (Figure 3). The majority of 'Blockers' reported having nasal blockage compared with just a fraction of 'Runners' ($p<0.05$) both as a relevant and a current nasal complaint. The same was observed regarding rhinorrhoea: the majority of 'Runners' compared with the minority of 'Blockers' reported having a runny nose ($p<0.05$). The prevalence of other nasal complaints, including sneezing, was not significantly different between the groups. There was no significant difference in daily and yearly duration of nasal complaints, intermittent/persistent disease (ARIA), and VAS. Yet, there were significantly more moderate/severe cases among 'Blockers' (Figure 4).

Discussion

We have performed a study describing the prevalence of CR complaints in the general population of the Netherlands. About 40% of general population have CR complaints.

Definition of chronic rhinitis

Defining CR and its classification are long-known challenges, especially in epidemiological studies. CR is defined as a symptomatic inflammation of the inner lining of the nose, leading to nasal obstruction, rhinorrhea (anteriorly or posteriorly), sneezing, or nasal/ocular itch (7). In 1994, the International

186 Rhinitis Management Working Group defined rhinitis by presence of at least two symptoms present
187 for more than one hour per day on most days (20). There are two major types of CR: allergic and non-
188 allergic. AR has been defined as a symptomatic disorder of the nose induced by an IgE-mediated
189 inflammation after allergen exposure of the membranes lining the nose (13), whereas NAR is
190 diagnosed in patients suffering of rhinitis without clinical signs of infection and without systemic
191 signs of allergy (7).

192 Originally AR was classified in 'seasonal' and 'perennial', however this division was not perfect due
193 to the fact that it did not reflect the course of the disease in all patients, for example when
194 sensitized to multiple allergens or living in areas where pollens are present all year around. For this
195 reason ARIA proposed to define rhinitis to 'intermittent' or 'persistent' and 'moderate/severe' or
196 'mild' (13).

197 In large epidemiological studies the tools to objectively confirm sensitizations or exclude sinus
198 involvement are mostly inaccessible. Though some epidemiological studies have attempted to get
199 objective measurements (21), most relied on symptoms reported by the participants. First, studies,
200 including GA2LEN (9) and ECHRS surveys (22) evaluated the prevalence of CR by asking the
201 participants whether they have allergic rhinitis or hay fever (3, 23). Most likely this type of question
202 leads to underestimation of the prevalence of CR, since it excludes participants with NAR,
203 participants having AR but being unaware and possibly also those with perennial AR not realizing that
204 their perennial AR is considered "hay fever". Later, studies evaluating CR prevalence used questions
205 such as: 'Do you suffer from nasal complaints that were not related to a common cold?' (2, 8, 12, 24),
206 which covers a wider spectrum of CR but does not allow for differentiation from chronic
207 rhinosinusitis (CRS). Based on our current data, it seems better to simply ask for the number of days
208 with nasal complaints per year.

209 *What number of nasal complaints is relevant?*

210 It was previously stated that at least two nasal complaints should be present to be defined as rhinitis
211 (20). Our data show that participants with just one nasal complaint have significantly higher VAS than
212 controls, therefore we think that already one nasal complaint can be relevant. As expected,
213 compared to the group with two or more nasal complaints, participants with one nasal complaint
214 had a lower VAS and significantly less moderate/severe cases. Thus, by defining rhinitis as at least
215 two nasal complaints, the diagnosis is narrowed down to more severe cases and the milder ones are
216 potentially being neglected.

217 *Daily duration of nasal complaints*

218 It was proposed that nasal complaints should be present for at least one hour per day to be regarded
219 as rhinitis (20). About a third of the CR group from our study had nasal complaints present for less
220 than an hour per day, and 65% of this subgroup had a moderate/severe form. Similarly, to one versus
221 two nasal complaints, this group had significantly less moderate/severe cases and a significantly
222 lower VAS compared with the group where complaints were present for at least one hour per day.
223 But still, they had a significantly higher VAS compared to the control group. Hence, we think that if
224 only the participants with at least one hour per day of complaints are regarded as CR, then a large
225 proportion of patients with milder (but potentially clinically relevant) rhinitis is being left out.

226 *Duration of nasal complaints per year*

227 In order to define the chronicity of nasal complaints, the borderline of days with complaints should
228 be established. In case of AR this is probably not entirely necessary (since allergic nasal complaints
229 are always relevant to exposure to the provoking allergen), whereas in NAR such a cutoff is of utmost
230 importance in order to be distinguished from 'normal' (common cold-related) nasal complaints.
231 Hellings et al. suggested that nasal complaints should be present for at least 12 weeks per year for
232 rhinitis to be considered 'chronic' (7). However, there is no data to support such definition.
233 We thought that since short-term nasal complaints are probably most often caused by common cold,
234 the borderline should lie somewhere on the upper border of average number of days with upper

235 respiratory tract infections. Seeing that adults have 2-4 episodes of common cold per year (25), each
236 lasting for about a week, we have chosen a cut-off of 3 weeks instead of 12.

237 We have additionally looked into the group with reported duration of nasal complaints between 3
238 and 12 weeks (data not shown): these cases were represented by a bigger proportion of mild rhinitis
239 (41% versus 19% in group with complaints present for more than 12 weeks per year). Therefore, we
240 think that the margin of 12 weeks selects only severe cases and leaves milder cases out.

241 Other conditions causing (sino-)nasal complaints

242 Seeing that it is hard to differentiate CR from CRS and other sinonasal conditions based on a
243 questionnaire solely (26), we expect that a certain proportion of CR group is represented by
244 participants with chronic rhinosinusitis (CRS), post-URTI olfactory loss, midfacial pain and/or
245 migraine. Since the clinically confirmed prevalence of CRS (3-6% of general population) (27, 28) and
246 the prevalence of migraine (1-2%) (29, 30) are considerably low, we suppose that only a minority of
247 CR group in our study is represented by the aforementioned conditions.

248 Prevalence of self-reported AR and NAR

249 It was previously reported that about 19-30% (2, 8, 12) of the European population had AR-related
250 symptoms and 10% - NAR (12). Our data are in line with the results of the aforementioned studies:
251 19% (N=249) of participants in full study group indicated having allergic rhinitis or hay fever. On the
252 other hand, 35% (N=89) of them were not included in the CR group due to short duration of their
253 nasal symptoms (or missing data on duration of nasal symptoms) and the fact that they did not
254 report using any nasal medication. Since the vast majority of them did not report any relevant nasal
255 complaints (80%) or any complaints at the moment of filling the questionnaire (70%), we think that
256 this subgroup is represented by participants with clinically irrelevant sensitizations, and participants
257 with very mild complaints.

258 Among the CR group, 30% (N=160) participants were classified as AR (and, thus, 70% NAR). Similarly
259 to the findings of Bauchau et al. (8), sensitizations were confirmed in 57% of the AR group. This
260 subgroup, that represents 16% of the CR group and 7% of the whole study group, may be considered
261 as having confirmed AR. Possibly, of the remaining 43%, some participants are allergic and some
262 think that they are allergic but have nasal complaints due to other reasons. Seeing that generally self-
263 reported AR has been found to be unreliable for the AR diagnosis (8, 31), the proportion of non-
264 allergy-related complaints within the CR group may be even higher. As such, the 'real prevalence' of
265 AR across the general population is probably somewhere between 7-10%.

266 It was previously reported that AR is more common than NAR (10, 12). Even though, as described
267 above, a part of those non-allergy-related complaints is probably caused by other sinonasal
268 conditions, our data suggests a higher prevalence of non-allergic rhinitis (NAR) than previously
269 reported. Our findings are in line with Jessen and Janzon, who reported a prevalence of AR of 5% and
270 20% of NAR (32).

271 'Runners' vs 'Blockers'

272 Based on the question 'What is your most important nasal complaint?', 'Runners' and 'Blockers'
273 subgroups were defined (Figure 3). Instead of 'Runners and sneezers' (14, 16), we used the term
274 'Runners' due to the fact that sneezing was equally prevalent among both subgroups. Moreover, in
275 the subgroup of the participants who reported 'Sneezing' as the most bothering nasal complaint, the
276 prevalence of runny nose was not higher than in 'Blockers' (data not shown).

277 The vast majority of 'Blockers' reported nasal obstruction as relevant and the current nasal
278 complaints compared to a fraction of 'Runners', and vice versa for rhinorrhea. Yet, about a third of
279 both groups still reported to have the other defining symptom, (i.e. rhinorrhea for 'Blockers' and
280 nasal obstruction for 'Runners'). The rest of the symptoms, including sneezing, was not significantly
281 different between the subgroups. Interestingly, there were significantly more participants with
282 moderate/severe rhinitis among 'Blockers' (85%) compared to 'Runners' (59%). Probably, nasal

obstruction is experienced as a more bothering nasal complaint compared to rhinorrhea. Furthermore, more than a half of the CR group (as well as the AR subgroup) reported another complaint as being the most important. Hence, more than a half of CR (and AR) are neither 'Blockers' nor 'Runners'. It is therefore debatable whether this division is really helpful.

Study limitations

One of the study limitations is that possibly the respondents of the questionnaire are older than the general population. According to the Statistics Netherlands (CBS), the average age of adult Dutch citizens is 49 years (33). On the other hand, the median age of the adult residents of municipality where the study took place lies between 45 and 60 years old (34).

Another study limitation is a low response rate (27%), hence nothing is known about the prevalence of nasal complaints among the non-responders. The low response rate could be explained by the fact that the Municipality where the participants were registered gave us permission to send out the questionnaire only once.

The questionnaire that we used was not previously validated, therefore our data are not directly clinically applicable. Nevertheless, the study results offer a valid overview of characteristics of the CR complaints across the general population and are valuable in understanding of the epidemiology of the disease.

Conclusion

We propose a new epidemiological definition of chronic rhinitis: at least one nasal symptom present for more than 3 weeks per year. This definition is a better indicator of chronic rhinitis than the question 'Do you have hay fever/allergic rhinitis?' and should be used in the further epidemiological studies. 'Runners' and 'Blockers' do indeed exist, though about a half of CR patients falls into neither of the groups.

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400 **Table 1. Characteristics of the respondents.**

	<i>Chronic Rhinitis group</i>	<i>Control group</i>	<i>Statistics</i>
N (%)	560 (42% of full study population)	774 (58% of full study population)	
Age: Mean ± SD (Min-max)	57±18 (18-94)	60±16 (18-95)	P=0.02 (t-test)
Gender: Female N (%)	277 (50% of CR group)	417 (54% of control group)	
Current smoker	51 (9% of CR group)	37 (5% of control group)	Chi-Square: p=0.03 OR=1.9 (95% CI 1.2-3.0) RR=1.4 (95% CI 1.14-1.67)
Former smoker	250 (45% of CR group)	326 (42% of control group)	Not significant
Self-reported asthma	51 (9% of CR group)	25 (3% of control group)	Chi-square: p<0.01 OR=2.9 (95% CI 1.8-4.7) RR=1.6 (95% CI 1.4-1.9)
Other pulmonary complaints (cough, dyspnea, shortness of breath, wheezing)	197 (35% of CR group)	87 (11.2% of control group)	Chi-square: p<0.01 OR=4.1 (95% CI 3.1-5.5) RR=2.0 (95% CI 1.7-2.2)
Regular use of nasal decongestants	116 (21% of CR group)	41 (5% of control group)	Chi-square: p<0.01 OR=4.3 (95% CI 3.0-6.3) RR=1.9 (95% CI 1.7-2.1)

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416 **Table 2. Characteristics of the chronic rhinitis group (N=560).**

The number of relevant nasal complaints		Mean ± SD	2.2 ± 1.7
		Median (IQR)	2 (1; 3)
The number of current nasal complaints		Mean ± SD	2.1 ± 1.5
		Median (IQR)	2 (1; 3)
Duration of nasal complaints per day		<1 hour per day	204 (36%)
		≥1 hour per day	310 (55%)
		Unknown	46 (9%)
Duration of nasal complaints per year (days per year)		Mean ± SD	206 ± 129
		Median (IQR)	200 (90; 365)
		Unknown	8
ARIA classification		Intermittent	247 (44%)
		Persistent	278 (50%)
		Unknown duration	35 (6%)
		Mild	128 (23%)
		Moderate/severe	396 (71%)
		Unknown severity	36 (6%)
VAS nasal complaints (0-100, mm)		Mean ± SD	39 ± 27
		Median (IQR)	34 (15; 61)
Self-reported allergic rhinitis			160 (30%)
Blockers vs Runners			
		Blockers	Runners
N		121	109
Age (Mean±SD)		53 ± 17	60 ± 20
Self-reported allergic rhinitis		42 (35%)	20 (18%)
ARIA classification	Intermittent	55 (46%)	37 (34%)
	Persistent	64 (53%)	68 (62%)
	Unknown duration	2 (2%)	4 (4%)
	Mild	15 (12%)	31 (28%)
	Moderate/severe	103 (85%) *	64 (59%) *
	Unknown severity	3 (3%)	14 (13%)
VAS nasal complaints (0-100 mm)		Mean ± SD	43 ± 27
		Median (IQR)	39 (17; 69)
			32 (19; 62)

417 *p<0.05

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426 **Figure 1: Chronic rhinitis group (N=560). Upper part: number of reported nasal complaints (%);**
427 **Lower part: prevalence (%) of nasal complaints.**

428 **Figure 2: Chronic rhinitis group (N=560). A: The most bothering nasal complaint, % of respondents**
429 **with chronic rhinitis who filled in this question (N=490). B: ARIA severity and duration.**

430 **Figure 3: 'Blockers' and 'Runners': prevalence (%) of nasal complaints.**

431 **Figure 4: 'Blockers' and 'Runners': ARIA severity& duration.**

432 **Attachment 1: The questionnaire on nasal and pulmonary complaints (Translated from Dutch)**

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