Respiratory Health Problems of Rice Mill Workers in Ampara Divisional Secretariat Division

KRM Chandrathilaka[1], SR De A Seneviratne[2], KN Lankatilake[3], DBDL Samaranayake[4], AK Karunarathna[5]

[1]*Faculty of Medicine, University of Colombo, Sri Lanka*
[2,3,4]*Department of Community Medicine, Faculty of Medicine, University of Colombo, Sri Lanka* [5]*Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya Sri Lanka*
[1] chandrathilaka86521@gmail.com, [2] srdeas@gmail.com, [3] kanthalankathilake@yahoo.com, [4]dulani_samaranayake@yahoo.com, [5]anujica@yahoo.com

Abstract— *Rice milling is one of the major occupations in Ampara district which is done in various production scales. Cough, phlegm, chest tightness and wheeze were common among rice mill workers.*

A descriptive cross sectional study was conducted to determine the prevalence of respiratory symptoms and lung function measurements of rice mill workers in the Divisional Secretariat Division of Ampara. The participants in the study and control groups were matched for age, height, weight and ethnicity. Prevalence of chronic respiratory symptoms was obtained by a validated questionnaire together with lung function measurements. Forced vital capacity (FVC), forced expiratory volume in the first second (FEV_1) and ratio of FEV1 compared to FVC were measured using mini-vitalograph spirometer and peak expiratory flow rate (PEFR) was measured using peak expiratory flow meter.
Breathing difficulty, wheezing and having cough were significantly high among the study group compared to the control group ($p<0.05$) and mean FVC and PEFR were significantly lower among the study group compared to the controls ($p<0.01$).Therefore, it may be concluded that dust originating from the rice mills causes increased prevalence of respiratory symptoms leading to mixed type of restrictive and obstructive respiratory diseases.

Keywords— rice mill workers, occupational health, lung function measurements

I. INTRODUCTION

Sri Lanka is a paddy growing country from ancient times. North-Central and Eastern provinces are the major paddy cultivating areas although it is done in most of the other parts of the country too.

Ampara district is one of the major paddy cultivating areas in Eastern province of Sri Lanka. As it is situated in dry zone paddy cultivation occur in both seasons, namely, in Yala and Maha with the help of irrigation facilities. Ampara district contributes to 14% (611,244 kg) of the total paddy production in Sri Lanka (Department of Census and Statistics, 2013a & b). After harvesting paddy it is prepared to its two major consumable forms; namely raw rice and parboiled rice by milling process. Raw rice is prepared by milling paddy as it is. To prepare parboiled rice in Sri Lanka it is soaked in water, then either boiled or steamed and then dried well before milling (Abeysekara, 1993; Sumanaweera, 1998; Batsungneon and Kulworawanichpong, 2011). The rice milling process is done in the rice mills using various machineries such as de-huskers, separators, de-stoners, polishers, graders and boilers. Once the paddy is cleaned, it is de-husked, de-stoned and polished.

The milling process being dusty, the mill workers are at a high risk of getting respiratory diseases (Abeysekara, 1993; Desai and Ghosh, 2003; Lim et al 2012; Sumanaweera, 1998). Most of the workers do not use protective equipment or any other form of protective gear although they may be aware of its hazardous outcomes. Therefore, this study attempted to determine the prevalence of respiratory health problems and to compare them with the general community residing from the same

area which will establish a baseline to implement necessary preventive measures.

II. MATERIALS AND METHODS

Ethical clearance was obtained from the Ethics Review Committee of the Faculty of Medicine, University of Colombo. Informed written consent was obtained from all the participants of the study. The study period was between March and April 2014. The study area was Ampara Divisional Secretariat Division (DS division), situated in Eastern Province, Sri Lanka.

A. Study Population

Study group (SG) consisted of all rice mill workers who have been employed for at least four months in each year for more than 3 consecutive years in the rice milling industry in the Ampara DS division. The control group (CG) was selected from the community residing from a randomly selected Grama Niladhari division in the same DS division. They were matched for age (±5 years), height (nearest 1cm), weight (nearest 1kg) and ethnicity on a frequency basis with the study subjects.

A total of 38 rice mill workers for the SG and 30 subjects from the community for the CG were eligible to participate in the study.

B. Study Instruments

British Medical Research Councils (BMRC) questionnaire on Respiratory Symptoms was used to obtain demographic data, personal data and information on respiratory symptoms such as breathing difficulty, wheezing, cough and phlegm.

The BMRC questionnaire on respiratory symptoms was translated to Sinhala and Tamil languages by two experts in the field and back translation was done to ensure the uniformity of the questionnaire with its English version. Content validity of the BMRC questionnaire was assessed to ensure its suitability to the Sri Lankan context with regard to suitability of the wording to the local context and appropriateness of the content to assess respiratory function in Sri Lankan rice millers. This was be done by a panel of 5 experts in the fields of community medicine, occupational medicine and respiratory physicians in clinical medicine and modified accordingly as recommended by them to suit the local context.

The following definitions of respiratory symptoms were adopted:

Chronic cough/phlegm: cough and/or phlegm production on most days in at least 3 months per year.

Breathing difficulty: Shortness of breath when walking with other people at an ordinary pace or their own on level ground.

Chronic bronchitis: presence of cough and phlegm production for a minimum of 3 months a year for at least 2 consecutive years (Jayawardana & Udupihille, 1997).

Wheezing: high pitched whistling sound during breathing (National Institute of Health, 2014).

The mini-vitalograph spirometer used in the field was validated against a more accurate spirometer available in the laboratory of the Department of Community Medicine, Faculty Medicine, University of Colombo. Daily calibration checks of the vitalograph spirometers were done according to American Thoracic Society Guidelines (Miller et al, 2005).

C. Analysis of Data

Socio-demographic characteristics of the study participants and those of the control group were analyzed using descriptive statistics. Control group was matched for age, height, weight and ethnicity with the study group on a frequency basis to ensure that the two groups are comparable.

Prevalence of identified respiratory conditions was calculated for both study and control groups and Chi-square test was used to compare the prevalence of respiratory symptoms in the two groups. Mean values of lung function parameters (VC, FVC, FEV1 and PEFR) were compared between the study and the control groups using independent samples t-test.

III. RESULTS

Mean ages of the SG and CG were 43.95±9.14 ($\bar{x}$ ±1SD) and 44.27±9.35 ($\bar{x}$±1SD) years. Mean height of the two groups were 166.39±4.75 cm ($\bar{x}$±1SD) and 167±3.91 cm ($\bar{x}$±1SD) respectively. Mean weight were 66.2±5.1 kg ($\bar{x}$±1SD) and 66.5±5.2 kg ($\bar{x}$±1SD) for the SG and CG respectively. Above

differences were statistically not significant ($p>0.05$). Also the two groups were comparable on age, height, weight and other demographic characteristics ($p>0.05$) on frequency basis (see Table 1).

The prevalence of the respiratory symptoms in the two groups is given in Table 2 where the study group had higher prevalence of breathing difficulty, cough and wheezing than the control group ($p<0.05$) although having phlegm and chronic bronchitis were slightly higher among the control group (see Table 2).

Mean values of the FVC and PEFR were significantly lower in the SG than the CG ($p<0.01$) (see Table 3).However, FEV_1 and FEV_1 ratio were not significantly different between the two groups.

IV. DISCUSSION

This study describes the possible respiratory health hazards and the lung function status of rice milling population in Ampara Divisional Secretariat division. Since the preliminary survey conducted by the principal author had showed a negligible numbers of females who fulfilled inclusion and exclusion criteria, only the male workers were considered for the study group and the control group was selected accordingly. Prevalence of breathing difficulty, chronic cough and chronic phlegm was higher than the findings of the study done in rice mill workers by Abeysekara (1993) which were 15.5%, 11% and 9.1% respectively. However, Wickramage *et al* (2010) had found a higher prevalence of chronic cough (42%) and chronic phlegm (55%) while wheezing was slightly lower (37%) in mill workers. The less sample size in the current study compared to other

Table 1. Comparison of socio-demographic characteristics between the study group and the control group

Characteristics	SG (n=38) No. (%)	CG (n=30) No. (%)	Total No.	Significance (p value)
Age (years)				
Less than 40	13 (65)	7 (45)	20	χ^2=1.907
41-50	14 (47)	16 (53)	30	d.f.=2
More than 51	11 (61)	7 (39)	18	p=0.385
Total	38	30	68	
Income (Rs.)	14 (74)	5 (26)	19	χ^2=5.563;
Less than 19,999	20 (45)	24 (55)	44	d.f. =2;
20,000-29,999	4 (80)	1 (20)	5	p=0.062
More than 30,000	38	30	68	
Total				
Education level				
Grade 1-5	26 (59)	18 (41)	44	χ^2=0.521;
Grade 6-O/L	12 (50)	12 (50)	24	d.f. =1;
Total	38	30	68	p=0.471
Height (cm)				
Less than 165	15 (58)	11 (42)	26	χ^2=0.075;
166-170	15 (54)	12 (46)	27	d.f. =2;
More than 171	8 (53)	7 (47)	15	p=0.963
Total	38	30	68	
Weight (kg)				
Less than 65	16 (59)	11 (41)	27	χ^2=0.312;
66-70	14 (52)	13 (48)	27	d.f. =2;
More than 71	8 (57)	6 (43)	14	p=0.856
Total	38	30	38	

Table 2. Prevalence of respiratory symptoms/ conditions in the study group and the control group

Symptom/ Condition	SG (n=38) No. (%)	CG (n=30) No. (%)	Significance (p value)
Dyspnoea	15 (39)	3 (10)	0.006*
Wheezing	15 (39)	3 (10)	0.006*
Chronic cough	14 (37)	3 (10)	0.011**
Chronic phlegm	7 (18)	6 (20)	0.869
Chronic bronchitis	1 (2.6)	1 (3.3)	0.865

* Significant at p<0.01 **Significant at p<0.05

Table 3. Comparison of mean lung function measurements between the study group and the control group

Lung function measurement	SG (n=38) (Mean ±SD)	CG (n=30) (Mean ±SD)	Significance (p value)
FVC (L)	2.68 ±0.36	2.91 ±0.32	0.006*
FEV_1 (L)	2.1 ±0.39	2.25 ±0.28	0.069
FEV_1 ratio	78.1 ±8.3	77.4 ±5.4	0.689
PEFR (L/min)	386 ±62.83	425 ±34	0.003*

* Significant at p<0.01

studies may be the reason for contradictory results although the methodology was apparently similar. Studies done in Sri Lanka by different authors on different occupations such as tea workers, cinnamon workers and coffee workers reported a higher prevalence of chronic cough than the current study which may be due to the unique occupational characteristics such as difference in composition of dust compared to the dust produced in rice mills and working pattern throughout the year.

The higher prevalence of respiratory symptoms in the study group than the control group found in the current study may be due to irritant effects of rice husk dust exposure together with allergic responses either due to protein constituent of rice husk or microbiological contaminant (Lim *et al,* 1984; Dhillion & Kaur, 2011).

Significant decline in FVC in the rice mill workers found in current study was parallel with Dhillion and Kaur (2011) which is suggestive of restrictive type of lung impairment due to changes in bronchi and elastic component of lungs (Dhillion and Kaur, 2011). Significant decrease of PEFR compared to the control group may be caused by hypertrophy of mucosal cells due to irritation by grain dust and smoke resulting in the increased secretion of mucous and formation of mucosal plugs which cause obstruction to the exhaled air (Dhillion and Kaur, 2011). However the other lung functions were not significantly differ from the control group.

The cross sectional nature of the current study prevented assessing temporal associations. Also this study was unable to highlight a dose-response relationship however, it is emphasized that other factors affecting the results should also be considered.

Considering all the factors, it is concluded that rice mill workers are at a risk of acquiring respiratory symptoms and lung impairments. Therefore, it is necessary to implement preventive measures by means of controlling dust emission, educating the workers regarding the risks and possible outcomes and the importance of using preventive measures.

ACKNOWLEDGMENT

The instrumental support given by the Department of Community Medicine, Faculty of Medicine, University of Colombo, Sri Lanka and guidance provided by Professor M. Udupihille are gratefully acknowledged.

REFERENCES

Abeysekara NTQM (1994). 'A study of the respiratory and other disorders in rice millers following exposure to dusts of occupational origin', MSc Thesis, University of Colombo.

Batsungneon K and Kulworawanichpong T. (2011). 'Effect of Dust Particles in Local Rice Mills on Human Respiratory System'. World Academy of Science, *Engineering and Technology*, vol. 56, 260-265pp.

Department of Census and Statistics. (2013a). 'Sri Lanka, Paddy Statistics - Extent, Sown, Harvested, Average Yield and Production by District - 2012/13 Maha Season', Available:<http://www.statistics.gov.lk/agriculture/Paddy%20Statististics/PaddyStatsPages/2013%20Yala%20%28MT%29.pdf>, 'Accessed 15 June 2014'

Department of Census and Statistics. (2013b). 'Sri Lanka, Paddy Statistics - Extent, Sown, Harvested, Average Yield and Production by District - 2013 Yala Season', Available:<http://www.statistics.gov.lk/agriculture/Paddy%20Statististics/PaddyStatsPages/2012_13%20Maha%20Table03%20FINAL.pdf>, 'Accessed 15 June 2014'

Desai MR and Ghosh SK. (2003). 'Occupational exposure to airborne fungi among rice mill workers with special reference to aflatoxin producing A. flavus strains'. *Annals of Agricultural and Environmental Medicine*, vol. 10, 159-162pp.

Dhillon SK and Kaur H. (2011). 'Study of Effect of Flour Dust and Rice Husk Dust on Pulmonary Functions'. *Indian Journal of Fundamental and Applied Life Sciences*, vol. 1, 100-106pp.

Jayawardana PL and Udupihille M. (1997). 'Ventilatory function of factory workers exposed to tea dust', *Occupational Medicine*, vol. 47, 2, 105-109pp. Available:<http://occmed.oxfordjournals.org/content/47/2/105.full.pdf+html.>, 'Accessed 15 June 2014'

Lim HH *et al*. (1984). 'Rice millers' syndrome: a preliminary report', *British Journal of Industrial Medicine*, vol. 41, 445-449pp. Available:<http://oem.bmj.com/content/41/4/445.full.pdf+html>, 'Accessed 01 June 2014'

Sumanaweera NP. (1998). 'Occupation related respiratory health hazards experienced by the rice mill workers in the district of Polonnaruwa', Thesis, University of Colombo.

Miller M et al., (2005). 'Standardisation of spirometry'. *European Respiratory Journal*, vol. 26, 319-338pp.

National Institute of Health. (2014). "Wheezing". [Online]. Available:<http://www.nim.nih.gov/medlineplus/ency/article/003070.htm>, 'Accessed 10 January 2014'

Wickramage S. Udupihille M and Rajaratne A. (2010). 'An Evaluation of the Respiratory Health of Rice Millers in Anuradhapura District, Sri Lanka', Proceedings of RUSL – Research Symposium, Available:<http://repository.rjt.ac.lk/jspui/handle/7013/565>'Accessed 10 January 2014'

BIOGRAPHY OF AUTHORS

[1]KRM Chandrathilaka is an M.Phil. candidate of Faculty of Medicine, University of Colombo, Sri Lanka. His research interest includes occupational health and ergonomics. At present he works as a research assistant under the Rural Health Project in Faculty of Medicine, University of Colombo funded by "Higher Education for 21st Century" (HETC).

[2]Prof. SR De A Seneviratne is a senior professor of Community Medicine of General Sir John Kotelawala Defense University, Sri Lanka. She has produced more than 30 referred international and local Journal publications to her credit. Prof. SR De A Seneviratne has successfully supervised 18 doctorial level theses (PhD and MD) and 4 Masters dissertations.

[3]Mrs. KN Lankatilake is a senior lecturer in Community Medicine of Faculty of Medicine, University of Colombo, Sri Lanka. Her research interests include occupational hazards and risks to workers in work settings, indoor and outdoor air quality and health effects, climate change and impact on health. She has produced 7 referred international and local Journal publications to her credit.

[4]Dr. DBDL Samaranayake is a senior lecturer in Community Medicine and consultant community physician of Faculty of Medicine of University of Colombo, Sri Lanka. Her research interests include occupational health, human resources for health, environmental health. She has produced 4 referred international and local Journal publications to her credit.

[5]Dr. AK Karunarathna is a senior lecturer of Faculty of Agriculture of University of Peradeniya, Sri Lanka. His research interests include waste management: 3Rs, treatment, resources recovery, waste-to-energy and sustainable land disposal systems. He has produced 5 referred international and local Journal publications to his credit.