Proceedings of Engineering Technology International Conference (ETIC 2015)
10-11 August 2015, Bali, Indonesia

A FRAMEWORK OF NON-FATAL OCCUPATIONAL INJURY SURVEILLANCE IN PALM OIL MILL – A PROPOSED STUDY

Rumaizah Ruslan 1[a,b*], Ishak Baba 2[a], Abdul Mutalib Leman 3[a], and Tan Lai Wai 4[c]

[a]Faculty of Engineering Technology
[b]Faculty of Technology Management and Business
[c]Faculty of Civil and Environmental Engineering
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, MALAYSIA.

*E-mail: rumaizah@uthm.edu.my

Abstract

Non-fatal occupational injuries have been reported in high number of cases based on current Malaysian statistic data yet there are limited published papers covering on the issue especially in an agriculture milling industry. This study intended to develop a framework on non-fatal occupational injury surveillance by using an epidemiological data, exposure data and non-fatal occupational injury data. Method development and research's instrument preparation will be established in the first phase of the study. These are including reviews on relevant literatures, questionnaire development and sampling procedure. In the second phase, workplace-based survey will be carried out by using questionnaire which consist data on epidemiological and non-fatal occupational injuries. Environmental and personal noise exposure monitoring will also be executed. All gathered data will be analysed in quantitative method by using a statistical software SPSS (Statistic Package for Social Science). It is expected that database of non-fatal injury surveillance consists of epidemiological data of workers and exposure data could be established. The study will contribute to an initial approach of developing a framework for occupational injury surveillance that beneficial in early detection of occupational disease and preventive action. Future intervention on occupational safety and health could be tailor-made based on this occupational injury surveillance by focusing on workers' safety and health in the palm oil mill.

Key words: Occupational Injury; Surveillance; Palm Oil; Mill Industry.

1. Introduction

Malaysia as developing country is still much depending on agriculture sector as the pillar of its economic growth especially when crude palm oil is one of nation's major product. Although the sector had been surpassed by manufacturing industries since year 1987 [1], the economic growth for agriculture keeps on increasing. The main business that plays the vital roles towards the positive growth is none other than palm oil industry. It is one of the largest contributor to Malaysia's economy, accounting for RM 56.1 billion of Malaysia's total exports in 2012 [2]. The industry contributed 39% of world palm oil production and 44% of world exports [3].

It is recognized that agriculture is one of the most hazardous occupations worldwide. While the political, economic, climatic and work condition may vary, agriculture consistently ranks among the most hazardous industries, along with mining and construction [4]. In several countries the fatal accident rate in agriculture is double the average for all other industries. The mortality rates in agriculture sector remained consistently high in the past decade [5]. This is particularly evident in developing countries where education, training and safety systems are largely inadequate to provide coverage to the sector.

According to Department of Occupational Safety and Health (DOSH) Malaysia, whereby occupational accidents is divided into 3 categories which are accidents with non-permanent disability, permanent disability and death, agriculture was rank in the top 3 sector that retain high rating of occupational accidents for the past 3 years. In 2014, there were 492 accidents reported and investigated by the Department of Occupational Safety and Health (DOSH) Malaysia. There were included 441 cases of non-permanent disability, nine cases of permanent disability and 42

accidents had caused death for the particular sector [6]. Details of figure for year 2012, 2013 and 2014 are shown in Table 1.

Table 1: Accidents reported and investigated by DOSH for agricultural sector (DOSH, 2015)

Year	Fatal		Non-Fatal	Total
	Death	Permanent Disability	Non-permanent Disability	
2012	38	26	385	449
2013	33	14	488	535
2014	42	9	441	492

Various studies had provided figures on occupational accidents [7] and diseases in agriculture sector. Machinery such as tractors and harvesters have the highest frequency and fatality rates of injury [8] in agriculture settings. Exposure to pesticides and other agrochemicals contributing to poisoning and in certain cases, it leads to work-related cancer and death [9, 10]. Other hazards due to the multiple contact with poisonous and wild animals, plants and biological agents which may give raise to allergies, respiratory disorders and lung disease, zoonotic infection and parasitic diseases [5]. Noise-induced hearing loss, musculoskeletal disorders (repetitive motion disorders, back disorders) stress [11, 12] and psychological disorders are also frequent [13]. The findings giving the idea of the severity of the problem it may arise from hazard exposure in agriculture sector, however official data on the incidence of occupational accidents and diseases are imprecise [5].

It is clear that occupational injuries in Malaysia shown an alarming number for the past three years based on local statistic data. The reported cases contained information regarding causes of injuries, rates and severity of injury. However, the data lack segregated and contain not specific information per occupational grouping such as job task or process. There is also gap in the literature on information regarding to identification of risk factors associated to injuries among workers in local palm oil mill. Therefore, a research of risk factors into specific occupational industry should be carried out to enhance knowledge on occupational injuries that could lead the way for more effective preventive strategies. As stated by Abas et al. [14], surveillance system in Malaysia is fragmented. It was suggested that more rigorous risk reduction strategies in agriculture sector should be adopted for specific subgroups and for particular jobs that are identified with a high risk for occupational injury. Thus by this means, there is need to initiate a non-fatal injury surveillance in palm oil mill to identify the distribution pattern of non-fatal occupational injury and a framework of its implementation could be recommended. Apart from that, it is expected that the work will support the future direction of implementing preventive measures and intervention strategies could be tailormade into specific high-risk group of workers in palm oil mill.

The study will be focusing on development of non-fatal occupational injury surveillance's framework by using epidemiological data and non-fatal occupational injury according to specific job task in oil palm mill.

2. Methodology

This study will be conducted in palm oil mill in southern area in Malaysia and it will be organized in three phases as referred in Figure 1.

2.1 Phase 1

In phase 1, research works will be conducted by four parts. In part 1, sampling location will be identified and formal approval from companies will be arranged. A random sampling will be conducted from a sampling frame of workers given out by the company after the approval is granted. In part 2, the potential hazards in workplace will be identified based on secondary data such as literature review and published articles. Based on this, a set of questionnaire will be developed which includes worker's epidemiological data consists of socio-demographic, employment, lifestyle and self-perceived health status. Part 3 will involve assessment on workplace noise and personal noise exposure. Dosimeter and sound level meter (Model: ISO-TECH SLM-1352N) will be used for the monitoring purposes. As in part 4, another set of questionnaire will be used to gather information on occupational injuries among workers. The questionnaire is adapted from Injury Surveillance Guideline by World Health Organization [15].

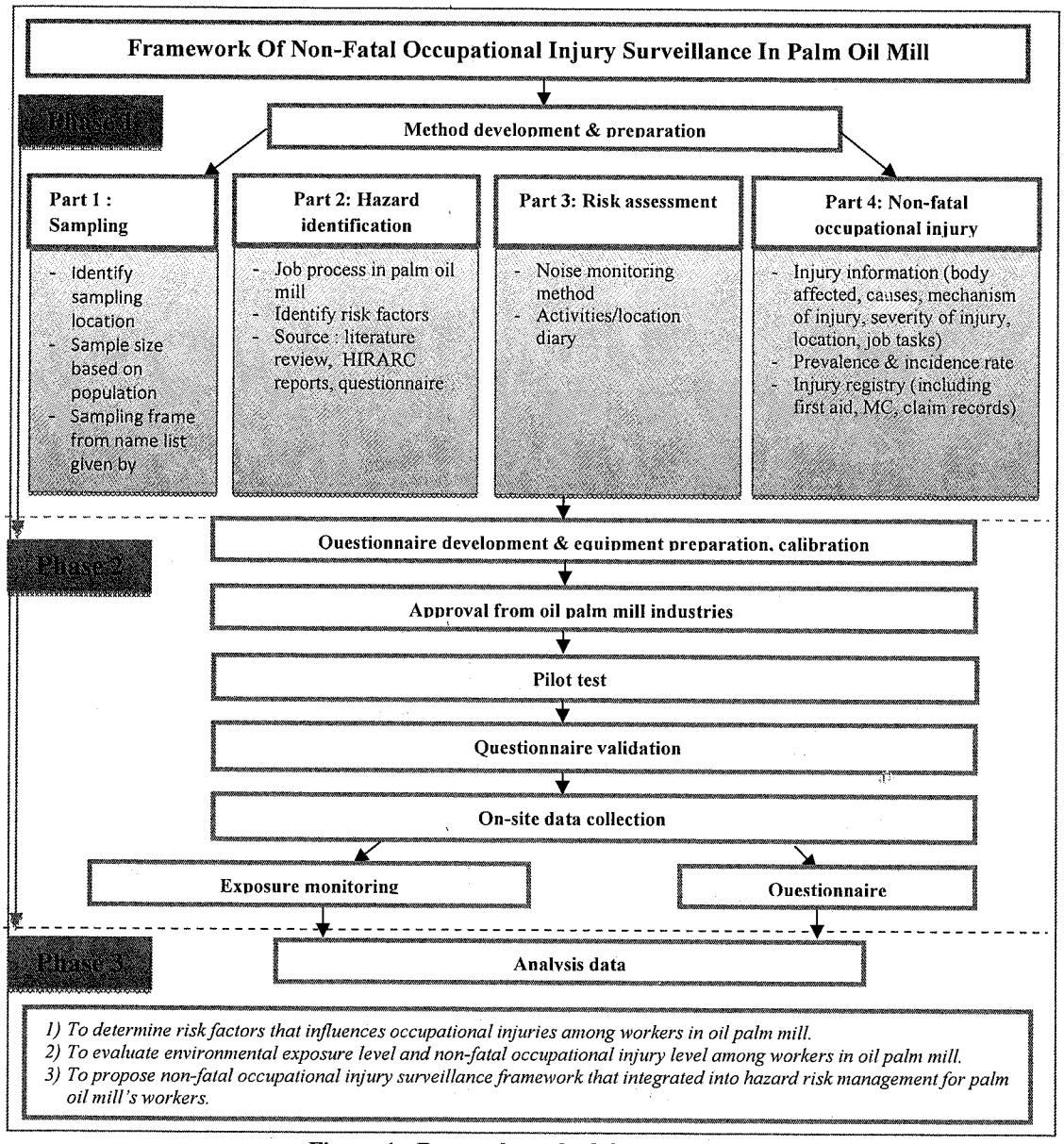

Figure 1 : Research methodology overview

2.2 Phase 2

Workplace-based survey will be commenced in Phase 2. A pilot study to test the reliability and validity of questionnaire will be carried out among 30 workers in selected palm oil mill. Only a revised questionnaire will be distributed to obtain the information on workforce's epidemiological data consists of socio-demographic, employment, lifestyle, self-perceived health status and data on occupation injury. Further information regarding workplace risk and injuries will be gathered from company's HIRARC (Hazard Identification, Risk Assessment and Risk Control) reports, noise monitoring reports and medical records. Workplace exposure level as well as personal exposure level in the workplace will be carried out and the results will be further evaluated in phase 3.

2.3 Phase 3

All data gathered from questionnaire, company's HIRARC and noise reports as well as medical records, workplace and personal risk assessment will be analysed in quantitative method. A statistical software SPSS (Statistic Package for Social Science) will be used to measure the objective of this study.

3. Results and discussion

3.1 Definition of epidemiological data

For the purpose of this study, epidemiological data is defined as data on exposure to occupational risks in the workplace and on health outcome. The epidemiological data which modified after Godderis *et al.* [16] are specified into several categories as shown in Table 2.

Table 2: Categories of epidemiological data [16]

Category	Items
Socio-demography data	Age, gender, education level
Employment data	Senority, profession, job task, duration of working in the workplace
Lifestyle	Leisure activity, alcohol use, smoking habits
Workplace hazard	Chemical, physical, and biological agents
Working environment	Noise, air, floor surface, fire and explosive
Health status	Medication, sick leave, medical history

3.2 Definition of non-fatal occupational injuries

The International Labour Organization's definition of an occupational injury is 'any personal injury, disease or death resulting from an occupational accident', with the definition of an occupational accident being 'an unexpected and unplanned occurrence, including acts of violence, arising out of or in connection with work which results in one or more workers incurring a personal injury, disease or death'. Occupational injury is also defined as an injury or illness which is to be work-related if an event or exposure in the work environment either caused or contributed to the resulting condition or significantly aggravated a pre-existing condition [17]. Non-fatal occupational injury, to be specific, is defined by any injury such as a cut, fracture, sprain or amputation, which results from a work-related event or from a single instantaneous exposure in the work environment [18]. Non-fatal occupational injury involves lost workdays of at least 4 hours, a condition that requires restricted activity; for example a person could not perform work or other normal duties, missed work, or a condition that required professional medical treatment [19]. For the purpose of this study, non-fatal occupational injury could be defined as a damaged to human body resulting from working activities, which can caused a minor injury to permanent disability to workers who work at palm oil mill industry. Meanwhile, indicators for non-fatal occupational injuries that will be used in this study are causes of injury, type of injury, mechanism of injury, body part affected, severity of injury, sick leave taken by involved workers [15, 20].

3.3 Non-fatal occupational injury in agriculture sector

In Malaysia, it was noted the highest annual average incidence rate of non-fatal occupational injuries in the agricultural sector (24.1/1000) in the year 2011. The main types of injuries reported were superficial injuries (17%), followed by sprains and strains (10%) and fractures (5%). Falling from heights (31%) was the main cause of accidents followed by being struck by objects (25%). The main accident agent was identified as working environment (45%) [14].

Research on health and safety related to palm oil workers in Malaysia have vigorously been done based on published articles for the past 2 years. The findings had proven that health and safety issue among palm oil workers is required full attention and commitment. Neglecting those aspects which are included for social wellbeing, may affect the sustainability of palm oil industry. However, lack attention had been paid for occupational injuries issues in local palm oil mill due to narrow references of related research that focusing in milling factory. Findings from past literature in Malaysia's perspective which is divided into two scopes of palm oil plantation and palm oil mill, could be referred in Table 3.

Judging from inadequate insight focusing on non-fatal occupational injuries in palm oil mill workers in Malaysia by the time this research was designed, we referred to other international research in milling industry. The study which was performed in Spain's olive oil mills found out that movement from one place to another, slips, trips or performs incorrectly coordinated movement had resulted in injuries such as sprain and strain. The most common frequent accident scenarios reported by workers were slip and trips on the same level, collision with an object, excessive physical efforts and contact with hazardous substances [28].

Table 3: Summary of past literature on occupational safety and health issues in Malaysia's palm oil plantation and palm oil mill

Scope	Hazards	Impact	References
Plantation	Ergonomics	Intention to leave; job satisfaction	[21]
		Productivity loss	[22]
		Musculoskeletal disease	[23, 24]
Mill	Heat stress	Heat related illness	[25]
	Mechanical hazards caused by sterilizer	Physical injury and musculoskeletal injury	[26]
	Noise	Occupational stress	[27]

3.4 Risk factors of non- fatal occupational injury

- Definition of risk factors

The state of health and safety of workers are always been influenced by various factors and not just by a single factor. Those factors that associated with ill health, disease, disability or death in some worse cases, are known as risk factors. The risk factor best described by World Health Organization (WHO) [29] as any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury. Risk factors often exist in complex interaction and relate with one another. Risk factors can be presented by behavioural, biomedical, environmental, genetic and demographic risk factors [30]. Detail description of risk factors could be referred in Table 4. The importance by having known the risk factors is it could lead to early detection of injury or disease. Furthermore, the identification of risk factors that would affect the workers' wellbeing could initiate an effective preventive action.

Table 4: Categories of risk factors and its explanation [30]

Categories	Explanation
Behavioral risk factors	Can be eliminated or reduced through lifestyle or behavioural changes include; tobacco smoking, excessive alcohol consumption, poor diet and nutrition, physical inactivity.
Biomedical risk factors	May be influenced by a combination of genetic, lifestyle and other broad factors. Biomedical risk factors include; overweight and obesity, high blood pressure, high blood cholesterol and impaired glucose tolerance.
Environmental risk factors	Environmental determinants of health cover a wide array of topics, and can be split into two broad categories : • Social, economic, cultural and political • Physical, chemical and biological
Genetic risk factors	Some diseases result entirely from an individual's genetic makeup whereas many others reflect the interaction between that makeup and environmental factors. There are three broad groups of genetic diseases: • Single gene (monogenic) disorders, for example haemophilia; • Chromosomal abnormalities, for example Down syndrome; and • Multifactorial diseases, such as asthma.
Demographic risk factors	Demographic factors include age, gender, and population subgroups.

Through review of past literature from year 2007 to year 2014, there are twenty-one risk factors identified that have significant influences on occupational injuries in agricultural settings. Based on the review, top six variables of risk factors will be evaluated in this study, namely: 1) Age, 2) Number of workers when accident occurs, 3) Existing preventive measures, 4) Education level, 5) Gender, and 6) Working experience. The ranking of the risk factors are shown in Table 5.

Table 5: Risk factors contributed to occupational injuries in agricultural workplace from year 2007 until 2014

References	[20]	[31]	[32]	[33]	[14]	[34]	[35]	[28]	[36]	[37]	
Year	2007	2008	2010	2010	2011	2011	2012	2012	2013	2014	Total
Region	US	Spain	India	Canada	Malaysia	Belgium	US/North	Spain	S.Korea	Norway	
Age	x		x	x	x		x	x	x		7
No of workers when accidents occurs				x		x		x		x	4
Existing preventive measures		x		x		x					3
Educational level	x		x			x					3
Gender			x				x	x			3
Working experience	x							x	x		3
Job content/ Task/ Activities								x		x	2
Ethnicity					x		x				2
Behavior						x			x		2
Income/ salary							x				1
Stress	x										1
Safety and health policies/ safety climate							x				1

3.5 Surveillance on non-fatal occupational injury in workplace

- Definition of injury surveillance

Injury surveillance is defined as a system that intended to record information on individual cases of injury and produce statistical overviews of an injury problem, with all the relevant data being classified and coded according to agreed international standards [15]. A comprehensive surveillance system for occupational disease and injury control includes acquisition of information about hazardous exposures, diseases and injuries, analysis of the information, and dissemination and interpretation of the information to identify the magnitude of problem, monitor changing patterns through ongoing analysis, and dissemination of information linked to public health programs [38].

The importance of a national injury surveillance system for all groups of workers in Malaysia's viewpoint was discussed in previous literature. Surveillance data is essential for a country-wide injury prevention program [14]. Additionally the comprehensive surveillance data is crucial in determining an appropriate and cost-effective intervention. It will act as an eye-opener for stakeholders or decision makers as attention from them with regards of workers' safety and health matters are needed for better implementation of preventive measures [23].

4. Industry contribution

It is expected that the outcome of this research will contribute to nation palm oil industry in terms of sustaining positive social impact in scope of safety and health. It is hope that recommendation that may arise from the research findings could improvise in preventive measures and mitigating the risk control.

5. Conclusion

Literature on non-fatal occupational injuries in palm oil mill was limited resulted in lack of evidence of major trends in injuries, causes of injuries, rates and severity of injury. Therefore, there is a need of research into risk factors of injuries with the direct effect of workplace risk exposure assessment. It is expected that this study would be an initial

approach of non-fatal occupational injury surveillance framework, which will assist in decision making of risk control and prevention for local palm oil mill industry.

Acknowledgement

The authors would like to thank the Office of Research, Innovation, Commercialization and Consultancy Management (ORICC) Universiti Tun Hussein Onn Malaysia for funding this research under Multidicplinary Research Grant Scheme (Project No: U099).

References

1. Ahmad, T. T. M. A., and Suntharalingam, C., 2009, "Transformation and Economic Growth of the Malaysian Agricultural Sector," Economic and Technology Management Review, 4, 1-10.
2. Economic Planning Unit, 2013, The Malaysian Economy in Figures, Putrajaya (Malaysia): Prime Minister's Department. Retrieved at http://www.epu.gov.my/the-malaysian-economy-in-figures-2013.
3. Malaysia Palm Oil Council (MPOC), 2013. Malaysia Palm Oil Industry. Retrieved from http://www.mpoc.org.my/Industry_Overview.aspx.
4. Myers, M.L. (Ed)., 2006, ILO Encyclopaedia of Occupational Health and Safety, Ontario (CA): Canadian Centre for Occupational Health and Safety (CCOHS).
5. Valentina, F., 1999, The ILO Programme on Occupational Safety and Health in Agriculture. Geneva: International Labour Organization.
6. Department of Occupational Safety and Health Malaysia, 2015, Statistic of Department: Occupational Accidents by Sector For the Category of NPD,PD and Death Until December 2014 (Investigated). Putrajaya (Malaysia): DOSH.
7. Joseph, B., and Minj, C., 2010, "Risk rating in the tea planting industry: The employees' opinion," Indian Journal Of Occupational and Environmental Medicine,14(3), 97.
8. Yiha, O., and Kumie, A., 2010, "Assessment of occupational injuries in Tendaho Agricultural Development S.C, Afar Regional State," Ethiopian Journal of Health Development, 24(3), 167-174.
9. Fieten, K. B., Kromhout, H., Heederik, D., and de Joode, B. V. W., 2009, "Pesticide exposure and respiratory health of indigenous women in Costa Rica," American Journal of Epidemiology, 169(12), 1500-1506.
10. Kesavachandran, C. N., Rastogi, S. K., Mathur, N., Siddiqui, M. K. J., Singh, V. K., Bihari, V., and Bharti, R. S., 2008, "Health status among pesticide applicators at a mango plantation in India," Journal of Pesticide Safety Education, 8, 1-9.
11. Bernard, C., Courouve, L., Bouée, S., Adjémian, A., Chrétien, J. C., and Niedhammer, I., 2011, "Biomechanical and psychosocial work exposures and musculoskeletal symptoms among vineyard workers," Journal of occupational health, 53(5), 297-311.
12. Rocha, F. L. R., Marziale, M. H. P., and Hong, O. S., 2010, "Work and health conditions of sugar cane workers in Brazil," Revista da Escola de Enfermagem da USP, 44(4), 978-983.
13. Wesseling, C., de Joode, B. V. W., Keifer, M., London, L., Mergler, D., and Stallones, L., 2010, "Symptoms of psychological distress and suicidal ideation among banana workers with a history of poisoning by organophosphate or n-methyl carbamate pesticides," Occupational and Environmental Medicine, 67(11), 778-784.
14. Abas, L., Said, A. R. B. M., Mohammed, M. A. B. A., and Sathiakumar, N., 2011, "Non-fatal Occupational Injuries among Non-governmental Employees in Malaysia," International Journal of Occupational and Environmental Health, 17(1), 38–48, doi:10.1179/107735211799031095.
15. Holder, Y., Peden, M., Krug, E., Lund, J., Gururaj, G., and Kobusingye, O., 2001, Injury Surveillance Guideline, Geneva:World Health Organization.
16. Godderis, L., Johannik, K., Mylle, G., Bulterys, S., and Moens, G., 2014, " Epidemiological and performance indicators for occupational health services: a feasibility study in Belgium," BMC Health Services Research, 14(1), 410. doi:10.1186/1472-6963-14-410.
17. United States Department of Labour , 2012, Injuries, Illness and Fatalities: Occupational Safety and Health Definitions. Retrieved at http://www.bls.gov/iif/oshdef.htm.
18. National Centers for Health Statistic, USA Department of Health and Human Services, 2010, Injuries, Non-Fatal, Work-related (per 100). Retrieved at http://www.healthindicators.gov/Indicators/Injuries-non-fatal-work-related-per-100_1308/Profile.

19. Centers of Disease Control and Prevention, National Institute of Occupational Safety and Health, USA Department of Health and Human Services, 2002, Workers Health Chatbook 2000 Nonfatal Injuries. Retrieved at http://www.cdc.gov/niosh/docs/2002-119/pdfs/2002-119.pdf.
20. Sprince, N., Park, H., Zwerling, C., Whitten, P., Lynch, C., Burmeister, L., ... Alavanja, M., 2007, "Risk factors for low back injury among farmers in Iowa: A case-control study nested in the agricultural health study," Journal of Occupational and Environmental Hygiene, 4(1), 10–6. doi:10.1080/15459620601067266
21. Govindarajo, N. S., Dileep, M, K, and Ramulu, S. S., 2014, "Identifying, Categorizing and Setting Variables on Ergonomics Issues in Oil Palm Plantations," 10(16), 113–122. doi:10.5539/ass.v10n16p113.
22. Ng, Y. G., Tamrin, S. B. M., Yik, W. M., Yusoff, I. S. M., and Mori, I., 2014, "The Prevalence of Musculoskeletal Disorder and Association with Productivity Loss: A Preliminary Study among Labour Intensive Manual Harvesting Activities in Oil Palm Plantation," Industrial Health, 52(1), 78–85. doi:10.2486/indhealth.2013-0017.
23. Ng, Y. G., Tamrin, S.B.M., Syah, Y. I., Mori, I., and Hashim, Z., 2013, "Ergonomics Observation: Harvesting Tasks at Oil Palm Plantation," Journal of Occupational Health, 55, 405–414.
24. Sukadarin, E. H., Deros, B. M., Ghani, J. A., Ismail, A. R., Mokhtar, M. M., and Mohamad, D., 2013, "Investigation of Ergonomics Risk Factors for Musculoskeletal Disorders among Oil Palm Workers Using Quick Exposure Check (QEC)," Advanced Engineering Forum, 10, 103–109. doi:10.4028/www.scientific.net/AEF.10.103.
25. Yusof, N.D.M., Karuppiah, K., Tamrin, S.B.M, 2014, "Heat Related Illness in Palm Oil Mill Workers under Heat Stress," Advances in Environmental Biology, 8(15), 171–176.
26. Hadi, H. M., Tamrin, S.B.M., and Karuppiah, K., 2014, "Hazard and Risk Analysis of Different Sterilizer Technology in Palm Oil Mills," Advances in Environmental Biology, 8(15), 85–90.
27. Naeini, R. L., and Tamrin, S.B.M., 2014, "The Prevalence of Occupational Stress as a Non-Auditory Effect of Noise," Asian Journal of Medical and Pharmaceutical Researches, 4(2), 78–84.
28. Parejo-Moscoso, J. M., Rubio-Romero, J. C., and Pérez-Canto, S., 2012, "Occupational Accident Rate in Olive Oil Mills," Safety Science, 50(2), 285–293. doi:10.1016/j.ssci.2011.08.064.
29. World Health Organization (WHO), 2015, "Health Topic – Risk Factors". Retrieved from http://www.who.int/topics/risk_factors/en/
30. Australian Institute of Health and Welfare, 2015, "Risk Factors to Health", Retrieved from http//:www.aihw.gov.aurisk-factors/
31. Arocena, P., Núñez, I., and Villanueva, M., 2008, "The impact of prevention measures and organisational factors on occupational injuries," Safety Science, 46(9), 1369–1384, doi:10.1016/j.ssci.2007.09.003.
32. Narasimhan, G. R., Peng, Y., Crowe, T. G., Hagel, L., Dosman, J., and Pickett, W., 2010, "Operational safety practices as determinants of machinery-related injury on Saskatchewan farms," Accident, Analysis and Prevention, 42(4), 1226–31. doi:10.1016/j.aap.2010.01.016.
33. Patel, S.K., Varmab, M.R., and Kumara, A., 2010, "Agricultural injuries in Etawah district of Uttar Pradesh in India," Safety Science 48(2), 222-229.
34. Van den Broucke, S., and Colémont, A., 2011, "Behavioral and nonbehavioral risk factors for occupational injuries and health problems among Belgian farmers," Journal of Agromedicine, 16(4), 299–310. doi:10.1080/1059924X.2011.605709.
35. Smith, T. D., and DeJoy, D. M., 2012, "Occupational injury in America: An analysis of risk factors using data from the General Social Survey (GSS)," Journal of Safety Research, 43(1), 67–74. doi:10.1016/j.jsr.2011.12.002.
36. Rhee, K. Y., Choe, S. W., Kim, Y. S., and Koo, K. H., 2013, "The trend of occupational injuries in Korea from 2001 to 2010," Safety and Health at Work, 4(1), 63–70. doi:10.5491/SHAW.2013.4.1.63.
37. Svendsen, K., Aas, O., and Hilt, B., 2014, "Nonfatal Occupational Injuries in Norwegian Farmers," Safety and Health at Wor. doi:10.1016/j.shaw.2014.05.001.
38. Thacker, S.B., and Berkelman, R.L., 1989, "Public health surveillance in the United States," Epidemiology Review 1989 (10),164– 190.