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Evaluation Of Dust Exposure among the Rice Mill Workers in East-Coast of Malaysia

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INTRODUCTION

- Rice dust is generated from several processes including de-husking (the separation of external husk from the rice grain), separation, removal of bran layer (polishing) and moving the grain along the conveyers
- Workers exposed to high rice dust concentrations may suffer pulmonary diseases that mimic silicosis due to the silica content inside the dust (Newman,1986).

RICE DUST STRUCTURE UNDER ELECTRON MICROSCOPE

- Rice husk is covered with small needlelike hairs that project outwards as sharp, elongated spines (figs 4 and 5)(Lim et al., 1984).
- 200-300 μ in length, 30-40 μ in diameter at the base, tapering into sharp ends (Lim et al., 1984).

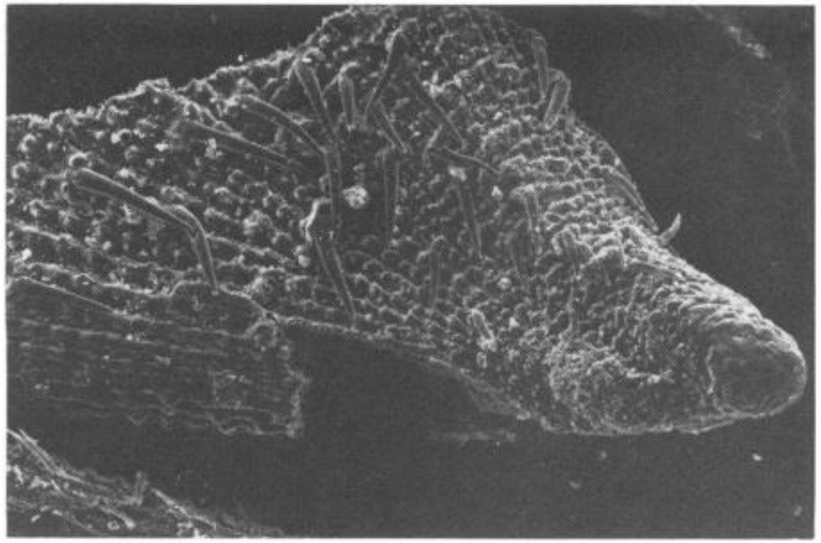

Fig 4 *Electron micrograph showing a fragmented piece of rice husk. Note elongated spikes projecting from husk surface. (Bar = 100 μ.)*

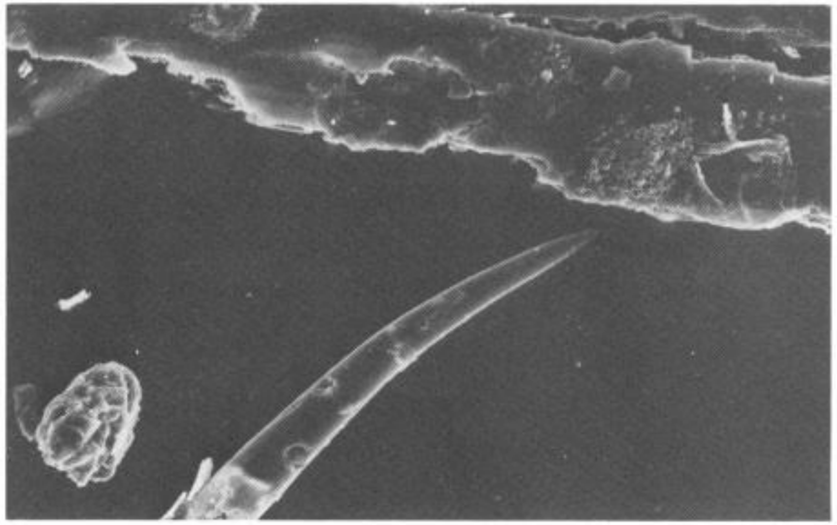

Fig 5 *Electron micrograph showing one of the elongated spikes detached from rice husk surface. (Bar = 100 μ.)*

Source: Lim et al., 1984

GRAIN DUST COMPOSITION

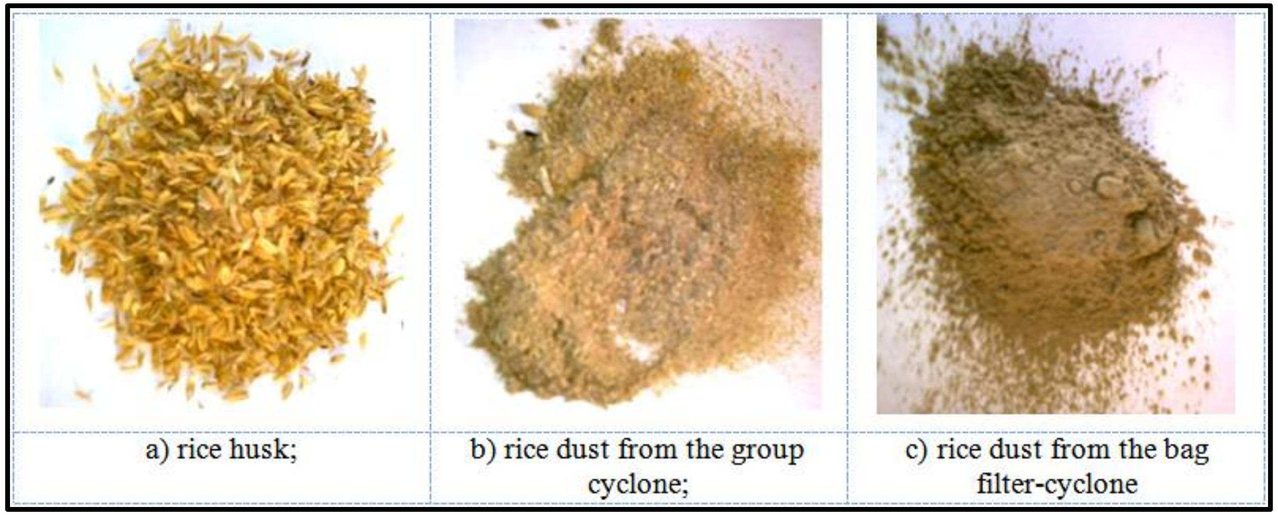

Figure 1: Rice dust

Source: Korotkova et al., 2016[15]

- Organic dust from grain contains fungi, bacteria and their endotoxins, pollens, insects, and arachnid mites and their debris (Swan et al., 2007).
- Apart from biological materials, grain dust also contains synthetic chemicals from pesticide usage (Ahmad et al., 2014) and silica (Rosiah Osman et al., 2017; Korotkova et al., 2016).
- Numerous studies have shown that rice dust exposure is associated with respiratory symptoms and impairment of lung function (Musa et al., 2000; Ghosh et al., 2014; Dewangan & Patil, 2015; Vijayashankar & Rajeshwari 2018; Wickramage et al., 2017).
- The organic content in rice dust husk is known as a respiratory sensitiser (Ghosh et al., 2014).

STUDY AIMS

- Limited studies documented the approximate concentration of dust inhaled by workers during their work shifts.
- Therefore, this study aims to quantify dust exposure ($PM_{2.5}$) among workers in rice mill industries in east coast of peninsular Malaysia.
- Additionally, the Personal Protection Equipment (PPE) usage among workers were also being investigated

MATERIALS & METHODS

PurpleAir-II-SD

- This study used Purple Air PA-II-SD (PurpleAir Llc, Utah, USA) device to measure the $PM_{2.5}$ exposure of dust in rice mill industries.
- The Purple-Air PA-II-SD Device or PA is a portable, lightweight particulate counter, air quality sensor that able to measure $PM_{2.5}$ concentrations in either indoor or outdoor settings.
- The PA device is a low-cost device that uses laser particle-counters to provide real time measurement of $PM_{2.5}$.
- It measured particle with a size range between 0.3 and 10 µm diameter. It was set automatically convert PM measurements to mass concentration in $PM_{1.0}$, $PM_{2.5}$ and PM_{10}.
- The PurpleAir has been used to numerous studies to measure $PM_{2.5}$ concentrations and proven to be reliable. (Gutpa et al., 2018; Karch et al., 2018; and Li et al., 2020).

MATERIALS & METHODS

- 31 workers were recruited from 5 workplaces
- $PM_{2.5}$-dust exposure were collected on workers- assume as personal sampling.
- $PM_{2.5}$-dust exposure were collected using PurpleAir-PA-II-SD
- Data collected were checked for consistency; $PM_{2.5}$ difference did not exceed 5 μg/m^3 (Barkjohn, et al., 2022) and both sensors A and B were in broad agreement on the one-hour average tab (R^2>0.90) (Awokola et al., 2020)
- Final data were averaged from both channels

HOW MUCH WAS INHALED?

Table 1: The dust-$PM_{2.5}$ exposure concentrations recorded at five rice mills measured

Workplaces	Number of workers	Dust-$PM_{2.5}$ concentrations (ug/m³)				Chi-Square (df)	*p-value***
		Mean (SD)	Median (IQR) **	Min	Max		
A	9	22.0 (19.7)	18.0 (17.5)	3.30	340.3	1279.1 (4)	<0.05
B	5	25.7 (19.0)	22.6 (19.1)	4.40	257.9		
C	7	30.0 (21.5)	23.8 (22.9)	0.70	222.1		
D	7	66.5 (89.1)	38.6 (37.1)	1.60	525.6		
E	3	49.7 (64.9)	30.8 (22.5)	10.7	478.6		

Significant at the level 0.05. The non-normality assumption is fulfilled

> 2 times than recommended WHO value of 25 μg/m³

21 times than recommended WHO value of 25 μg/m³

Higher than a study conducted in Italy (Ielpo et al., 2020) and France (Mounier-Geyssan et al, 2007) (Max-$PM_{2.5}$ 281 μg/m³ & 360 μg/m³)

The WHO guideline for the 24-hour average concentration of $PM_{2.5}$ is 25 μg/m³ to minimize health risks associated with short-term exposure to particulate matter.

DUST CONCENTRATIONS ACROSS SECTIONS

Table 2: The dust-$PM_{2.5}$ exposure concentrations across sections

Sections	Dust-$PM_{2.5}$ concentrations (ug/m^3)			
	Mean (SD)	Median (IQR) **	Min	Max
Drying	32.6 (27.2)	26.6 (21.1)	2.7	341.4
Milling	45.1 (62.8)	30.7 (22.8)	1.6	525.6
Storage	56.9 (79.2)	28.8 (43.5)	4.8	478.6
Packaging	14.9 (15.7)	11.5 (8.1)	3.3	210.9
Pallette	22.7 (21.2)	19.0 (15.4)	4.8	340.3
Not classified	22.1 (25.2)	15.9 (14.0)	0.7	191.2

PPE?

Table 3: Participants characteristics and PPE usage analysis

Characteristic	N (%)
Mean age ± SD	31 ± 6 years
Mean working experience ± SD	3 ± 3 years
Practice of proper PPE Usage	Yes: 13 (41.9 %)
	No: 18 (58.1 %)

58.1% used scarf/bandana as PPE

CONCLUSION

- Highest $PM^{2.5}$-dust exposure recorded was 525.6 µg/m^3
- Across sections, the top three highest exposure to $PM_{2.5}$-dust was at Milling, Storage and Drying Sections
- More than half of workers sampled do not practice proper PPE usage

REFERENCES

- Ahmad, M. I., Ahmad, N. A., Muhammad, S.A. & Esa, N. (2014). A Survey on Use, Hazards and Potential Risks of Rice Farming Pesticides in Permatang Keriang, Pulau Pinang, Malaysia. *International Journal of Scientific and Research Publications*, Vol 4 (10): 132-143
- Dewangan, K. N. & Patil, M. R. (2015). Evaluation of Dust Exposure among the Workers in Agricultural Industries in North-East India*. Ann. Occup. Hyg.*, 2015, Vol. 59, No. 9, 1091–1105
- Ghosh, T., Gangopadhyay, S. & Das B. (2014). Prevalence of respiratory symptoms and disorders among rice mill workers in India. *Environmental Health and Preventive Medicine 2014,* Vol 19 :384, 226-233
- Gupta, P., Doraiswamy, P., Levy, R., Pikelnaya, O., Maibach, J., Feenstra, B., et al. (2018). Impact of California fires on local and regional air quality: The role of a low-cost sensor network and satellite observations. GeoHealth, 2, 172–181.
- Ielpo, P., Placentino, C. M., Genga, A., Ancona, V., Uricchio, V.F. & Fermo, P. (2020). $PM_{2.5}$ in Indoor Air of a Bakery: Chemical Characterization and Size Distribution. *Atmosphere,* Vol 11: 415
- Karch, D., Sievwright, J., Nayet, C., Parson, M., Jones, K. & Schiller, C. 2019. Small Air Quality Sensor Applications to Improve Community Engagement in Western Canada. Retrieved from https://www.rockies.ca/CitSciAlberta/pdfs/ParsonsPoster.pdf
- Korotkova, T. G., Ksandopulo, S. J., Donenko, A. P., Bushumov, S. A. & Danilchenko, A. S. (2016). Physical Properties And Chemical Composition Of The Rice Husk And Dust. *Oriental Journal Of Chemistry*, Vol. 32(6), 3213-3219
- Lim, H.H., Domala, Z., Joginder, S., Lee, S.H., Lim, C. S. & Abu Bakar, C. M. (1984). Rice Millers' Syndrome: A Preliminary Report. *British Journal Of Industrial Medicine*, 41:445-449
- Li, J. (2019). Recent advances in low-cost particulate matter sensor: calibration and application. Washington University in St. Louis, Washington, The United States of America.
- Mounier-Geyssant E, Barthélemy JF, Mouchot L, et al.Exposure of bakery and pastry apprentices to airborneflour dust using PM2.5 and PM10 personal samplers. BMCPublic Health. 2007;7:311.
- Musa, R., Lin Naing, L., Ahmad, Z. & Kamarul, Y. (2000). Respiratory Health Of Rice Millers In Kelantan, Malaysia. *The Southeast Asian Journal Of Tropical Medicine And Public Health,* Vol 31(3):575-578
- Newman R. Association of biogenic silica with disease. *Nutr Cancer* 1986; 8: 217-21
- Rosiah Osman, Nor Hapishah Abdullah, Khamirul Amin Matori, Mohd. Nizar Hamidon, Ismayadi Ismail & Syazwan Mustaffa. (2017). Effect of Temperature towards Rice Husk Silica Characterization with Different Preparation Methods. *International Journal of Basic & Applied Sciences* Vol:17(1): 15-20
- Swan, J.R.M., Blainey, D. & Crook, B. (2007). *RR540 Research Report: The HSE grain dust study workers' exposure to grain dust contaminants, immunological and clinical response: Health and Safety Executive United Kingdom, 2007*. Retrieved from the Health and Safety Executive http://www.hse.gov.uk/research/rrpdf/rr540.pdf
- Vijayashankar U, Rajeshwari L. (2018). Effect of rice mill dust on peak expiratory flow rate among rice mill workers of Mysore district. *National Journal of Physiology, Pharmacy and Pharmacology*, Vol 8 (8):1240-1243.
- Wickramage, S.P., Rajaratne, A. A. J. & Udupihille, M. (2017). Factors Affecting Respiratory Function of Rice Millers in Anuradhapura District. *Anuradhapura Medical Journal*, Vol 11(1) :4-10

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