

Occupational exposures and health-related quality of life in the Manaus Metropolitan Region, Amazonas State, Brazil: a cross-sectional study

Exposições ocupacionais e qualidade de vida relacionada à saúde na Região Metropolitana de Manaus, Estado do Amazonas, Brasil: um estudo transversal

Exposiciones ocupacionales y calidad de vida relacionada con la salud en la región metropolitana de Manaus, estado del Amazonas, Brasil: estudio transversal

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Abstract

We aimed to investigate the association between occupational exposures and health-related quality of life among both informal and formal workers in the Brazilian Amazon. We conducted a cross-sectional study with working adults in the Manaus Metropolitan Region, Amazonas State, in 2015. Participants were selected through a three-step probabilistic sampling. The primary outcome was the health-related quality of life indicator, measured by the Brazilian validated version of the European Quality of Life 5-Dimensions 3-Levels (EQ-5D-3L) tool. Adjusted multivariate analysis was performed by Tobit regression and considered the complex sampling design. Results were converted to odds ratio (OR). Out of the 1,910 working individuals from the sample, 60.2% were formal workers. Informal workers were significantly more exposed to occupational risks than formal workers ($p \leq 0.05$). Mean utility score for informal and formal workers was 0.886 (95%CI: 0.881; 0.890). Quality of life of informal workers was negatively impacted by exposure to noise (OR = 1.28; 95%CI: 1.13; 1.52), occupational stress (OR = 1.95; 95%CI: 1.65; 2.21), and industrial dust (OR = 1.46; 95%CI: 1.28; 1.72), while formal workers were negatively associated with exposure to chemical substances (OR = 1.58; 95%CI: 1.28; 1.87), noise (OR = 1.40; 95%CI: 1.23; 1.65), sun (OR = 1.65; 95%CI: 1.09; 1.40), occupational stress (OR = 1.65; 95%CI: 1.46; 1.87), biological material (OR = 2.61; 95%CI: 1.72; 3.97), and industrial dust (OR = 1.46; 95%CI: 1.28; 1.65). Exposure to occupational risks among workers from the Manaus Metropolitan Region was high, affecting both informal and formal workers. Brazilian policies need to be enforced to reduce the impacts on quality of life among workers in this region.

Occupational Risks; Occupational Exposure; Occupational Health; Quality of Life

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Introduction

It is estimated that approximately 2.3 million deaths related to occupational diseases occur every year worldwide, mainly due to cancer (32%), work-related circulatory diseases (23%), communicable diseases (17%), and occupational accidents (18%)¹.

In 2013, 154,240 cases of work-related diseases and injuries were reported in Brazil². Between 2008 and 2013, an increase in the proportion of informal workers among the reported cases was observed in the country². Informal workers showed worse self-reported status, greater difficulty in accessing healthcare services, and less interest in seeking healthcare services when compared to formal workers in a nationwide survey from 2008³.

Studies evaluating the occupational risks and quality of life for both formal and informal workers are scarce in Brazil. The aim of this study was to assess the association between occupational exposures and health-related quality of life among informal and formal workers in the Brazilian Amazon.

Methods

This was a cross-sectional population-based study conducted in the Manaus Metropolitan Region, Amazonas State, Brazil, in 2015⁴.

This study specifically included the working population of a major survey, which selected adults (≥ 18 years) through a probabilistic three-step complex sampling design⁴. Participants were divided into two categories: formal and informal workers. Formal workers are those with formal employment relationship, which guarantees labor rights and social benefits, such as vacations, maternity leave, retirement, and unemployment support⁵. Informal workers are defined as individuals who develop their own economic activities and do not have any social security or formal relationships with an employer⁵.

The primary outcome was the health-related quality of life. Individual variables included: sex (male, female), age group (18-24, 25-34, 35-44, 45-59, ≥ 60 years old), socioeconomic classification (A/B, C1, C2, D/E, where A refers to the wealthiest and E, to the poorest⁶), educational level (higher education or above, high school, middle school, elementary school or less), work type (informal/formal), and occupational exposure related to work activities (work in nocturnal periods, work for more than 24 consecutive hours, exposure to chemical substances, noise, sun, radioactive material, garbage, occupational stress, biological material, industrial dust).

Health-related quality of life was assessed by the *European Quality of Life 5-Dimensions 3-Levels* tool (EQ-5D-3L)⁷. It includes five dimensions (mobility, self-care, pain/discomfort, anxiety/depression, and usual activities). Each dimension can be scored in three levels (1 = no problems, 2 = moderate problems, and 3 = severe problems). Levels of quality of life were transformed into utility values using the conversion formula in accordance with the Brazilian valuation of EQ-5D-3L^{8,9}.

Data collection was performed through face-to-face interviews with trained interviewers using standardized questionnaires. The responses were registered in electronic tablets (Tab 3 SM-T110 Samsung Galaxy).

We used descriptive statistics to evaluate the sociodemographic characteristics of the working population and the results of each dimension of the EQ-5D-3L, stratified by formal and informal workers. We also calculated the means of the quality of life utility scores considering 95% confidence intervals (95%CI). Multivariate analyses were performed by Tobit regression adjusted by age group, socioeconomic classification, educational level, and the complex sampling design¹⁰. The Tobit regression model was chosen as it is suitable for censored or bounded data that can produce ceiling effect (i.e. inability to discriminate among high levels of health status)¹¹, such as the EQ-5D-3L utility scores¹². The utility scores were included as the latent dependent variables in the model. Significant associations were transformed into odds ratio (OR) using the following equation: $\ln(\text{OR}) = \pi/\sqrt{3} \times \beta$ ¹³. To facilitate interpretation, the inverse of the OR was presented to indicate the association between occupational exposures and lower quality of life. Stata version 14.2 (<https://www.stata.com>) was used for the data analyses.

Results

Out of the 4,001 participants of the main population-based study, 1,910 were workers, of which 60.2% were formal workers. The majority of the individuals were men (66.6%), aged 25-44 years old (57.7%), part of the socioeconomic classification C (middle class; 58.3%), and with an educational level up to high school (51.8%; Table 1). Most occupational exposures were observed among informal workers, except for exposure to the sun and working for more than 24 consecutive hours. Significant differences between informal and formal working groups were observed in the following occupational exposures: working in nocturnal periods ($p < 0.001$), exposure to chemical substances ($p < 0.001$), noise ($p < 0.001$), sun ($p < 0.001$), radioactive material ($p = 0.023$), occupational stress ($p = 0.009$), and biological material ($p < 0.001$).

Table 1

Social, demographic, and economic characteristics of the participants (N = 1,910) and frequency of occupational exposures by type of work. Manaus Metropolitan Region, Amazonas State, Brazil, 2015.

Variables	Total	Informal worker		Formal worker		p-value **
		n	% *	n	% *	
Sex						0.346
Male	1,273	517	67.9	756	65.8	
Female	637	244	32.1	393	34.2	
Age group (years)						< 0.001
18-24	274	154	20.2	120	10.4	
25-34	611	262	34.4	349	30.3	
35-44	491	196	25.9	295	25.7	
45-59	455	129	16.9	326	28.4	
≥ 60	79	20	2.6	59	5.2	
Socioeconomic classification ***						< 0.001
A/B	378	188	24.6	190	16.5	
C1	441	196	25.8	245	21.3	
C2	672	261	34.3	411	36.0	
D/E	419	116	15.3	303	26.2	
Educational level						< 0.001
Higher education or above	106	71	9.4	35	3.0	
High school	990	468	61.5	522	45.4	
Middle school	273	104	13.7	169	14.8	
Elementary school or less	541	118	15.4	423	36.8	
Occupational exposure						
Work in the nocturnal period	347	172	22.7	175	15.2	< 0.001
Work for more than 24 consecutive hours	138	51	6.7	87	7.6	0.459
Chemical substances	160	87	11.5	73	6.4	< 0.001
Noise	461	225	29.6	236	20.5	< 0.001
Sun	370	108	14.2	262	22.8	< 0.001
Radioactive material	70	37	4.9	33	2.9	0.023
Garbage	62	31	4.1	31	2.7	0.091
Occupational stress	376	172	22.6	204	17.7	0.009
Biological material	52	33	4.4	19	1.7	< 0.001
Industrial dust	421	172	22.8	249	21.8	0.621
Total	1,910	761	39.8	1,149	60.2	

* Frequency adjusted by sample complex design;

** Chi-squared test;

*** Social class according to the Brazilian criteria of economic classification ⁶. Average household income in 2015: A/B, USD 6,500-USD 1,419; C, USD 463-USD 772; D/E, USD 205.

Health-related quality of life scores for all five dimensions were mostly reported as good (without any problem). For formal workers, the mean utility score was 0.907 (95%CI: 0.899; 0.915); for informal workers, it was 0.882 (95%CI: 0.874; 0.889). The mean utility score for both informal and formal workers was 0.886 (95%CI: 0.881; 0.890). Informal workers reported better health statuses in mobility (96.1% vs. 92.8%) and pain/discomfort (63.7% vs. 56.6%) dimensions in comparison to formal workers. The dimensions with higher proportion of individuals with bad statuses were pain/discomfort and anxiety/depression (Table 2).

In the adjusted analysis, informal workers' had a higher chance of reduced quality of life by exposure to noise (OR = 1.28; 95%CI: 1.13; 1.52), occupational stress (OR = 1.95; 95%CI: 1.65; 2.21), and industrial dusts (OR = 1.46; 95%CI: 1.28; 1.72), when compared to absence of this exposure (Table 3). The quality of life of formal workers was negatively impacted by exposure to chemical substances (OR = 1.58; 95%CI: 1.28; 1.87), noise (OR = 1.40; 95%CI: 1.23; 1.65), sun (OR = 1.65; 95%CI: 1.09; 1.40), occupational stress (OR = 1.65; 95%CI: 1.46; 1.87), biological material (OR = 2.61; 95%CI: 1.72; 3.97), and industrial dusts (OR = 1.46; 95%CI: 1.28; 1.65). Formal workers had a higher chance of better quality of life in the presence of exposure to radioactive material (OR = 0.58; 95%CI: 0.38; 0.92).

Table 2

Characteristics of each domain of the *European Quality of Life 5-Dimensions 3-Levels* (EQ-5D-3L) of all workers, stratified by formality in the Manaus Metropolitan Region, Amazonas State, Brazil, 2015 (N = 1,910).

EQ-5D-3L domain	All workers		Informal worker		Formal worker	
	n	% *	n	% *	n	% *
Mobility						
No problems	1,797	94.1	731	96.1	1,066	92.8
Some problems	111	5.8	30	3.9	81	7.0
Confined to bed	2	0.1	0	0.0	2	0.2
Self-care						
No problems	1,864	97.6	748	98.3	1,116	97.1
Some problems	44	2.3	13	1.7	31	2.7
Extreme problem	2	0.1	0	0.0	2	0.2
Usual activities						
No problems	1,859	97.3	742	97.5	1,117	97.2
Some problems	50	2.6	19	2.5	31	2.7
Extreme problem	1	0.0	0	0.0	1	0.1
Pain/Discomfort						
None	1,138	59.5	486	63.7	652	56.6
Moderate	686	36.1	256	33.8	430	37.6
Extreme	86	4.5	19	2.5	67	5.8
Anxiety/Depression						
None	1,564	81.9	637	83.6	927	80.7
Moderate	315	16.5	118	15.6	197	17.1
Extreme	31	1.6	6	0.8	25	2.2

* Frequency adjusted by sample complex design.

Table 3

Occupational exposures and means of quality of life utility scores calculated by Tobit adjusted regression analysis stratified by formality in the Manaus Metropolitan Region, Amazonas State, Brazil, 2015 (N = 1,910).

Occupational exposures	Informal worker quality of life *		Formal worker quality of life *	
	Mean (95%CI)	Tobit coefficient ** (95%CI)	Mean (95%CI)	Tobit coefficient ** (95%CI)
Work in the nocturnal period				
No	0.91 (0.90; 0.92)	Reference	0.88 (0.87; 0.89)	Reference
Yes	0.90 (0.88; 0.92)	-0.02 (-0.06; 0.03)	0.88 (0.86; 0.90)	-0.01 (-0.05; 0.03)
Work for more than 24 consecutive hours				
No	0.91 (0.90; 0.92)	Reference	0.88 (0.88; 0.89)	Reference
Yes	0.89 (0.86; 0.92)	-0.03 (-0.09; 0.04)	0.86 (0.83; 0.89)	-0.05 (-0.10; 0.00)
Chemical substances				
No	0.91 (0.90; 0.92)	Reference	0.89 (0.88; 0.89)	Reference
Yes	0.89 (0.86; 0.91)	-0.05 (-0.10; 0.01)	0.82 (0.79; 0.85)	-0.11 (-0.15; -0.06)
Noise				
No	0.92 (0.91; 0.93)	Reference	0.89 (0.88; 0.90)	Reference
Yes	0.89 (0.87; 0.90)	-0.06 (-0.10; -0.03)	0.85 (0.84; 0.87)	-0.08 (-0.12; -0.05)
Sunlight				
No	0.91 (0.90; 0.92)	Reference	0.89 (0.88; 0.90)	Reference
Yes	0.89 (0.87; 0.91)	-0.04 (-0.09; 0.01)	0.86 (0.84; 0.87)	-0.05 (-0.08; -0.02)
Radioactive material				
No	0.91 (0.90; 0.91)	Reference	0.88 (0.87; 0.89)	Reference
Yes	0.95 (0.92; 0.98)	0.09 (-0.01; 0.18)	0.93 (0.89; 0.97)	0.13 (0.02; 0.23)
Garbage				
No	0.91 (0.90; 0.92)	Reference	0.88 (0.88; 0.89)	Reference
Yes	0.88 (0.84; 0.92)	-0.05 (-0.14; 0.03)	0.82 (0.77; 0.88)	-0.07 (-0.15; 0.01)
Occupational stress				
No	0.92 (0.92; 0.93)	Reference	0.89 (0.88; 0.90)	Reference
Yes	0.85 (0.83; 0.86)	-0.16 (-0.19; -0.12)	0.83 (0.81; 0.85)	-0.12 (-0.15; -0.09)
Biological material				
No	0.91 (0.90; 0.91)	Reference	0.88 (0.88; 0.89)	Reference
Yes	0.92 (0.89; 0.96)	0.02 (-0.07; 0.12)	0.73 (0.65; 0.81)	-0.23 (-0.33; -0.13)
Industrial dust				
No	0.92 (0.91; 0.93)	Reference	0.89 (0.88; 0.90)	Reference
Yes	0.87 (0.86; 0.89)	-0.09 (-0.13; -0.06)	0.85 (0.83; 0.86)	-0.09 (-0.12; -0.06)

* Quality of life values were measured by the *European Quality of Life 5-Dimensions 3-Levels* instrument and transformed as utility values based on values from a previous study in the Brazilian population ⁸;

** Adjusted by sample complex design, age group, social class and education level.

Discussion

Informal workers were significantly more exposed to working in nocturnal periods, chemical substances, noise, radioactive material, occupational stress, and biological material, whereas formal workers were more frequently exposed to sun. Health-related quality of life was high among workers, similarly to the general population from the Manaus Metropolitan Region ⁹.

Recall bias from the self-reporting model may have influenced the results as participants might not remember being exposed to certain occupational risks. Selection bias is also possible since only individuals who were present at their residences during the interview period were invited to participate in the survey. Although the EQ-5D-3L instrument is easy to apply and is currently used in different contexts worldwide for measuring quality of life, its discriminant ability is lower when compared to other specific instruments ¹⁴. Relevant data such as physical activity, religious beliefs,

chronic diseases, fruit and vegetable consumption, and leisure time were not collected, which may play an important role on quality of life ¹⁵.

The Brazilian Labor Reform approved by the National Congress in 2017, two years after this study was conducted, resulted in significant changes to the employment regulations by allowing employers to determine hiring conditions, use of workforce, and other social rights ¹⁶. This process led to increased insecurity among workers, loss of labor rights, and reduced social protection ¹⁶. Empirical evidence from after the implementation of the Labor Reform showed that this act probably impacted workers' health and quality of life ¹⁷.

Exposure to noise in occupational settings was negatively associated with the quality of life of both informal and formal workers. A study conducted in 2015 in Belo Horizonte, Minas Gerais State, with professionals working in ambulances found that auditory (tinnitus, intolerance to intense sounds, and aural fullness) and nonauditory symptoms (irritability, headache, difficulty in talking in noisy environments, and sleep alterations) were frequent among these professionals ¹⁸. Preventive measures should be adopted to reduce the risks and improve the quality of life of these workers.

Occupational stress was also a negative factor for the workers' quality of life. A cross-sectional study conducted in Pelotas, Rio Grande do Sul State, in 2012 with community health agents showed that 71% of the 181 professionals were in a state of stress resistance, 30.5% were in the alert state of stress, and 32.8% were in the stress state of exhaustion, which were confirmed by higher salivary cortisol levels. Depressive episodes were observed in 28.2% of the participants and low scores for quality of life were reported ¹⁹.

Occupational exposure to biological materials and industrial dust were associated with worse quality of life among informal and formal workers. Healthcare professionals are particularly at increased risk of occupational exposure to biological materials since they are frequently in contact with body secretions and can be injured by handling sharp instruments, which may lead to microbiological infections ²⁰. A previous study conducted in Namibia from 2013 to 2014 with 307 workers from charcoal factories showed that exposure to dust was significantly associated with usual cough, usual phlegm, episodes of phlegm and cough, and shortness of breath ²¹.

Exposure to chemical substances and to sunlight negatively affected the quality of life. Such exposures are risk factors for chronic noncommunicable diseases. A cross-sectional study carried out in 2014 with 545 civil construction workers from Cuiabá, Mato Grosso State, found that the odds of developing respiratory symptoms (e.g., cough) were higher for those exposed to chemicals, such as paint and hydrocarbon solvents ²². A previous cross-sectional study conducted in 2017 with 348 outdoor workers (farmers, gardeners, and mountain guides) and 215 indoor workers (office employees) from Germany found an increased risk of developing non-melanoma skin cancer in outdoor professionals ²³.

Radioactive materials were positively associated with the quality of life of formal workers. Labor protection associated with contracts of workers involved with radiation activities in Brazil may explain these results. A meta-analysis from 2014 investigating the renal effects and carcinogenicity of occupational exposure to uranium in 71,114 workers found a significantly lower tumor risk in the case groups when compared to control groups, and the risk of nephrotoxicity was also not increased ²⁴. This finding contrasts with the results of a previous case-control study conducted in Shanghai, China, from 1987 to 1989, where a significant increase in the risk of leukemia was observed in workers who self-reported exposure to benzene, synthetic fiber dust, toluene, and radioactive materials ²⁵.

Conclusions

The exposure to occupational risks among the working population of the Manaus Metropolitan Region is high and affects both informal and formal workers. Quality of life was negatively associated with exposure to noise, occupational stress, industrial dust, chemical substances, sunlight, and biological materials. Health policies and labor rights should be protected and reestablished in Brazil to reduce health inequalities among informal and formal workers, as well as minimize potential risks associated with occupational exposure.

Contributors

G. M. B. Tiguman analyzed and interpreted the data of the work and drafted the manuscript. M. Caicedo-Roa analyzed the data of the work and critically revised the manuscript. M. T. Silva and T. F. Galvao designed the work, analyzed and interpreted the data of the work and revised critically the manuscript. All authors approved the version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Additional informations

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Resumo

O estudo buscou investigar a associação entre exposições ocupacionais e qualidade de vida relacionada à saúde entre trabalhadores informais e formais na Amazônia brasileira. Realizamos um estudo transversal com trabalhadores adultos na Região Metropolitana de Manaus, Amazonas, em 2015. Os participantes foram selecionados por amostragem probabilística em três estágios. O desfecho primário foi a qualidade de vida relacionada à saúde, medida pela versão brasileira validada do instrumento European Quality of Life 5-Dimensions 3-Levels (EQ-5D-3L). Foi realizada a análise multivariada ajustada por regressão de Tobit, considerando o desenho complexo da amostra. Os resultados foram convertidos em razão de chances (OR). Entre os 1.910 indivíduos na amostra que estavam trabalhando, 60,2% eram trabalhadores formais. Os trabalhadores informais foram mais expostos aos riscos ocupacionais ($p \leq 0,05$). A média de utilidade para trabalhadores informais e formais foi 0,886 (IC95%: 0,881; 0,890). A qualidade de vida dos trabalhadores informais foi impactada negativamente pela exposição ao ruído (OR = 1,28; IC95%: 1,13; 1,52), estresse ocupacional (OR = 1,95; IC95%: 1,65; 2,21) e poeiras industriais (OR = 1,46; IC95%: 1,28; 1,72), enquanto trabalhadores formais mostraram uma associação negativa com exposição a substâncias químicas (OR = 1,58; IC95%: 1,28; 1,87), ruído (OR = 1,40; IC95%: 1,23; 1,65), luz solar (OR = 1,65; IC95%: 1,09; 1,40), estresse ocupacional (OR = 1,65; IC95%: 1,46; 1,87), material biológico (OR = 2,61; IC95%: 1,72; 3,97) e poeiras industriais (OR = 1,46; IC95%: 1,28; 1,65). A exposição a riscos ocupacionais entre trabalhadores na Região Metropolitana de Manaus é alta, afetando trabalhadores informais e formais. Políticas brasileiras devem ser implementadas para reduzir os impactos sobre a qualidade de vida dos trabalhadores nessa região do país.

Riscos Ocupacionais; Exposição Ocupacional; Saúde do Trabalhador; Qualidade de Vida

Resumen

El objetivo era investigar la asociación entre exposiciones ocupacionales y calidad de vida relacionada con la salud entre trabajadores formales e informales en la Amazonia Brasileña. Realizamos un estudio transversal con trabajadores adultos en la región metropolitana de Manaus, estado del Amazonas, en 2015. Los participantes fueron seleccionados a través de una muestra probabilística en tres pasos. El resultado primario fue la calidad de vida relacionada con la salud, medida por la versión brasileña validada de la herramienta European Quality of Life 5-Dimensions 3-Levels (EQ-5D-3L). Se realizó un análisis ajustado multivariado mediante la regresión Tobit y se consideró el diseño complejo de la muestra. Los resultados se convirtieron en odds ratio (OR). De los 1.910 trabajadores procedentes de la muestra, un 60,2% fueron trabajadores formales. Los trabajadores informales estuvieron significativamente más expuestos a los riesgos ocupacionales que los trabajadores formales ($p \leq 0,05$). La puntuación media de utilidad para los trabajadores informales y formales fue 0,886 (IC95%: 0,881; 0,890). La calidad de vida de los trabajadores informales estuvo negativamente impactada por la exposición al ruido (OR = 1,28; IC95%: 1,13; 1,52), estrés ocupacional (OR = 1,95; IC95%: 1,65; 2,21), y polvos industriales (OR = 1,46; IC95%: 1,28; 1,72), mientras que los trabajadores formales estuvieron negativamente asociados con la exposición a sustancias químicas (OR = 1,58; IC95%: 1,28; 1,87), ruido (OR = 1,40; IC95%: 1,23; 1,65), sol (OR = 1,65; IC95%: 1,09; 1,40), estrés ocupacional (OR = 1,65; IC95%: 1,46; 1,87), material biológico (OR = 2,61; IC95%: 1,72; 3,97), y polvos industriales (OR = 1,46; IC95%: 1,28; 1,65). La exposición a riesgos ocupacionales entre trabajadores en la región metropolitana de Manaus es alta, afectando tanto a trabajadores informales como formales. Se necesitan imponer políticas brasileñas para reducir los impactos en la calidad de vida entre trabajadores en esta región.

Riesgos Laborales; Exposición Profesional; Salud Laboral; Calidad de Vida

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