Multidisciplinar (Montevideo). 2024; 2:96
doi: 10.62486/agmu202496
ISSN: 3046-4064

ORIGINAL

Respiratory signs and symptoms due to dust exposure in wheat mill workers

Signos y síntomas respiratorios por exposición a polvo en trabajadores de un molino de trigo

Elisa M. Teixeira Villamediana[1], Cheyla Másin[2], Leonard Colmenares[2], Evelin Escalona[3], Estela Hernández-Runque[3]

[1]Maestría en Salud Ocupacional e Higiene del Ambiente Laboral de la Universidad de Carabobo. Venezuela.
[2]Universidad de Carabobo. Venezuela.
[3]Programa de Doctorado de Salud Pública. Universidad de Carabobo, Venezuela.

Cite as: Teixeira Villamediana EM, Másin C, Colmenares L, Escalona E, Hernández-Runque E. Respiratory signs and symptoms due to dust exposure in wheat mill workers. Multidisciplinar (Montevideo). 2024; 2:96. https://doi.org/10.62486/agmu202496

Submitted: 19-12-2023 **Revised:** 14-04-2024 **Accepted:** 08-08-2024 **Published:** 09-08-2024

Editor: Telmo Raúl Aveiro-Róbalo

ABSTRACT

Objective: describe the respiratory signs and symptoms presented in workers exposed to dust in a wheat mill in Venezuela.
Method: descriptive, field, non-experimental and cross-sectional design; SNOT-22, ATS-DLD-78A questionnaire and physical examination were applied.
Results: the identified symptoms consisted of sneezing, subsequent rhinorrhea, wheezing and dyspnea, however, they predominated in the positions with lower exposure to dust (p-value <0,05). The use of personal respiratory protective equipment and joint exposure to chemical vapors imply the presence of anterior rhinorrhea; and wheezing episodes two or more times a year occurred with a greater number of hours exposed to dust (p-value=0,028).
Conclusion: the level of exposure did not have statistical significance with upper respiratory manifestations except in cases where there was joint exposure to chemical vapors; however, recurrent wheezing was related to the hours of exposure to dust.

Keywords: Occupational Exposure to Dust; Wheat Mill; Allergic Rhinitis; Respiratory Symptoms.

RESUMEN

Objetivo: describir los signos y síntomas respiratorios presentados en trabajadores expuestos a polvo en un molino de trigo en Venezuela.
Método: diseño descriptivo, de campo, no experimental y corte transversal; Se aplicó cuestionario SNOT-22, ATS-DLD-78A y examen físico.
Resultados: la clínica identificada consistió en estornudos, rinorrea posterior, sibilancia y disneas, sin embargo, predominaron en los cargos de menor exposición a polvo (p-valor <0,05). El uso de equipo de protección personal respiratoria y la exposición conjunta a vapores químicos determinó presencia de rinorrea anterior; y los episodios de sibilancia dos o más veces al año se presentaron ante mayor número de horas expuestos a polvo (p-valor=0,028).
Conclusión: el nivel de exposición no tuvo significancia estadística con las manifestaciones respiratorias altas salvo en casos donde existió exposición conjunta a vapores químicos; sin embargo, la sibilancia recurrente tuvo relación a las horas de exposición a polvo.

Palabras clave: Exposición Ocupacional a Polvo; Molino de Trigo; Rinitis Alérgica; Síntomas Respiratorios.

INTRODUCTION

The respiratory system serves as a conduit for a multitude of occupational hazards, including fumes, toxic vapors, and particulate matter.[1] The latter encompasses dust, defined as "solid particles originating from the mechanical breakdown of solids".[2] Wheat milling, which consists of a grain crushing process, is a source of dust both in residue and in its final product: wheat flour:[3] a heterogeneous organic dust composed of various allergens[4] capable of causing irritation upon acute exposure to large quantities[5] and IgE-mediated sensitization upon prolonged exposure.[6]

The magnitude and duration of occupational exposure, in addition to an individual's inherent susceptibility to wheat, serve as pivotal determinants in the characterization of the body's response.[5,7] This response, which is initially manifested as inflammation, mucus production, and irritation,[8] is contingent upon these risk factors. Since the upper respiratory tract has greater contact with dust, upper respiratory symptoms prevail in exposed workers; rhinitis manifested by sneezing and rhinorrhea is the most frequent symptoms,[5,9,10] with hoarseness, nasal obstruction, itching of the nose, ears and throat[8], commonly accompanied by ocular irritation.[11]

Rhinitis precedes the appearance of lower respiratory symptoms in up to 50 % of cases of occupational asthma,[11] defined as chronic pulmonary disease that generates respiratory symptoms described as the presence for at least three months in a year of cough, expectoration, dyspnea, wheezing and/or chest tightness.[12] Wheat flour is identified as the etiologic agent in one-tenth of cases of occupational asthma, which is referred to as "baker's asthma".[8,9]

The wheat milling industry is characterized by poorly sealed processes with dust leakage,[10,11,13] and poor ventilation,[6] which increases the exposure of workers to dust, especially in facilities with old technology and manual execution of tasks.[14]

The object of study is one of the 14 wheat mills in Venezuela[15] located in the central-northern region. This particular mill has an automated milling unit and dust atmospheres that exceed the reference limits (established at 4 mg/m^3 of respirable fraction,[16] in 37 % of the production areas.[17] In order to address these issues, the following control measures have been implemented: dust filters, provision of respiratory personal protective equipment (PPE) and periodic spirometry.

Despite the high prevalence of occupational respiratory symptoms, the worldwide relevance of the milling sector, and the recognition of greater exposure to dust in the mills, studies in Latin America are primarily focused on bakeries.[11] There is a paucity of research describing the respiratory symptoms experienced by workers in this industry. This research aimed to address this gap in the literature. The objective of this study was to describe the respiratory signs and symptoms presented by workers exposed to dust in a wheat mill in Venezuela.

METHOD

The research was conducted in accordance with the principles of the positivist, descriptive, field, non-experimental, and cross-sectional paradigms, as well as the ethical standards set forth in the Declaration of Helsinki. Written consent was obtained from all subjects prior to their participation. The population is comprised of 40 workers, sampled purposively in accordance with the following inclusion criteria: 1. Exposure to dust during the working day, 2. Written acceptance of participation in the study, 3. At least one year of work seniority, 4. Active status at the time of the research. Two subjects were excluded from the study because they did not meet the aforementioned criteria, resulting in a final sample size of 38 workers.

Data collection was conducted between July and September 2023 through the administration of a self-report questionnaire. This instrument was utilized to ascertain sociodemographic and occupational variables, in addition to rhinosinusitis-related symptoms as delineated in sections 1-10 and 21-22 of the SNOT-22. The latter were quantified according to a Likert scale, reflecting the perceived severity of the problem. Lower respiratory symptoms and history of interest were taken from sections 7-15 of the American Thoracic Society ATS-DLD-78A questionnaire (adult version). The two instruments have been subjected to rigorous validation by other researchers.

A comprehensive physical examination was conducted at the company's occupational medical service facilities to identify any respiratory signs. This entailed performing pharyngoscopy, tonsil graduation according to the Brodsky scale, rhinoscopy, turbinate graduation, otoscopy, external inspection of the eye, and inspection and thoracic auscultation.

The data were processed using the statistical analysis software IMP SPSS Statistics, version 25. This enabled the determination of absolute and relative frequency, statistical mean, standard deviation, and significance parameters by Pearson correlation with a p-value of less than 0,05. These were then presented in tables for subsequent analysis.

RESULTS

The mean age of the subjects in the wheat mill was 43,11 years (standard deviation ±11,74), with a clear

predominance of individuals in the 20-39 age range. The male-to-female ratio was 7:1.

Table 1. Personal history of workers in a wheat mill. Venezuela

Antecedents	Category	Fr	%
Sex	Male	33	86,8 %
	Female	5	13,2 %
Age* (años)	20-39	20	52,6 %
	40-59	13	34,2 %
	>60	5	13,2 %
Personal	Rhinosinusopathy	11	28,9 %
	Asthma	5	13,2 %
	Covid19	16	42,1 %
	Atopy	11	28,9 %
	Nasal trauma	2	5,3 %
	Smoking	9	23,7 %
Family	Atopy/Asthma	14	36,8 %

* Age: Min-max:: 21 - 67 years old

Covid-19 was the most prominent personal history (Table 1), followed by rhinosinusopathy and atopy; in the latter, dust was reported as an allergen in 100 % of the cases. The other records reviewed did not yield statistically significant results for the respiratory manifestations in question.

Regarding work history (Table 2), the length of service was 14,66 years (±12,2). 65,8 % work in production area positions (mill operator, wheat cleaning, bagging; loading and unloading assistant; and supervisor) with high exposure to wheat dust of more than 4 hours, while 34,2 % work in operational positions (electromechanic, quality inspector, area manager and manager) with low to moderate exposure, less than 4 hours, at a ratio of 2:1.

The total sample utilizes some form of respiratory protective equipment (PPE), yet only 60,5 % of the sample does so without interruption and with adequate characteristics for exposure to dust (N95 filter and double filter). In contrast, the entire high-exposure group, which is exclusively male, has access to more appropriate masks (p-value=0,049). Continuous use of PPE is more prevalent in older people, while younger people and those exposed to chemical vapors tend to use them intermittently with statistical significance by p-value=0,022 and p-value=0,02 respectively.

Furthermore, the workers reported exposure to additional respiratory risk agents, including chemical vapors (solvents), vehicle fumes, and excreta (birds and rodents). A significant correlation was observed between exposure to these agents and self-reported cases of “dust allergy” (p-value = 0,021).

Table 2. Labor history of workers in a wheat mill. Venezuela

Labor	Category	Fr	%
Seniority* (years)	1-10	18	47,4 %
	11-20	9	23,7 %
	21-30	6	15,8 %
	31-40	3	7,9 %
	41-50	2	5,3 %
Job	Operator: Mill	7	18,4 %
	Operator: wheat cleaning	4	10,5 %
	Operator: bagging	6	15,8 %
	Auxiliary: Loading/Unloading	3	7,9 %
	Supervisor	5	13,2 %
	Electromechanical	2	5,3 %
	quality inspector	4	10,5 %
	Management/Area Manager	7	18,4 %
Exposure (hours)	<4	13	34,2 %
	4-8	17	44,7 %
	8-12	8	21,1 %
EPP	None	0	0,0 %
	Disposable/Cloth	15	39,5 %
	N95 Filter	3	7,9 %
	Double filter	20	52,6 %

https://doi.org/10.62486/agmu202496 ISSN: 3046-4064

Use of EPP	Always	23	60,5 %
	Intermittently	15	39,5 %
	Never	0	0,0 %
Other respiratory hazards	Excretes (Birds/Rodents)	19	50,0 %
	Vehicle Smoke	16	42,1 %
	Chemical Vapors	21	55,3 %
*Seniority: Min-Max: 1 - 47 years			

Table 3 on self-reported respiratory symptoms shows that workers with high dust exposure had higher percentages of asymptomatic, only high respiratory symptoms, and only low respiratory symptoms with no significant relationship; on the other hand, workers with low-medium exposure had a significant relationship for the simultaneous presence of both high and low respiratory symptoms (p-value=0,046).

The low-medium exposure group had a higher frequency of upper respiratory tract manifestations, self-reporting 1 to 11 out of 12 symptoms (mean: 5±3), with sneezing being the most frequent and intense, followed in frequency by the need to blow the nose, persistent nasal mucus, and secretion behind the throat, and in intensity by coughing, nasal congestion, and secretion behind the throat. In contrast, the high dust exposure group self-reported 1 to 8 symptoms (mean: 5 ± 2), with nasal obstruction being the most common, followed by sneezing and the need to blow the nose; loss of smell and taste, facial pressure, and secretion behind the throat dominated in intensity. No significance was found between dust exposure and these symptoms; however, in both groups, the highest number of upper respiratory tract manifestations was found in cases with a history of Covid-19 (p-value=0,01).

In relation to lower respiratory symptoms, the presence of 7 manifestations was consulted, identifying 1 to 4 symptoms in both exposed groups (mean 2 ±1); with a percentage predominance for those with low to medium exposure, significant for Dyspnea (p-value=0,005) and Phlegm (p-value=0,20); on the other hand, in the high exposure group, pulmonary complications predominated, although without statistical significance.

When correlated with other variables, hours of exposure was found to be significant for the recurrence of wheezing episodes (p-value=0,028); furthermore, the greater the likelihood of having low respiratory symptoms, the greater the number of high respiratory symptoms reported (p-value=0,038).

Table 3. Self-reported respiratory symptoms of workers in a wheat mill. Venezuela

Respiratory Symptoms	**Low-Medium Exposure (n=13)**			**High Exposure (n=25)**			***P-valor***
	Fr	**%**	**Medium intensity**	**Fr**	**%**	**Medium intensity**	
Asymptomatic	1	7,69 %	-	5	20,0 %	-	0,337
High	3	23,08 %		11	44,0 %		0,399
Low	1	7,69 %		2	8,0 %		0,053
High and Low	8	61,54 %		7	28,0 %		0,046
High Total	11 (5)*	84,62 %	-	18 (5)*	72,0 %	-	0,540
Need to blow the nose	6	46,15 %	1,83	11	44,0 %	2,27	0,710
Sneezing	7	53,85 %	2,29	13	52,0 %	2,38	0,984
continuous runny nose	6	46,15 %	2	9	36,0 %	2,22	0,776
Cough (Throat)	4	30,77 %	2,25	8	32,0 %	1,75	0,712
Discharge from the back of the throat	6	46,15 %	2,16	8	32,0 %	2,5	0,664
Thick nasal discharge	4	30,77 %	1,75	5	20,0 %	1,8	0,535
Blocked ear	5	38,46 %	1,6	10	40,0 %	2,2	0,514
dizziness	2	15,38 %	1	1	4,0 %	1	0,228
Earache	1	7,69 %	1	1	4,0 %	1	0,640
Pressure/pain in the face	2	15,38 %	1	2	8,0 %	2,5	0,828
nasal obstruction	5	38,46 %	2,2	14	56,0 %	1,85	0,654
Loss of smell/taste	2	15,38 %	1,5	1	4,0 %	4	0,781
Low Total	9 (2)*	69,23 %	-	9 (2)*	36,0 %	-	0,072
Cough (chest)	0	0,00 %		2	8,0 %		0,308
phlegm	4	30,77 %		1	4,0 %		0,020
Cough with Phlegm	3	23,08 %		3	12,0 %		0,388
Wheeze	4	30,77 %		5	20,0 %		0,472
Wheeze +2/years	1	7,69 %		4	16,0 %		0,486
Dyspnea	5	38,46 %		1	4,0 %		0,005
Pulmonary complication	3	23,08 %		5	20,0 %		0,831

* Expressed in: Frequency of people affected (Average number of symptoms).

On physical examination (table 4), the main sign identified was posterior rhinorrhea, which predominated in workers with low to medium exposure (p-value=0,016), who also presented granular pharynx with a significant relationship (p-value=0,018); anterior rhinorrhea predominated in the high exposure group, without statistical significance for the level of exposure to dust, but with the use of better respiratory protection equipment for dust (p-value=0,019) and common exposure to chemical vapors (p-value=0,016).

In contrast, the high exposure group exhibited diminished thoracic expansibility in 24 % of cases, accompanied by increased variability in thoracic morphology and greater turbinate and tonsillar grading. Conversely, the identification of aggregate respiratory sounds (wheezing) was consistent across both exposure groups, though these findings lacked statistical significance.

Table 4. Signs identified on physical examination of workers in a wheat mill. Venezuela

Signs Fr		Low-Medium Exposure (n=13)		High Exposure (n=25)		*P-valor*
		%	Fr	%		
Rhinorrhea	Anterior	1	7,69 %	8	32,0 %	0,100
	Posterior	10	76,92 %	9	36,0 %	0,016
Sinus Pain		1	7,69 %	1	4,0 %	0,64
Granular Pharynx		6	46,15 %	3	12,0 %	0,018
Turbinates (Grades)	1	6	46,15 %	6	24,0 %	0,479
	2	3	23,08 %	12	48,0 %	
	3	4	30,77 %	7	28,0 %	
	4	0	0,00 %	0	0,0 %	
Tonsils (Grades)	0	2	15,38 %	0	0,0 %	0,055
	1	5	38,46 %	9	36,0 %	
	2	6	46,15 %	12	48,0 %	
	3	0	0,00 %	3	12,0 %	
	4	0	0,00 %	1	4,0 %	
Thoracic Expandability	Normal	12	92,31 %	19	76,0 %	0,230
	Reduced	1	7,69 %	6	24,0 %	
Thorax	Normal	12	92,31 %	19	76,0 %	0,130
	Barrel	0	0,00 %	2	8,0 %	
	Excavatum	0	0,00 %	3	12,0 %	
	Kyphotic	1	7,69 %	1	4,0 %	
Respiratory sounds	Bullous	1	7,69 %	1	4,0 %	0,5
	wheezing	1	7,69 %	1	4,0 %	
	No Aggregates	11	84,62 %	23	92,0 %	
Other Findings	Cough	0	0,00 %	1	4,0 %	0,478
	Dermatitis	0	0,00 %	3	12,0 %	0,203
	Telangiectasia Nasal	0	0,00 %	5	20,0 %	0,088
	Pterygium	0	0,00 %	1	4,0 %	0,478
	Conjunctivitis Irritative	2	15,38 %	6	24,0 %	0,549
	Dark Circles	2	15,38 %	3	12,0 %	0,777

Extra-respiratory findings predominated in workers with high dust exposure, without significance; however, history of atopy was a determining factor in their prevalence (p-value=0,001); similarly, cases with a history of rhinorrhea were associated with the presence of irritant conjunctivitis (p-value=0,049) and dark circles under the eyes (p-value=0,022).

DISCUSSION

Consistent with previous studies, the wheat milling industry is characterized by a predominantly male population;[6,12,14,18] the average age is much higher than that found in African studies.[6,12,14] In comparison to research conducted in Latin America, the average age and length of service were considerably higher than those observed in Costa Rica.[18] In the mill under examination, 100 % of the sample population utilized some form of respiratory protection. In contrast, the background information reviewed was characterized by insufficient, minimally utilized,[6] or non-existent[13] measures.

Regarding exposure to other occupational agents of respiratory interest, Iyogun et al.[14] highlight diesel

fumes in rudimentary mills; since the mill studied is industrial and automated, exposure to hydrocarbon combustion fumes does not result from the milling process per se, but from vehicles loading raw materials and finished products, and occupies the third place of importance considered by workers, preceded by the presence of excreta (birds/rodents) and chemical vapors from solvents used in maintenance and bag printing activities.

Regarding respiratory signs and symptoms, Lagiso et al.[12] identified chronic low respiratory manifestations predominantly dry cough with statistical significance for hours of exposure and seniority (p-value<0,05), a result similar to that previously found by Demeke, & Haile[6]; and slightly higher than the present investigation where low respiratory symptoms were reported in 47,37 % of the sample; wheezing being the self-reported sign of higher net frequency, for the general sample and workers with higher exposure to dust.

The aforementioned studies did not consider upper respiratory tract manifestations, which were the predominant ones in the present study; in this regard, Said *et al.*[13] identified 10 % of subjects with upper respiratory tract symptoms, a marked difference from the 76,32 % reported in the present study; coinciding with sneezing as the most frequent sign and congruent with the 83,33 % reported by Ahire et al.[10], in millers of Kolhapur City, India.

Ocular irritation was the most frequent non-respiratory finding for the sample (21,1 %) in both exposure groups; followed by the presence of dermatitis (Eczema), a similar result although with a lower percentage than those found in previous research.[10,18]

CONCLUSIONS

The research approached the reality of a wheat mill in Venezuela, identifying no relationship between the magnitude of exposure to dust and the respiratory manifestations studied, except in cases where there was joint exposure to chemical vapors that favor the processes of previous rhinorrhea, reminding that hazardous work processes are not isolated and although dust is the main respiratory risk in milling, it is not the only one; therefore, it should be taken into account when establishing a respiratory protection program.

Recurrent wheeze was related to hours of exposure to dust, and history of Covid-19 was significant for more symptoms; specific studies would be needed to determine if there is reduced tolerance to allergens due to pathophysiological changes caused by the virus.

Finally, the identified clinical findings should be supplemented with pulmonary function evaluation by spirometry and IgE antibody testing to establish the diagnosis of occupational asthma and wheat sensitivity, respectively, and to differentiate irritative processes by biological agents (excreta) and vapors in those who reported double exposure.

BIBLIOGRAPHIC REFERENCES

1. Gelatin, T.R Alterações da função respiratória em trabalhadores portuários e a exposição a fontes de riscos ocupacionais. [Alteraciones de la función respiratoria en trabajadores portuarios y exposición a fuentes de riesgos laborales]. Repositorio institucional Universidade Federal Do Rio Grande 2015. https://repositorio.furg.br/handle/1/8358

2. Borsato, A, F. Riscos respiratórios em uma agroindústria dos Campos Gerais. [Riesgos respiratorios en una agroindustria de los Campos Gerais]. Repositorio Institucional de la Universidade Tecnológica Federal do Paraná. 2018. Recuperado en http://riut.utfpr.edu.br/jspui/handle/1/23376

3. Guerrón Dávila, N. Análisis de los patrones espirométricos en trabajadores expuestos a inhalación prolongada de polvo de harina de trigo en una planta molinera en Quito y Manta en el mes de noviembre del año 2014. Pontificia Universidad Católica del Ecuador, 2015. Recuperado en http://repositorio.puce.edu.ec/handle/22000/8862

4. Mohammadien, H. A., Hussein, M.T. y El-Sokkary, R. T. Effects of exposure to flour dust on respiratory symptoms and pulmonary function of mill workers. [Efectos de la exposición al polvo de harina sobre síntomas respiratorios y función pulmonar en trabajadores de molino] Egyptian Journal of Chest Diseases and Tuberculosis. 2013. 62 (4) 745-753. DOI: https://doi.org/10.1016/j.ejcdt.2013.09.007

5. Cedeño Gabriel, K. P., Rubial Carvajal, G. & Ruiz Almirón, C. Patología laboral sensibilizante, respiratoria y cutánea en la industria alimentaria. Medicina y Seguridad del Trabajo. 2014. 60(236), 536-565. https://dx.doi.org/10.4321/S0465-546X2014000300007

6. Demeke, D., & Haile, D. W. Assessment of Respiratory Symptoms and Pulmonary Function Status among Workers of Flour Mills in Addis Ababa, Ethiopia: Comparative Cross-Sectional Study [Evaluación de síntomas respiratorios y estado de función pulmonar en trabajadores de molinos harineros en Addis Ababa, Ethiopia: Estudio transversal comparativo], Pulmonary Medicine, vol. 2018 https://doi.org/10.1155/2018/9521297

7. Barber CM, Cullinan P, Feary J, et al British Thoracic Society Clinical Statement on occupational asthma. Thorax; 2022. 77:433-442. http://dx.doi.org/10.1136/thoraxjnl-2021-218597

8. Cortés, A. S. P., Oliveros, E. P. R., & de la Caridad Montero, R. Problemas a la salud que provoca la exposición al polvo de harina. Revista Colombiana de Salud Ocupacional. 2020. 10 (1). Recuperado de https://dialnet.unirioja.es/servlet/articulo?codigo=7890261

9. Melo, C.A., Konda, S., Shah, T. y Padwale, Y., Lung function abnormalities in flour mill workers using spirometry. [Anormalidades en la función pulmonar de trabajadores de molino de harina usando espirometría]. International Journal of Medical Science and Public Health. 2016. 5 (7) DOI: https://doi.org/10.5455/ijmsph.2016.25112015234

10. Ahire, K., Kulkarni, A., Desai, A., & Chavan, K. Effects of Flour Dust on the Health of Flour Mill Workers in Kolhapur City. [Efecto del polvo de harina en la salud de trabajadores de molino de harina en Kolhapur City]. International Journal of Latest Research in Engineering and Technology 2017. 3(5) 67-71. Recuperado en: https://www.researchgate.net/publication/317783861_Effects_of_Flour_Dust_on_the_Health_of_Flour_Mill_Workers_in_Kolhapur_City?enrichId=rgreq-8aa35c5ead40bea7c218491b39e480de-XXX&enrichSource=Y292ZXJQYWdlOzMxNzc4Mzg2MTtBUzo1MDgwNzI0MDcyNTI5OTJAMTQ5ODE0NTMwOTU5MQ%3D%3D&el=1_x_3&_esc=publicationCoverPdf

11. Chamorro, R. M. G., Padrón, H. D., Novas, A. J., Lafargue, B. L. F., Guerra, C. C., Rodríguez, L. V., & Jiménez, L. J. L. Exposición laboral a polvo de harina de trigo en una industria molinera. Revista Cubana de Salud y Trabajo. 2021. 22(3), 11-18. Recuperado de https://revsaludtrabajo.sld.cu/index.php/revsyt/article/view/228

12. Lagiso, Z.A., Mekonnen, W.T., Abaya, S.W., Takele, A. y Workneh, H. Chronic respiratory symptoms, lung function and associated factors among flour mill factory workers in Hawassa city, southern Ethiopia: "comparative cross-sectional study" [Síntomas respiratorios crónicos, función pulmonar y factores asociados entre trabajadores de fábrica de molino de harina en Hawassa city, al sur de Etiopía: Estudio transversal comparativo]. BMC Public Health. 2020. 20-909 https://doi.org/10.1186/s12889-020-08950-9

13. Said, A. M., AbdelFattah, E. B., & Almawardi, A. A. M. Effects on respiratory system due to exposure to wheat flour. [Efectos en el sistema respiratorio debido a exposición a harina de trigo]. Egyptian Journal of Chest Diseases and Tuberculosis. 2017. 66 (3) 537-548, https://www.sciencedirect.com/science/article/pii/S0422763816301558 https://doi.org/10.1016/j.ejcdt.2016.11.006.

14. Iyogun, K., Lateef, S. A., & Ana, G. R. Lung Function of Grain Millers Exposed to Grain Dust and Diesel Exhaust in Two Food Markets in Ibadan Metropolis, Nigeria [Función pulmonar de molineros de granos expuestos al polvo de granos y escape de diesel en dos mercados de alimentos en la metrópolis de Ibadan, Nigeria] Revista: Safety and Health at Work. 2019. 10 (1) 47-53 DOI: https://doi.org/10.1016/j.shaw.2018.01.002

15. Santistevan, B. Aseguran que hay dos molinos de trigo habilitados en el país. El Universal. 29 de enero de 2020. https://www.eluniversal.com/economia/60634/aseguran-que-hay-dos-molinos-de-trigo-habilitados-en-el-pais

16. Comisión Venezolana de Normas Industriales. Concentraciones ambientales permisibles de sustancias químicas en lugares de trabajo e índices biológicos de exposición. Norma COVENIN 2253:2001 Recuperado en https://www.medicinalaboraldevenezuela.com.ve/archivo/covenin/aire-ventilacion/2253-2001_Concentraciones_ambientales_de_sustancias_quimicas.pdf

17. Operadora CENPROACA. Polvo Respirable. Estudio Ambiental (no publicado) realizado en Empresa de Molino de Trigo, Venezuela. (Junio 2020)

18. Rodríguez-Zamora, M., Zock, J.P., Joode, W. y Mora, A.M. Respiratory Health Outcomes, Rhinitis, and Eczema in Workers from Grain Storage Facilities in Costa Rica [Resultados de salud respiratoria, rinitis y eczema en trabajadores de almacenes de granos en Costa Rica]. Annals of Work Exposures and Health. 2018. 62 (9) 1077–1086, https://doi.org/10.1093/annweh/wxy068

FINANCING

The authors did not receive funding for the development of this research. the present study.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Elisa M. Teixeira Villamediana, Cheyla Másin, Leonard Colmenares, Evelin Escalona, Estela Hernández-Runque.

Data curation: Elisa M. Teixeira Villamediana, Cheyla Másin, Leonard Colmenares, Evelin Escalona, Estela Hernández-Runque.

Research: Elisa M. Teixeira Villamediana, Cheyla Másin, Leonard Colmenares, Evelin Escalona, Estela Hernández-Runque.

Editor - original draft: Elisa M. Teixeira Villamediana, Cheyla Másin, Leonard Colmenares, Evelin Escalona, Estela Hernández-Runque.

Writing - proofreading and editing: Elisa M. Teixeira Villamediana, Cheyla Másin, Leonard Colmenares, Evelin Escalona, Estela Hernández-Runque.