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CHRONIC BRONCHITIS IN AGRICULTURAL AND CHEMICAL WORKERS

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Epidemiological study of chronic bronchitis was performed in a group of 1193 randomly sampled agricultural workers and 268 chemical workers. The prevalence rates of respiratory symptoms and functional impairments were analysed according to occupation, sex, smoking habit and area of residence.

The statistical data compiled so far show that respiratory diseases are very frequently a cause of disability among the rural population as well as among some industrial workers. Recent studies emphasize the rôle of physical and chemical agents in the etiology of chronic bronchitis (1), though mere exposure cannot be incriminated as the only cause of these conditions: several factors act in combination. We tried to study the problem by observing two population groups with their particular living and working conditions. In our study of the prevalence of bronchitis which was carried as a field study the choice of criteria was of great interest. We had to keep in mind that all persons invited would not come for examination because of acute illness and therefore according to strict criteria suggested by *Higgins* (2) the real figures of the prevalence of bronchitis would be probably underestimated. From the multiplicity of criteria we selected some that were computer processed (in the Computer Center of Slovak Planning Committee by IBM 7040) and after finding the significant symptom combinations we used them throughout the study. The syndromes agreed with the findings of the British authors *Fairbairn, Wood* and *Fletcher* (3).

MATERIAL AND METHODS

The following methods were employed in our study of chronic bronchitis:

1) the interview concerning the symptoms of respiratory diseases, smoking habit and occupational history was conducted by three inde-

pendent specially trained interviewers in accordance with the standard British Medical Research Council's questionnaire translated into Slovak. The symptoms associated with chronic bronchitis such as cough, phlegm production, chest colds, brethlessness, wheezing, acute chest illness causing work incapacity for a week or more were classified according to their severity;

2) Godard's expirograph was used to measure breathing capacity, defined as forced vital capacity and forced expiratory volume/1 sec;

3) radiography of the lungs was performed (10×10 cm, in suspect cases also 35×35 cm);

4) some simple laboratory tests were perfomed, e. g. sedimentation rate (Westergreen), blood γ-globulin level and blood total mucoprotein level determination.

In this study 1193 agricultural workers and 268 factory workers were examined.

The system of syndrome grouping was based on *Šilink's (5)* mathematical approach evaluating the relative frequency of a symptom group in a population sample. The two groups examined were compared as to the probability of coexistence of certain respiratory symptoms, where (as shown in Table 1) figure 1 means cough first thing in the morning, 3

Table 1.

Brochitic symptom groups in agricultural workers (total number 1191.0)

Persistent cough and expectoration	
symptom-group proved	
/1+/3—5—6/+8/—10	
inequality left side = 0.196474	inequality right side = 0.101255
Simple bronchitis	
symptom-group proved	
/6+8/—10—2	
inequality left side = 0.162049	inequality right side = 0.019988
Chronic bronchitis with spells (recurrent exacerbations)	
symptom-group proved	
/1+/3—5—6/+8/—1/—21	
inequality left side = 0.076406	inequality right side = 0.002232
Chronic bronchitis with obstructive symptoms	
Simple bronchitis	
6—12—14	
inequality left side = 0.037783	inequality right side = 0.005530

Symbols: + or
— and

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usual cough during the day and at night in winter, 5 cough most days for as much as three months each year, 6 the bringing upof phlegm first thing in the morning in winter, 8 the bringing up of phlegm from the chest during the day or at night in winter, 10 the bringing up of phlegm most days for as much as three months each year, 12 periods of increased cough and phlegm lasting 3 weeks or more, 14 shortness of breath when walking quickly on level ground or walking up a slight hill, and finally 21 chest illness within the past 3 years keeping the patient out of work, indoors or at home in bed.

The results of this evaluation in the group of agricultural and chemical workers are presented in Tables 1 and 2.

Table 2.

Brochitic symptom groups in chemical factory workers (total number 268.0)

Persistent cough and expectoration	
symptom-group proved	
/1+/3—5—6/+8/—10	
inequality left side = 0.313433	inequality right side = 0.255652
Simple bronchitis	
symptom-group proved	
/6+8/—10—2	
inequality left side = 0.238806	inequality right side = 0.072332
Chronic bronchitis with spells (recurrent exacerbations)	
symptom-group proved	
/1+/3—5—6/+8/—1/—21	
inequality left side = 0.070896	inequality right side = 0.008637
Chronic bronchitis with obstructive symptoms	
symptom-group proved	
6—12—14	
inequality left side = 0.037783	inequality right side = 0.005530

Symbols: + or
— and

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The grouping of symptoms into characteristic syndromes was considered acceptable with a satisfactory level of probability.

Prevalence of chronic bronchitis

The actual prevalence of nonspecific respiratory diseases at the time of study on grouping the symptoms according to occupation, sex, smoking habit and residence area (northern and southern region) was evaluated as shown in Table 3.

The prevalence of bronchitis amounted to 19.8% in farmers and 31.7% in chemical workers. According to sex and smoking habit the rate of bronchitis was, as expected, more than three times higher in males than in females the relation of smokers to nonsmokers being the same. The residence factor (north, south) seemed to be a much weaker influencing factor than sex and smoking habit, but more pronounced differences were found in the distribution pattern of particular syndromes, such as simple bronchitis and recurrent bronchitic exacerbations. The distribution pattern shows an increase in the prevalence of persistent cough in chemical workers as compared with agricultural workers. A striking decrease in the prevalence rate of the recurrent exacerbating form of bronchitis in chemical workers also deserves mention. The unfavourable influence of smoking on the prevalence of bronchitis seems to be equally pronounced in both groups.

Breathing tests

To evaluate the relationship between the prevalence rate of chronic bronchitis and expiratory volumes FVC and $FEV_{1.0}$ tests expressed as percentage of standard values were carried out. The results of the tests performed in healthy and bronchitic population subgroups are summarized in Tables 4,5 and 6 according to sex. occupation and geograplical location. The FVC and $FEV_{1.0}$ values obtained in healthy persons were 86.83% and 73.65% for men and 72.21% and 75.02% for women; the difference was significant at a probability level of 1% in the case of FVC only. In mixed groups (men+women) comparison of $FEV_{1.0}$ values was reliable, the difference between the values for men and women being insignificant. A significant decrease in $FEV_{1.0}$ values was found in chemical workers. Surprisingly the difference was not demonstrable between healthy and bronchitic persons in the two groups examined in so far as the $FEV_{1.0}$ value was concerned. A comparison between the two regions (north and south) proved slightly in favour of the southern part when spirometric values were compared between healthy and $FEV_{1.0}$ values were considered for both sexes. The smokers both cupation were considered (Table 5) a very complex relationship was found between the groups. Contradictory results surprised us when FVC and $FEV_{1.0}$ values were considered for both sexes. The smokers both healthy and bronchitic, among agricultural as well as among chemical workers had often better values than nonsmokers, so that presumably the smoking habit in healthy or bronchitic groups cannot be considered as a decisive factor in respiratory impairment. On the other hand, a decrease in the expiratory volumes was demonstrable when healthy and bronchitic persons were compared and in the whole studied population the difference was significant at a level of 1%. To answer the question, whether smoking habit is more detrimental in one of the

Table 3.
Prevalence rate of chronic bronchitis. Agricultural workers

	Total number				Syndromes % (related to total)				Syndromes % (related to »Bronchitis«)			
	%	Bronchitis		%	p. c	s. b.	r. b. e.	ch. o. b.	p. c	s. b.	r. b. e.	ch. o. b.
Total:												
all	1193	100,0	236	19,8	2,1	10,0	3,8	3,9	10,6	50,4	19,1	19,9
males	587	49,2	176	30,0	3,0	15,5	5,4	6,1	9,6	51,7	18,2	20,4
females	606	50,8	60	9,9	1,3	4,6	2,1	1,8	13,3	46,7	21,7	18,3
smokers	357	29,9	126	35,3	2,5	19,6	6,7	6,4	7,1	55,5	19,0	18,2
nonsmokers	836	70,1	110	13,1	1,9	5,8	2,5	3,0	14,5	44,5	19,1	21,8
North:												
all	480	100,0	93	19,4	8,3	12,3	2,3	3,9	4,3	63,4	11,8	20,4
males	160	33,3	62	38,7	1,2	24,4	4,4	8,7	3,2	62,3	11,3	22,6
females	320	66,6	31	9,7	0,6	6,0	1,2	1,7	6,4	64,5	12,9	16,1
smokers	110	22,9	48	43,6	1,8	27,3	4,6	10,0	4,2	62,5	10,4	22,9
nonsmokers	370	77,1	45	12,2	0,5	7,8	1,6	2,2	4,4	64,4	13,3	17,8
South:												
all	713	100,0	143	20,0	2,9	8,4	4,8	3,9	14,7	41,9	23,8	19,6
males	427	59,9	114	26,7	3,5	12,8	5,8	5,1	13,1	45,6	21,9	19,3
females	286	40,1	29	10,1	2,1	2,8	3,1	2,1	20,7	27,6	31,0	20,7
smokers	247	34,6	78	31,6	2,8	16,2	7,7	4,8	9,0	51,3	24,3	15,3
nonsmokers	466	65,3	65	13,9	3,0	4,3	3,2	3,4	21,5	30,8	23,0	24,6
Chemical workers												
all	286	100,0	85	31,7	6,0	16,2	1,9	7,8	18,8	50,6	5,9	24,7
males	260	97,0	85	32,7	6,1	16,5	1,9	8,1	18,8	50,6	5,9	24,7
females	8	3,0	0	—	—	—	—	—	—	—	—	—
smokers	165	61,6	73	44,2	7,9	23,0	3,0	10,3	17,8	52,0	6,8	23,3
nonsmokers	103	38,4	12	11,6	2,9	4,8	—	3,9	25,0	41,7	—	33,3

Abbrev.: p. c. = persistent cough; s. b. = simple bronchitis; r. b. c. = recurrent bronchitis exacerbations; ch. o. b. = chronic obstructive bronchitis

Table 4.

FUC and $FEU_{1.0}$ values as percentage of standard values

		Healthy				Bronchitic				Healthy vs. Bronch.
		N	ϕ	δ	t	N	ϕ	δ	t	t
men	FVC %	559	86.83	19.56		204	79.70	18.84		
	FEV_1 %		73.65	16.13			71.52	17.15		
					11,338				**5.010**	
					1.415				1.104	
women	FVC %	455	73.21	18.31		44	64.73	14.74		
	FEV_1 %		75.02	14.10			74.59	14.33		
agricult.	FVC %	815	77.17	19.39		179	72.64	17.39		**3.013**
w.	FEV_1 %		76.65	14.62			74.72	16.79		1.559
					12.089				**6.477**	
					10.508				**4.149**	
chemical	FVC %	119	95.23	20.70		69	88.75	17.71		**2.314**
w.	FEV_1 %		64.49	14.65			65.17	14.43		0.333
north	FVC %	437	79.35	21.73		96	70.56	17.61		
r.	FEV_1 %		69.30	15.19			68.23	17.20		
					1.874				**4.497**	
					9.298				**2.903**	
south	FVC %	577	81.75	18.86		152	81.26	18.53		
r.	FEV_1 %		78.02	13.79			74.18	15.95		

[ ] Significant at the 1 % level

Table 5.

Relationship of smoking habit and FUC and $FEV_{1.0}$ values

			Healthy				Bronchitic				Healthy vs. Bronch.
			N	ϕ	δ	t	N	ϕ	δ	t	t
Total	smokers	FVC %	244	87.38	17.90		165	81.50	18.14		**3.370**
		FEV_1 %		72.87	16.57			72.61	16.61		0.374
						3.776				**2.795**	
						5.054				1.664	
	non smokers	FVC %	265	85.74	23.00		39	72.43	19.51		**3.478**
		FEV_1 %		74.43	15.84			66.48	18.76		**5.748**
Agricult. w.	smokers	FVC %	193	83.25	16.89		107	77.21	17.65		**2.887**
		FEV_1 %		78.51	13.78			76.61	17.05		0.695
						1.009				**2.620**	
						0.455				**2.319**	
	non smokers	FVC %	175	81.08	19.55		28	67.14	17.60		**3.400**
		FEV_1 %		79.21	15.66			67.48	20.07		**3.432**
Chemical w.	smokers	FVC %	101	94.98	17.19		58	89.43	14.54		**2.056**
		FEV_1 %		62.48	16.23			64.14	19.16		0.576
						0.056				1.107	
						1.486				0.015	
	non smokers	FVC %	90	94.83	18.63		11	85.29	16.34		**1.602**
		FEV_1 %		65.09	7.96			64.04	14.72		0.361

[ ] Significant at the 1 % level

Table 6.

FVC and $FEV_{1.0}$ values in agricultural and chemical workers as related to smoking habit

			Healthy				Bronchitic			
			N	ϕ	δ	t	N	ϕ	δ	t
Smokers	agricult. w.	FVC %	193	83.25	16.89		107	77.21	17.65	
		FEV_1 %		78.51	13.78			76.61	17.05	
						6.317				4.559
						8.789				4.177
	chemical w.	FVC %	101	94.98	17.19		58	89.43	14.54	
		FEV_1 %		62.48	16.23			64.14	19.16	
Non smokers	agricult. w.	FVC %	175	81.08	19.55		28	67.14	17.60	
		FEV_1 %		79.21	15.66			67.48	20.07	
						5.440				2.823
						8.038				0.518
	chemical w.	FVC %	90	94.83	18.63		11	85.29	16.43	
		FEV_1 %		65.09	7.96			64.04	14.72	

[ ] Significant at the 1 % level

two occupations, we compared smokers and nonsmokers among agricultural and chemical workers, taking healthy and bronchitic persons separately (Table 6). Although the FVC and $FEV_{1\cdot0}$ values were rather contradictory, the general pattern was clearly independent of occupation and smoking habit.

Chest radiography

Chest radiography was performed to detect the so called »emphysema – bronchitis« complex using accepted criteria (6, 7). The prevalence of »emphysema« according to the criterion B (Table 7) including X-ray finding indicative of »emphysema« and $FEV_{1\cdot0}$ values below 60% of standard values was only 1% in the entire group examined. When criterion A was applied the corresponding figure amounted to 11.5%. Corresponding figures for agricultural and chemical workers are presented in the same table. A low prevalence rate of »emphysema« in the related groups was evident even when stricter criteria were used. According to these data the coincidence of »emphysema - bronchitis« seemed to be 51.6% in the case of chemical and only 30% in the case of agricultural workers.

Laboratory examinations

Results of blood sedimentation rate, γ – globulin level and total mucoprotein level determination are summarized in Table 8. It is shown, that only 30.5% of increased erythrocyte sedimentation rate coincided with chronic bronchitis, while 24.3% of increased γ – globulin level and 22.7% of elevated mucoprotein level were present in persons who at the same time had bronchitis symptoms. The highest rate of coincidence between positive laboratory findings and particular syndromes was found, surprisingly, in simple bronchitis and not in its complicated form.

DISCUSSION

Our study into the prevalence of chronic bronchitis partly confirms the supposition, that the agricultural worker is not so frequently affected by chronic airway disturbances as the industrial worker. The question whether the latter is also more disabled is of great interest from the practical point of view.

The fact that chronic bronchitis can be recognized in its early stages only from the patient's account of symptoms (3) underlines the essential rôle of the interview method in many studies. To our opinion the great value of the questionnaire lies in its being able to reveal all suspect cases in a large population sample. The data obtained must be evaluated by further analyses. According to our experience, the great differences in the rates of prevalence amounting sometimes from an insignificant

Table 7.

Prevalence of »emphysema« in agricultural and chemical workers

	N	Criterion A	Bronchitis (related to criterion A)	Criterion B	Bronchitis (related to criterion B)
Agricult. w.	809	90 (11.1 %)	27 (30.0 %)	10 (1.2 %)	6 (60.0 %)
Chemical w.	241	31 (12.8 %)	16 (51.6 %)	1 (0.4 %)	0
Total	1050	121 (11.5 %)	43 (35.5 %)	11 (1.0 %)	6 (54.5 %)

Criterion A : $FEV_1 < 60\%$

Criterion B : $FEV_1 < 60\%$ + X-Ray symptoms

Table 8.

Laboratory tests

Sedimentation rate

Total	N	Healthy	Bronchitis	p. c.	s. b.	r. b. c.	ch. o. b.
>30 mm/2 hrs.	36 (16.7%)	25 (69.5%)	11 (30.5%)	3 (27.3%)	4 (36.4%)	0	4 (36.4%)
<30 mm/2 hrs.	180 (83.3%)	120 (66.7%)	60 (33.3%)	24 (40.0%)	24 (31.7%)	2 (3.3%)	15 (25.0%)

γ – globulin level

Total	N	Healthy	Bronchitis	p. c.	s. b.	r. b. c.	ch. o. b.
>22 %	256 (32.8%)	194 (75.7%)	62 (24.3%)	9 (14.5%)	33 (53.2%)	9 (14.5%)	11 (17.7%)
<22 %	542 (67.9%)	415 (76.6%)	127 (23.4%)	28 (22.0%)	67 (52.7%)	19 (15.0%)	13 (10.2%)

Total mucoproteins (as mg thyrosine)

Total	N	Healthy	Bronchitis	p. c.	s. b.	r. b. c.	ch. o. b.
>2.2 mg	66 (13.9%)	51 (77.3%)	15 (22.7%)	2 (13.3%)	11 (73.3%)	0	2 (13.3%)
<2.2 mg	408 (86.1%)	296 (72.5%)	112 (27.5%)	14 (12.5%)	63 (56.3%)	15 (13.4%)	20 (17.8%)

p. c. = permanent cough
s. b. = simple bronchitis
r. h.c. = recurrent bronchitis exacerbations
ch. o. b. = chronic obstructive bronchitis

percentage to as much as 50–70% are partly due to the fact that complaints are not always interpreted uniformly by interviewers. In general it seems that farmers are more stoical and do not like admitting respiratory troubles apparently underestimating cough and expectoration. In our earlier studies we emphasized the relative independence of the prevalence rate of respiratory syndromes and their functional equivalents. The fact, that agricultural workers showed faster functional deterioration with age than chemical workers (9) should also be taken into account. Though many factors responsible for the occurrence of chronic bronchitis are well known, the smoking habit playing an important role, the problem of the etiology of chronic bronchitis in different population groups still remains to be solved. The smoking habit was fairly uniformly distributed among the population groups observed and no evidence was found, that smoking might be more detrimental to the agricultural than to the chemical worker. The climatic factor playing an obvious rôle in agricultural work was also taken into consideration but without satisfactory results. Air pollution, which dominates as an unfavorable factor in chemical industry might have certain but not dominant influence in agricultural work. Thus it seems probable, that a complex of detrimental factors, partly physical and partly of social nature are responsible for the incidence of bronchitis. The fact that only healthy people who went through a medical examination are employed in industry, while in agriculture such selection is not made, might also account for impaired health condition. Further information concerning these problems must be gathered to clear up the question of the occupational origin of respiratory impairments in agricultural workers.

CONCLUSIONS

In an epidemiological study of chronic bronchitis 1193 randomly sampled agricultural workers and 268 chemical workers were examined by means of the standard British Medical Research Council's questionnaire and some supplementary methods. The prevalence rates were 19.8% and 31.7% respectively, males being more affected than females, smokers more than nonsmokers. Functional impairments were almost equal in both groups. The influence of an unfavorable complex of physical and social factors in the occurence of chronic bronchitis in agricultural workers is discussed.

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Sadržaj

KRONIČNI BRONHITIS U POLJOPRIVREDNIKA I RADNIKA ZAPOSLENIH U KEMIJSKOJ INDUSTRIJI

Provedeno je ispitivanje prevalencije kroničnog bronhitisa u grupi od 1193 poljoprivrednika i 268 radnika zaposlenih u hemijskoj industriji.

Za ispitivanje korišten je upitnik o respiratornim simptomima koji je izradio Komitet za etiologiju kroničnog bronhitisa Britanskog savjeta za medicinska istraživanja. Određivan je forsirani vitalni kapacitet i forsirani ekspiratorni volumen u 1,0 sek. Pored toga ispitanici su rendgenski pregledani i izvršeni su i jednostavni laboratorijski testovi (brzina sedimentacije eritrocita, gama-globulini i totalni proteini u krvi).

Prije prikaza odnosno ocjene rezultata izvršeno je grupiranje simptoma odnosno sindroma dobivenih anketiranjem ispitanika. Za to je korišten matematski model koji je razradio Šilink.

Utvrđena stopa kroničnog bronhitisa iznosila je 19,8% u poljoprivrednika i 31,7% u radnika zaposlenih u kemijskoj industriji. Prevalencija pojedinačnih respiratornih simptoma odnosno njihovih kombinacija (sindroma) također je analizirana u svakoj od ispitanih grupa, vodeći računa o spolu, navici pušenja i prebivalištu (sjeverni i južni dio Slovačke). Muškarci su imali veću učestalost respiratornih simptoma-sindroma od žena a pušači od nepušača. Nisu utvrđene razlike s obzirom na geografsku distribuciju prebivališta.

Funkcionalna oštećenja bila su gotovo jednako raspoređena u grupi poljoprivrednika i grupi tvorničkih radnika.

U diskusiji se pokušavaju izložiti moguća tumačenja dobivenih rezultata.

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