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An Application of Self-Health Risk Assessment among Populations Living in the Vicinity of a Fiber-Cement Roofing Factory

Phayong Thepaksorn

***Abstract*—**The objective of this study was to assess whether living in proximity to a roofing fiber cement factory in southern Thailand was associated with physical, mental, social, and spiritual health domains measured in a self-reported health risk assessment (HRA) questionnaire. A cross-sectional study was conducted among community members divided into two groups: near population (living within 0-2km of factory) and far population (living within 2-5km of factory) (*N*=198). A greater proportion of those living far from the factory (65.34%) reported physical health problems than the near group (51.04%) (p =0.032). This study has demonstrated that the near population group had higher proportion of participants with positive ratings on mental assessment (30.34%) and social health impacts (28.42%) than far population group (10.59% and 16.67%, respectively) (p <0.001). The near population group (29.79%) had similar proportion of participants with positive ratings in spiritual health impacts compared with far population group (27.08%). Among females, but not males, this study demonstrated that a higher proportion of the near population had a positive summative score for the self-HRA, which included all four health domain, compared to the far population (p<0.001 for females; p = 0.154 for males). In conclusion, this self-HRA of physical, mental, social, and spiritual health domains reflected the risk perceptions of populations living in the vicinity of the roofing fiber cement factory. This type of tool can bring attention to population concerns and complaints in the factory's surrounding community. Our findings may contribute to future development of self-HRA for HIA development procedure in Thailand.

***Keywords*—**Cement dust, health impact assessment, risk assessment, walk-though survey.

I. Introduction

THE understanding of self-health risk assessment (HRA) for possible effects and impacts on human health and the procedures of health impact assessment (HIA) are not well documented. Mostly health studies were conduct self-reported data to assess the risk factors and health behaviors such as smoking, risk screening for diabetes, and heart disease [1]-[3]. Such studies have been widely used to measure health status and as a tool for disease and mortality risk screening [4], [5]. Only few studies have been conducted to assess opinions on health impact assessment in community settings [6]-[8]. However, no studies have been conducted on self-HRA in HIA procedure.

The framework and approach within HIA protocol implementation in Thailand allows key stakeholders and affected populations to participate at the beginning and ongoing HIA procedures [7], [8]. They can participate in public hearings throughout different stages including in the initial steps of the screening process—identifying points of health impact, prevalent risk factors in the public scoping process, and estimating change in health outcome appraisal within public reviewing process. However, there is great opportunity for a number of limitations and obstacles need to be scrutinized for further directions [8].

In Thailand's conceptualization of health, the component of a healthy state is defined as "physical, mental, social and spiritual well-being" [8]. This term has been redefined as a broader perception of health. Specifically, the spiritual health aspect has been taken into consideration when conducting the HIA process [9], [10].

In fiber-cement roofing factories (FCR), work processes consist of 4 main processes for material production [11]. First, a bag opener teases open cement bags and then mixed pulp and sodium bentonite are poured into a turbo mixer. After all materials are combined, the cement is introduced into a rod mill. The mixing ingredients are then weighed and rinsed by water into slurry by controlled density before being sent to the rack and cured. Raw materials are then transformed into sheets through a curing process. The sheet has been prepared with pre- and post-cure coating and drying, and are then sprayed the assigned color. Finally, the sheet is stripped and inspected for quality check and control. Finally, the final products are ready to be collated, packaged, and stored in the warehouse. The chemicals and airborne dust that can be found and sampled in this work environment include inhalable and total dust, chromium (III) compound, iron oxide fume, hydrogen chloride, and methyl ethyl ketone [12].

There are several processes in roofing fiber cement factory production, where airborne dust exposure among workers is likely. Previously, a walk-through survey was conducted by [13] that included measurements of environmental and personal dust samplings. The mean exposure level of total cement dust in the factory was 0.45 mg/m^3 (SD 0.28), and the respirable dust exposure level was 0.61 mg/m^3 (SD 0.84). Therefore, the roofing fiber cement productions and emissions could be one of the major potential sources of cement dust exposure that cause respiratory health risks and that led to attention of and complaints from in the surrounding community [12], [13]. In a cross-sectional study, [13] observed that the exposed group had significantly higher

Phayong Thepaksorn is with Trang Research Center for Occupational Halth, Sirindhorn College of Public Health, Trang, 9200 Thailand (phone: 66-88-7531547; fax: 66-75-263324; e-mail: phayongthep@ gmail.com).

prevalence than the unexposed group for shortness of breath (OR = 2.19). The ventilated respiratory function values (FEV1 and FVC) were slightly lower for the exposed group [13].

In order to achieve the objectives of this study, the authors developed self-HRA questionnaire assessments, in which the variables were integrated from health determinants and a healthy state of well-being. In-depth interviews were also conducted to assess opinions on health risks due to pollutant exposures from roofing fiber cement factory. The aim of this study was to assess whether the data collected through the self-report questionnaires is associated with their health status. In addition, published studies examining cement dust exposure of populations living in varied vicinities of the factory are scarce. The application of the self- HRA among populations living near the roofing fiber cement factory where the HIA tool can be used to quantify levels of public's coping could be a valuable addition to the HIA process. Consequently, the suggested tool was included to enhance the scope of the study.

II. Methods

A. Study Design and Population Settings

As a part of the study on developing HIA tools for cement factories, this cross-sectional study was conducted between July and September 2011 among populations living nearby the roofing cement factory in the South of Thailand. There were 6,746 people in our population (males = 3,220; females =3,376). The health data registries were accessed and extracted from two corresponding Health Centers. According to Kongsoa Health Center (KHC), there were totally 2,140 populations living factory within a 2-km radius of the factory whereas 4,606 population living (Kaewsaen Health Center; KSC) within a 5-km radius from the factory.

The descriptive characteristic data for assigned populations were extracted from the Java Health Center Information System (JHCIS) of KHC and KSC [17]. This program has been recorded since 2009. The registered data have been recorded according to basic data classified into 21 family folders for outpatient registries. Most cases were recorded on JHCIS of both health centers.

The sample size employed in the study allowed the estimation of sensitivity and specificity at a 95% confidence interval of width ± 10% was 90 in each group [14]. A sample size of 96 participants living within 2-km and 101 participants living within at least a 5-km radius from the roofing fiber cement factory was surveyed for this study. Fourteen questionnaires for participants living within 2-km and 9 questionnaire surveys for participants living least 5-km were removed during the analyses because they were not completed.

The semi-structured questionnaire interviews have been developed according to health determinants for self-HRA aspects of health dominants including physical, mental, social, and spiritual health aspects of the study of [15] in both positive and negative statements [10], [14], [16] (Fig. 1). The content validity and reliability have been identified [15]. There were 4 positive and negative statements for mental health impacts, 6 positive and 4 negative statements for social health impacts, and 5 positive and 3 negative statements for spiritual health impacts. Face-to-face interviews of each were conducted with 10 representatives. The researcher team contacted the Director of Health Center in both KHC and KSC. They helped us to identify the key informants and representatives to recruit for participating in this study. The health volunteers were also assisted us in organizing the interview for participants. The authors gave a brief explanation of the HIA and the purpose of the study to all participants. The discussions were semi-structured using a list of open-ended questions.

B. Ethical Considerations

This study was approved by the ethics committee of the Chulalongkorn University Review Board (Ref No. 189.2/54, 2012/02/24). All of the participants were clearly informed of the purpose of this study and agreed by signing a consent form.

C. Statistical Analysis

The data analyses were derived by SPSS for Windows (version 17, Chicago, IL, USA). Means and SD were used to characterize the difference between both groups including descriptive demographic characteristics, frequencies and percentages. The evaluation criteria for self-health risk assessment have been rated into positive and negative effects that could be potentially affected by the cement factory. The options for self-health risk rating have been clarified and clearly demonstrated their opinions. The score for each question has been coded and rated (positive statement; 'yes' (1); 'no' (0) and negative statement; 'yes' (0); 'no' (1)). The evaluative criteria for health impacts have been classified into three categories and calculated in percentages (positive impacts =score 67-100%, between positive and negative impacts = score 34-66%, and negative impacts = score 0-33%), respectively. Chi-square was used to detect differences in the frequencies of categorical characteristics such as age, sex, education, and occupation between the groups. An independent t-test was used when analyzing difference in means between group of exposure and control group. A p-value of less than 0.05 was considered statically significant. The questionnaire interview results were grouped into four aspects.

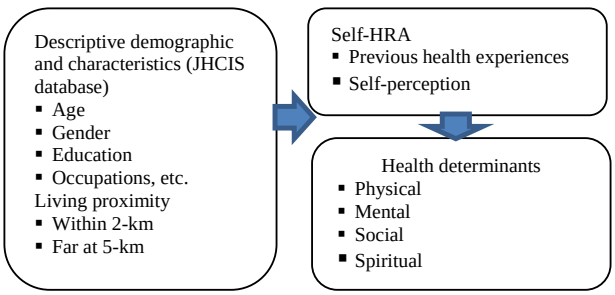

Fig. 1 Logical framework for self-HRA of associations between health determinants and living proximity

III. Results

Quantitative Results

Data from the JHCIS online records between 2009 and 2011show the number and prevalence of six leading chronic diseases at KHC were 200.77 per 1,000 for respiratory diseases, 100.92 per 1,000 for digestive system, 100 per 1,000 for cardiovascular disease, 68.30 per 1,000 for skin diseases, 64.32 per 1,000 for musculoskeletal symptoms, and 27.87 per 1,000 for hypertension, respectively. In KSC data, the number and prevalence of six leading chronic diseases at KHC were 174.76 per 1,000 for respiratory diseases, 80.24 per 1,000 for cardiovascular disease, 76.12 per 1,000 for digestive system, 39.16 per 1,000 for musculoskeletal symptoms, 30.77 per 1,000 for skin diseases, and 23.34 per 1,000 for hypertension, respectively. The respiratory symptoms and diseases were reported, including common cold and fever, pneumonia, and sore throat infection (Table I).

TABLE I
NUMBER AND PREVALENCE OF 6-LEADING OUTPATIENT ACCORDING TO JHCIS DATABASE OF KHC AND KSC, 2009-2011 [A]

Diseases	Kongsoa HC (*n* = 6,530)		Kaewsaen HC (*n* = 13,584)	
	No.	Rate/ 1,000	No.	Rate/r 1,000
1. Respiratory system	1,311	200.77	2,374	174.76
2. Digestive system	659	100.92	1,034	76.12
3. Cardiovascular disease	653	100.00	1,090	80.24
4. Skin disease/coetaneous	446	68.30	418	30.77
5. Musculoskeletal	420	64.32	532	39.16
6. Hypertension	182	27.87	317	23.34

[a] JHCIS = the use of graphic user interface according to data record of MOPH by 18 folders; A number of total population summed up of 3 years, 2009-2011

TABLE II
DESCRIPTIVE CHARACTERISTICS OF SELF-HEALTH RISK ASSESSMENT FOR PARTICIPANTS WHO LIVE NEAR AND FAR FROM THE FACTORY

Characteristics	Near [c](*n*=96)	Far(*n*=101)	*P* value
Age (years), mean (SD)	38.77(14.87)	42.62 (18.17)	0.101[a]
Sex (%)			
Male	28(29.17)	47(46.53)	0.011[b]
Female	68(70.83)	54(53.47)	
Status (%)			
Single	21(21.87)	23(22.77)	
Married	67(69.79)	75(74.25)	0.140
Divorce/separate	8(8.34)	3(2.98)	
Education (%)			
Primary	36(37.50)	43(42.57)	
Secondary	35(36.45)	35(34.65)	0.588
Higher	25(26.05)	23(22.78)	
*Occupation (%)*Agriculturist (rubber plantation and palm oil)	70(72.92)	74(73.26)	
Temporary workers	6(16.67)	16(15.84)	
Own business	5(5.20)	4(3.96)	0.883
Governmental and public enterprise employees	5(5.21)	7(6.94)	

[a] Independent student's t-test (significant at level of 0.05), [b] Chi-square test, [c] Near = within 2 km; far = at least 5 km far from the factory

Ninety-six participants of near and 101 subjects of far group were participated in this study. The mean age of near group was insignificantly lower than far group with 38.8 years old on average compared to 42.6 years old. The ratio of male to female was significantly different between both groups (p = 0.011) by response rate of male in near group was lower than far group. There were insignificantly different in marital status (p = 0.140), educational levels (p = 0.588), and occupations (p = 0.883) between both groups. The majority of participants were married (70%) and agriculturist (72%) in both groups (Table II).

Four main health determinants of self-HRA were physical, mental, social, and spiritual aspects and were classified in both positive and negative statements. The near population group had significantly lower ratings in health related issues due to physical health due to nervous systems than far population group (p = 0.032). The near population group had significantly higher positive ratings in mental health impacts than far population group (p < 0.001) whereas they had significantly lower negative rating such as worries and concerns (p =0.022), pollutant releases (p=0.050), environmental changes (p < 0.001), and toxic and chemical exposed (p =0.006), respectively. The near population group also had significantly higher positive rating in social health impacts than far population group such as providing information (p = 0.011), good cooperation (p = 0.002), creating jobs (p < 0.001); conversely whereas the near population group had significantly lower negative rating in increasing drug uses and crime (p = 0.018). The near population group had significantly higher positive rating in spiritual health impacts than far population group such as humanize care (p = 0.027), human rights (p = 0.001), culture preservation (p =0.033) and beneficial cooperation (p = 0.008), whereas the near population group had significantly lower negative rating in increasing income (p = 0.033) (Table III).

In cumulative ratings for self-HRA of each health determinant, the near population group (30.34%) had significantly higher positive ratings in mental assessment than far population group (10.59%) (p <0.001) whereas they had lower ratings on negative impacts (14.61% vs. 38.82%, respectively).

Similarly to mental assessment, the near population group had significantly higher positive rating in social health impacts (28.42%) than far population group in social aspects (16.67%) whereas they had significantly lower negative rating in social aspects 9.47% vs 32.22%.

The near population group (29.79%) had a similar positive rating in spiritual health impacts compared with far population group (27.08%), but the near population group (7.45%) had lower negative rating in spiritual health impacts than for far population group (29.17%). However, there were no significant differences for male (p <0.001) (Table IV).

TABLE III
SELF-HEALTH RISK ASSESSMENT OF PARTICIPANTS WHO LIVE NEAR AND FAR FROM THE FACTORY

Health determinants	Near (*n*=96)		Far (*n*=101)		*P* value
	Yes (%)	No (%)	Yes (%)	No (%)	
1. Physical assessment aspects (in last 6-month)					
1.1 Anyone of your family members or you has respiratory symptoms and illnesses such as allergies, common cold, etc.	72(75.00)	24(25.00)	70(69.31)	31(30.69)	0.364
1.2 Anyone of your family members or you has problem related to nervous systems such as headache, dizziness, and drowsiness.	49(51.04)	47(48.96)	66(65.34)	35(34.66)	0.032
1.3 Anyone of your family members or you has skin or dermal diseases such itchy skin, rash, etc.	42(43.75)	54(56.25)	50(49.50)	51(50.50)	0.381
2. Mental assessment aspects					
2.1 You are happy even though the factory is located near your neighborhood.	71(73.96)	25(26.04)	44(43.56)	57(56.44)	<0.001
2.2 You are satisfied that the factory is located near your neighborhood since it improves your community.	73(76.04)	23(23.96)	47(46.53)	54(53.47)	<0.001
2.3 You are satisfied that the factory creates job opportunities and income.	65(67.71)	31(32.29)	56(55.45)	45(44.55)	0.078
2.4 You are confident that the owner of the factory takes good responsibility for waste management and control.	40(41.67)	56(58.33)	35(34.65)	66(65.35)	0.308
2.5 You are worried or concerned that the factory was established in your community.	47(48.95)	49(51.06)	65(64.36)	36(35.64)	0.022
2.6 You are unhappy that the factory was established in your community since it creates toxic dust pollutions and chemical waste.	63(65.62)	33(34.37)	83(82.17)	18(17.83)	0.050
2.7 The factory has changed community environment in a way that threatens your life and living	38(39.58)	58(60.42)	65(64.35)	36(35.65)	<0.001
2.8 You are worried or stressed when you are exposed to dust, chemicals, or contaminated drinking water released from the factory.	61(63.54)	35(36.46)	81(80.19)	20(19.81)	0.006
3. Social assessment aspects					
3.1 Your community members or you have a good relationship with a responsible person from the factory.	59(61.45)	37(38.55)	53(52.47)	48(47.53)	0.237
3.2 The representative of the factory gives health information to you.	49(51.04)	47(48.96)	34(33.66)	67(66.34)	0.011
3.3 The owner or employees and your community members have good cooperation.	66(68.75)	30(31.25)	47(46.53)	54(53.47)	0.002
3.4 The factory establishment creates job employment and improves economic and social ties in your community.	76(79.17)	20(20.83)	47(46.53)	54(53.47)	<0.001
3.5 After the factory was established it improved your quality of living.	40(41.67)	56(58.33)	35(34.65)	66(65.35)	0.337
3.6 The factory owner supports and facilitates environmental improvement in the community such as waste management and recycling.	34(35.42)	62(64.58)	31(30.69)	70(69.31)	0.478
3.7 Advantages provided by factory such as job employment increase the gap between poor and rich family.	38(39.58)	58(60.42)	44(43.56)	57(56.44)	0.544
3.8 After the factory was established the community members placed more value on materialistic gains.	41(42.71)	55(57.29)	43(42.57)	58(57.43)	0.896
3.9 Since the factory was established the community has increased in drug use and crime.	41(42.71)	55(57.29)	59(58.41)	42(41.59)	0.018*
3.10 After the factory was established conflict among community members increased.	47(48.95)	49(51.06)	47(46.53)	54(53.47)	0.734
4. Spiritual assessment aspects					
4.1 The owner and employees treat your community members with humane care.	51(53.12)	45(46.87)	38(37.62)	63(62.38)	0.027
4.2 The owner and employees have respect for human rights of your community members.	65(67.71)	31(32.29)	44(43.56)	57(56.44)	0.001
4.3 There is good cooperation between employees and your community members for preserving culture.	54(56.25)	42(43.75)	41(40.59)	60(59.41)	0.033
4.4 There is good cooperation and beneficial involvement between employees and your community members.	55(57.29)	41(42.71)	38(37.62)	63(62.38)	0.008
4.5 Forgiveness occurs between employees and community members when conflicts occur.	56(58.33)	40(41.67)	48(47.52)	53(52.47)	0.168
4.6 The factory owner takes advantage of the community in terms of natural resources and environment.	41(42.71)	55(57.29)	48(47.52)	53(52.48)	0.457
4.7 After the factory were established the community members gained higher income.	34(35.41)	62(64.58)	51(50.49)	50(49.50)	*0.033*
4.8 The community members are selfish in terms of community participation and involvement.	32(33.33)	64(66.67)	34(33.66)	67(66.34)	0.921

Yes = agree or accept; No = disagree or deny; Type of positive statements (item: 2.1-2.4; 3.1-3.6; 4.1-4.5) and negative statements (item: 1.1-1.3; 2.5-2.8; 3.7-3.10; 4.6-4.8)

Independent student's t-test (significant at level of 0.05)

Qualitative Results

The results of semi-structured questionnaire interviews for self-HRA from the populations in both positive and negative impacts according to the 4 health determinants, including physical, psychological, social, and spiritual aspects, have been grouped.

In both 2-km and 5-km population groups, the physical health impacts from respiratory health diseases and symptoms and skin diseases were not clearly demonstrated from the health reports. There were concerns that cement dust from the factory might cause respiratory health diseases and symptoms and allergies. The mental and psychological health impacts from cement dust exposure and respiratory health diseases and symptoms are concerns. According to complaints about cement dust exposure during summer seasons with dry and warm climates, the populations feel they may not be safe from cement dust exposure from the factory. Social health impacts have been interviewed according to relationships between the factory owner, employees and populations, work employment and living and social and environmental changes.

TABLE IV
SUMMATIVE SCORE FOR SELF-HEALTH RISK ASSESSMENT FOR PARTICIPANTS WHO LIVE NEAR AND FAR FROM THE FACTORY, BY GENDER

	Male		*P* value [b]	Female		*P* value [b]
	2-km [c]	5-km [d]		2-km	5-km	
	Mental assessment [a]					
Negative	3 (12.00)	11(30.56)	0.237	10(15.87)	22(45.83)	<0.001
Between	17(68.00)	19(52.78)		31(49.21)	23(47.92)	
Positive	5(20.00)	6(16.67)		22(34.92)	3(6.25)	
Total	25(100.00)	36(100.00)		63(100.00)	48(100.00)	
	Social assessment aspects					
Negative	5(18.52)	11(27.50)	0.698	4(5.97)	18(36.73)	<0.001
Between	15(55.56)	20(50.00)		43(64.18)	25(51.02)	
Positive	7(25.93)	9(22.50)		20(29.85)	6(12.24)	
Total	27(100.00)	40(100.00)		67(100.00)	49(100.00)	
	Spiritual assessment aspects					
Negative	4(14.81)	11(23.91)	0.642	3(4.55)	16(32.65)	0.001
Between	14(51.85)	22(47.83)		44(66.67)	20(40.82)	
Positive	9(33.33)	13(28.26)		19(28.79)	13(26.53)	
Total	27(100.00)	46(100.00)		66(100.00)	49(100.00)	
	Sum of 3 aspects					
Negative	3(12.00)	9(25.00)	0.154	3(4.92)	14(32.56)	<0.001
Between	16(64.00)	24(66.67)		41(67.21)	27(62.79)	
Positive	6(24.00)	3(8.33)		17(27.87)	2(4.65)	
Total	25(100.00)	36(100.00)		61(100.00)	43(100.00)	

[a] Negative = sum of impact (0-33 %); between = sum of impact (34-66 %); positive = sum of impact (67-100 %); [b]Chi-square test , [c] KHC; [d] KSC

These statements have been summarized as follows:

Physical Health

I have respiratory health illness symptoms such as runny nose, cough and sore throat sometimes, but I am not sure that is related to cement dust exposure from the roofing cement factory nearby. (Female, 36, Rubber plantation)

I used to work at this factory for four to five years around ten years ago, but right now I am working in my own rubber farm since at that time I did not have my own. At that time, I think cement dust exposure could have caused respiratory illnesses and symptoms if I did not wear protective mask. (Male, 32, Rubber plantation)

I got a cold and my family members also have one. (Female, 41, Self-employed own business) *I never experience any respiratory symptoms and/or illnesses.* (Male, 29, Rubber plantation)

I had some kinds of skin irritation, so I think it could be because of skin contact with cement when I was working at mixing and pulping department. (Female, 45, Rubber plantation)

Mental Health

I think it is good to have this factory in our neighborhood as it would create new jobs and have advantages in terms of improving our economy. However, I think populations who are living near the factory may not get these benefits since we are working in our own rubber farms or even working with someone else's rubber farms and could get paid higher than working in the factory. In addition, this factory employed mostly college-educated workers, so some of us may not qualify for the jobs. (Male, 29, Rubber plantation)

I am very concerned about the released cement dust from the factory into the community. I think it would be not safe for us. We do not know what ingredients that they used for roofing cement production. I heard the employees at the factory have to have physical exam checks every year such as chest-x-ray *radiography. Therefore, it could be dangerous to be exposed to some chemicals or other contaminants in the factory*. (Female, 36, Rubber plantation)

I am not sure about waste management and control. It could be released from the factory if they discharge it into river or canal near the factory. They should report to us or allow us to examine the factory. (Male, 32, Rubber plantation)

I believe that if they have a good system for controlling dust and noise, it would not be present or make any health impact on populations' health near the factory. (Male, 32, Rubber plantation)

Social Health

The relationships between the factory owner, employees and populations

I think the factory owner and populations have a good relationship. The factory manager and employees have some activities in the community such as they help to improve the playground at primary school. In addition, they also have sports games between employees and populations some years. I got a free t-shirt too. (Male, 32, Rubber plantation)

Work Employment and Living

Only a few of our residents are working at the roofing cement factory since we are working at our own rubber farm and we get paid well. Therefore, I think working at our own rubber farm it is better. We don't have to worry about being laid off. (Male, 29, Rubber plantation; Male, 32, Rubber plantation)

In this factory, they unusually employ degree or diploma-graduated workers. Therefore, some of us do not quality to work there. However, for some kinds of jobs they employ lower educated employees for working on daily basis. (Male, 29, Rubber plantation)

Social and Environmental Changes

I did not see any change in environment, but I agree that there are an increasing number of employed workers from other districts or provinces. (Male, 32, Rubber plantation)

I think it was not affected in terms of environmental and natural resource usage levels. The ingredients and raw materials have been imported from outside the community. (Female, 36, Rubber plantation)

Spiritual Health

I think the owner and employees at the factory participated in community events such as religious ceremonies and elderly engagement activities. (Female, 36, Rubber plantation)

The factory owner has a program to develop and improve the facility in the community such as donating the roof fiber cement for a new building of the pre-school kids' center. They also support sport activities in the villages and sponsored and participated in the customs and religion. They donated the garbage bins and asked for living in the community. (Female, 36, Rubber plantation)

IV. Discussion

The primary interest of this study arose from the framework and approach within HIA protocols that encourage stakeholders and affected populations to participate in HIA procedures. They can participate in different initial to end steps of the project. This is the first attempt to integrate self-HRA into HIA tool assessment. The questionnaire interviews have been developed and tested for health impacts according to health determinants.

The physical assessment has been conducted in last 6-months and presented significantly higher on problem related to health symptoms on far population (65.34%) such as headache and dizziness than near group (51.04%) ($p = 0.032$). However, both groups of populations have no different of nobody in family members has respiratory symptoms and illnesses such as allergies, common cold, coughing, etc. and has problem related to nervous systems such as headache, dizziness, and drowsiness.

This study has demonstrated that the near population group (30.34%) had significantly higher positive rating opinions on mental assessment than far population group (10.59%) ($p < 0.001$), whereas they had lower ratings on negative impacts (14.61% vs 38.82%), respectively. They were satisfied for having roofing fiber cement established in their community in relevant semi-structured questionnaire interviews. They thought the factory would create new jobs and have advantages in terms of increasing their economy.

However, some of them were concerned about cement dust exposure since they did not have any information about health risks. Similar to mental assessment, the near population group had significantly higher positive rating in social health impacts (28.42%) than far population group in social aspects (16.67%) whereas they had significantly lower negative rating in social aspects (9.47% vs. 32.22%). They commented on good relationships between the factory owner, employees and populations. Moreover, they were concerned about work employment and living and environmental changes.

The near population group (29.79%) had similar positive ratings in spiritual health impacts compared with far population group (27.08%), but the near population group (7.45%) had lower negative rating in spiritual health impacts than far population group (29.17%). This may not clearly demonstrate the spiritual aspects of community life for a practical conceptual framework for appraising spiritual aspects. The agreement between health statistics reports for both near and far groups were not conclusive. The additional data analysis has warranted the relationships between health symptoms and self-HRA such as the matched between the same cases for health records from JHCIS and self-HRA questionnaire interviews. Unfortunately, we could not perform further analysis because limitations were encountered while conducting research.

Self-perceptions of health have indicating affected populations' opinion of their own present health status and/or past health risks, as indicators of health behaviors. Using self-reported data has several advantages. First, it is a convenient and cost-effective way for evaluating opinions on health risk perception from environmental risk exposure; specifically, in this case, roofing fiber cement productions and emissions could be one of the major suspected sources of air pollution causing respiratory health risks and given considerable attention within population concerns and complaints in the surrounding community. However, the response in self-administered questionnaires is likely a misclassification, resulting in under or overestimations of effects.

In this study the spiritual health impact assessment is not only religious by meaning, but it can be also a non-religious perception such as self-fulfillment in a humanistic way. In order for such prevalence estimates and outcome measures to be useful, the self-report items must provide an accurate measurement of that which they are supposed to be measuring. Inaccurate self-report could lead to underestimation or overestimation of the prevalence of risk factors or health behaviors in the community or of the misclassification of risk status at the individual level, which could obscure causal relationships between risk factors and subsequent diseases.

This study has some limitations. First, within the cohort of this study we did not conduct the baseline or follow-up study to confirm consistency of their opinions. Secondly, we did not have the comparison data between both registered health centers; thus, clearly this data deserves further evaluation.

The strengths of this study lie in its representative sample and different measured domains of health aspects. The follow-up and sufficient numbers of cases enables the required statistical analyses to be performed. Also, because of the JHCIS program, the data on medical records were reliable and inclusive. To be useful in developing HIA tools on risk

assessment, tools need to be extensive in their ability to discriminate between persons at risks who living near and living far who are not at risk. Self-HRA alone or in association with other measures has been recommended as a substitute for longer risk-screening instruments, particularly for triaging those reporting worse health into more intensive evaluation and care management programs, but there is no consensus on this recommendation.

In conclusion, an association between self-HRA of positive mental, social, and spiritual could be effective for evaluating risk perceptions of populations in the affected community and living in the vicinity of a roofing-fiber cement factory. The agreement between health statistics reports for both near and far groups were not conclusive. Applying self-reported data has several advantages, including a convenient, less time consuming and cost-effective way for evaluating opinions on health risk perception from environmental risk exposure; specifically, in roofing fiber cement productions and emissions could be one of the major suspected sources of air pollution causing respiratory health risks and given considerable attention within population concerns and complaints in the surrounding community. This may raise health issues concerning HIA establishing cement factory in communities; residents may request to conduct HIA according to Thai's National Health Act, 2007. The main implication of this study relies on the living proximity effect on their awareness and concerns for health risks from environmental health risk exposures.

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