Original Article

Effectiveness of Modified Iodine Consumption Behavior Model in Pregnant Women by Civil Society Integrated Participation in Khon Kaen Province: A Participatory Action Research

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Objective: To study the effectiveness of Modified Iodine Consumption Behavior (MICB) Model in Pregnant Women by Integrated Civil Society Participation. The results were evaluated from the changes in knowledge, iodine consumption behavior, and median urinary iodine concentration (MUIC) among the intervention group (IG) and control group (CG) of pregnant women (PW) during pre- and post-intervention period.

Materials and Methods: This participatory action research (PAR) had IG and CG. The authors organized the MICB model by PAR methodology under integrated collaboration of civil society (all sectors) in community via district health board. The present study was conducted in Khon Kaen Province for nine weeks between July and September 2018. The subjects were 88 PW. Forty-seven PW participated in IG and were recruited from antenatal care (ANC) of Chum Phae Hospital. The other 41 PW were assigned as CG and were recruited from ANC of Phu Wiang Hospital. Descriptive statistics, Student's t-test or Mann-Whitney U test, Chi-squared test or Fisher's exact test, paired t-test or Wilcoxon signed-rank test, McNemar's test, adjusted means or ANCOVA, and Student's t-test or Chi-square test were conducted for analysis.

Results: The authors with civil society and subjects in Chum Phae District had developed the MICB model that resulted in improving knowledge of iodine consumption behavior and MUIC level of IG. The IG significantly gained more knowledge (11.17±2.69 versus 12.45±2.03, p=0.012) when comparing pre- and post-intervention. The IG was found to be using significantly more iodized salt (66.7% versus 89.1%, p=0.013) and iodine supplemented fish sauce (53.1% versus 77.3%, p=0.039) as food condiments when comparing the pre- and post-intervention. The IG received significantly more iodine supplemented multivitamin (ISM) tablets than the CG (100% versus 90.2%, p=0.028) before the intervention. The ISM tablets intake was not different between the two groups. The MUIC level of the IG increased significantly more than those of the CG [386.83 (SE 51.53) versus 254.98 (SE 38.44), p=0.047] comparing pre- and post-intervention.

Conclusion: The MICB model could improve knowledge on iodine consumption behavior and MUIC level of the pregnant women.

Keywords: Participatory action research, Iodine deficiency in pregnant women, Civil society

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Iodine deficiency disorder (IDD) is an important public health problem. Iodine is a precursor for synthesizing thyroid hormone, a major substance for fetal brain growth and physical metabolism. Maternal iodine deprivation could result in neurodevelopment disorder and cause impairment on the offspring intellectual quotients by 10 to 15 points(1). Thailand Iodine surveillance by the Bureau of Nutrition, Department of Health(2) revealed that median urinary iodine concentration (MUIC) in pregnant women (PW) were less than 150 µg/L in North-eastern and Northern regions between 2014 and 2016. The people in the region have been designated as an iodine deficient population. In the year 2016, the Department of Mental Health(3) reported that the Intellectual Quotients of first grade primary school children in North-eastern region had a weighted-mean

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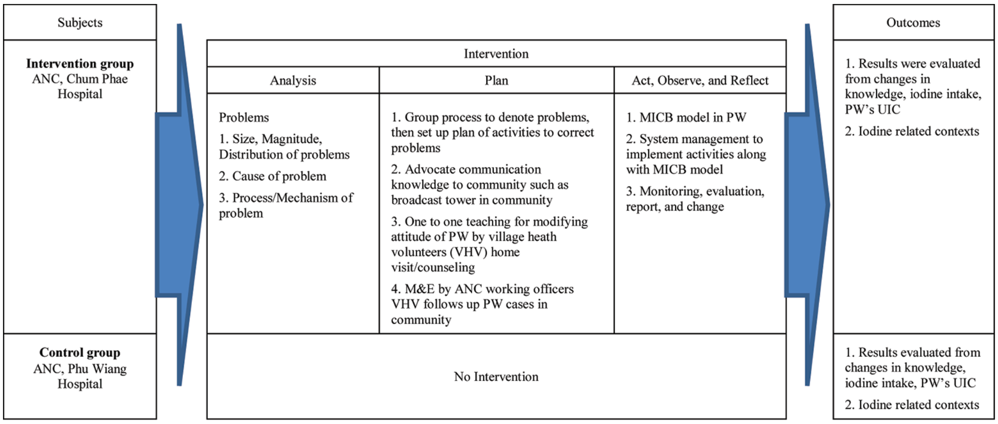

Figure 1. Conceptual framework of impact of MICB model in pregnant women.

score of 94.49, which is lower than in other regions. Although the effort on the control and prevention of iodine deficiency project has been processed over 50 years[4], iodine status still has some major problems to be addressed. The authors utilized the participatory action research (PAR) methodology with collaboration of civil society for advocating iodine intake adequacy of the PW, which expected that the developed model could achieve a desired result. The objectives of the present study were 1) to develop the model for modifying iodine intake behavior of PW and 2) to evaluate effectiveness of the model on knowledge of iodine intake behavior, MUIC level of PW, and related contexts.

Materials and Methods

Subjects

Both the intervention and control subjects were purposive sampling from PW who attended antenatal care (ANC) at Chum Phae Hospital, and Phu Wiang Hospital in July 2018. The number of intervention group (IG) and control group (CG) were 47 and 41 subjects. Both hospitals reported to have more newborn delivery than the other hospitals in Khon Kaen Province. The surveillance report indicated that the north-eastern region was a high-risk area of iodine deficiency. All subjects had ANC at the original hospital, stayed in their own district, had Thai language literacy capacity, had good consciousness status, and voluntarily completed the study, which was between July and September 2018. Exclusion criteria were PW of both hospitals, who did not have Thai language literacy capacity, had poor consciousness, or did not want to participate in the study.

Sample size calculation using G power proportion[5], proportion of population pre-intervention was 60% below sufficient level of urinary iodine concentration (150 μg/L) by World Health Organization (WHO) references. Predicted proportion post-intervention was expected at 30%. The value of α was 0.05 and β was 0.2 giving a result of n = 33/group +20% (correction for 20% drop out cases). Total corrected sample were 40 PW per group.

The first task of the study was to manage and collaborate with community civil society and public health sectors in Chum Phae District. The civil society conference took place at the Chum Phae Hospital, then a model was developed through integrated action plan for PW and children under five years of age in the community. All the different sectors participated.

The modified iodine consumption behavior (MICB) model

The MICB model for PW used a PAR approach by collaborative participation of civil society. The PAR cycle consists of four steps, plan, act, observe, and reflect. Fifty-two PW participants were included. One hundred civil society including 34 health officers, 50 village health volunteers, 10 local administrative officers, four community people, one community wisdom, and one salt entrepreneur joined the present study, attending two consecutive cycles. Brainstorming and participatory learning had been conducted for these cycles of PAR and the MICB model was developed. Most subjects participated in the activities of two consecutive cycles (three weeks period of each cycle). The model is presented in Figure 1.

Measurements

Questionnaires: The authors adapted the questionnaire of iodine to the village program with

Table 1. Modified iodine consumption behavior model in pregnant women

Objectives	Activities	Target/setting	Authorities
1. To advocate childhood iodine intake	• Lunch meal seasoned with iodized salt	• Pre-school day care • Primary school	• MCH care officer • Local administrative agents
2. To control and prevent iodine deficiency status among pregnant women	• Screening iodine deficiency status, providing iodine-supplement tablet and iodized salt • Providing knowledge on iodine in pregnant women & childhood by home visit • By home visit providing proactive counselling and monitor iodine-supplement tablet intake of the pregnant women	• ANC unit in hospital • Pregnant women/ households	• Health care officer • Village health volunteer
3. Advocate recognition of iodine benefit for iodine content foodstuffs contexts in community	• Knowledge about benefit of taking iodized salt • Certification for selling quality iodized salt to food stall/vendor	• Food stall/shop • Beverage stall/shop	• Civil society (surveillance): MCH Board (issue out certification & reward), consumer right protection officers • District/sub-district committee

ANC=antenatal care; MCH=Mother and Child Health

a grant from the Bureau of Nutrition[6]. It developed and tested for reliability of the questionnaire. The questionnaire composed of four major parts, 1) demographics, 2) knowledge (KR-20=0.75), 3) iodine consumption behavior (KR-20=0.84), and 4) satisfaction to community project to control and prevent IDD (KR-20=0.89). Following an evaluation method of Bloom, the cutoff point of knowledge scores are 1) less, for a score of 8 or less, 2) middle, for a score of 9 to 11, and 3) high, for a score of 12 to 15[7]. Satisfaction of the project was measured from the score above 75%.

Urinary iodine concentration

The urine samples, which were collected from spot urine of subjects, were analyzed by the laboratory of the Bureau of Nutrition to quantify iodine amounts using their analytic techniques. A cutoff point of MUIC below 150 μg/L was used following the WHO recommendation[8] as insufficient iodine intake.

Ethical review

The present research proposal was approved by the Ethics Committee of Department of Health, Ministry of Public Health (ref. project number 255; 23 July 2018). Written informed consent was obtained from each subject prior to study. In addition, permission to do the study was given by the chief medical officer of Khon Kaen Provincial Public Health Office, and both directors of Chum Phae and Phu Wiang Hospital.

Data analysis

Data were analyzed using SPSS version 22.0 for windows. Frequency, percentage, mean, and standard deviation were used to describe personal factors of both study groups. Chi-square test or Fisher's exact test analysis were conducted to determine the statistical significance of group differences. Student's t-test was conducted to compare the mean score and standard deviation (SD) between groups. Student's t-test or Mann-Whitney U test and Chi-squared test or Fisher's exact test were conducted to qualitatively compare the mean score of knowledge, consumption behavior, and satisfaction of group differences. Paired t-test or Wilcoxon signed-rank test and McNemar's test were conducted to qualitatively compare the mean score of knowledge, consumption behavior, and satisfaction of pre- and post-intervention differences.

Results

The present PAR was conducted by collaborative participation of civil society, then underwent the two cycles of PAR, inclusively implemented the activities of the plan, and finally became the model to modify iodine intake of the PW. The outcomes were evaluated from knowledge, intake of iodine contained in foodstuffs, salt, iodine supplemented multivitamin (ISM) tablets, MUIC level, and related contexts. The output of the study was the model as shown in Table 1.

Table 2. Comparison of personal factors between intervention group and control group (n = 88)

Characteristic	Intervention group (n = 47) n (%)	Control group (n = 41) n (%)	p-value
Age (years), Mean±SD	23.47±5.45	26.83±6.25	0.008[a]
Education level			0.484[b]
Primary school	6 (12.8)	5 (12.2)	
Junior high school	14 (29.8)	16 (39.0)	
Senior high school	15 (31.9)	16 (39.0)	
Vocational certificate	2 (4.3)	0 (0.0)	
High vocational certificate	5 (10.6)	1 (2.4)	
Bachelor of Arts	5 (10.6)	3 (7.3)	
Occupation			0.003[b]
House wife	22 (46.8)	26 (63.4)	
Employee	18 (38.3)	3 (7.3)	
Civil officer	1 (2.1)	2 (4.9)	
Agriculturist	2 (4.3)	7 (17.1)	
Merchant	4 (8.5)	3 (7.3)	
Family member			
0 to 2 years children			0.552[b]
• None	38 (80.9)	35 (85.4)	
• 1	8 (17.0)	5 (12.2)	
• 2	0 (0.0)	1 (2.4)	
• 3	1 (2.1)	0 (0.0)	
3 to 5 years children			0.722[b]
• None	31 (66.0)	30 (73.2)	
• 1	15 (31.9)	11 (26.8)	
• 2	1 (2.1)	0 (0.0)	
Post-partum women 0 to 6 months			
• None	43 (91.5)	41 (100)	
• 1	1 (8.5)	0 (0.0)	
Elderly >60 years			0.691[b]
• None	24 (51.1)	23 (56.1)	
• 1	11 (23.4)	11 (26.8)	
• 2	10 (21.3)	7 (17.1)	

SD=standard deviation

[a] Student's t-test, [b] Fisher's exact test

Outcomes

The developed MICB model consisted of four parts as 1) objectives to advocate childhood and PW iodine intake, advocate food vendor and cook in the community about benefit of iodine, and collaboration of all sectors in community to promote iodized salt, 2) activities to achieve the objectives, 3) settings target, and 4) responsible authorities who were members of civil society in community. Lunch meal at a randomized pre-school day care center was seasoned with iodized salt, which passed the standard concentration level at 30 ppm (20 to 40 ppm) by I-kit test. At a primary school, the seasoned salt of the lunch meal was 10 ppm, which did not pass the standard. The salt was mixed between non-iodized and iodized salt by outsourced cook.

Prior to intervention, IG had significantly received ISM tablet more than CG (100% versus 90.2%, p=0.028). The study found that there were 664 shops selling iodized salt and 92 shops selling non-iodized salt in Chum Phae District. There were 297 shops selling iodized salt and 777 shops selling non-iodized salt in Phu Wiang District. The retailer informed local people that non-iodized was preferable to iodized.

The authors found that 39 of 52 IG (75%) had been home-visited by village health volunteers or sub-district health care officers.

The local salt funds were found more at sub-district health care centers in Chum Phae District for selling the iodized salt at non-profit price.

Characteristics of study groups

Both groups were similar in some factors as educational level, family member, household iodized salt intake, but different in age and occupation. The age of IG and CG were 23.47±5.45 and 26.83±6.25 years, respectively, (p=0.008) and the occupation as housewives of IG and CG were 46.8% and 63.45, respectively, (p=0.03). Those are shown in Table 2.

Pre-intervention, knowledge about IDD of IG was significantly less than CG (11.17±2.69 versus 12.44±1.73, p=0.009). Pre-intervention, the IG who had low knowledge score were significantly more than CG (12.8% versus 4.9%, p=0.009) as shown in Table 3.

The IG had significantly gained much more knowledge comparing pre- and post-intervention (11.17±2.69 versus 12.45±2.03, p=0.012). The IG who had low knowledge score and high knowledge score were significantly improved (12.8% versus 10.6% and 48.9% versus 80.9%, p=0.002) as shown in Table 4.

Prior to intervention, the IG had significantly less than CG in consumption behavior of food additives items such as iodine-supplemented soy sauce (46.9% versus 78.8%, p=0.008), and no iodine-supplemented fish sauce (68.1% versus 87.8%, p=0.028). The IG had significantly received ISM tablet more than CG (100% versus 90.2%, p=0.028). IG bought iodized salt significantly more from village shop (59.6% versus 31.7%, p=0.009) and flea market (12.8% versus 0.0%, p=0.018) than CG. There were no differences between

Table 3. Comparison of knowledge about iodine de-ficiency disorders (IDD) prevention between intervention group (IG) and control group (CG)

IDD prevention knowledge	Intervention group (n = 47) n (%)	Control group (n = 41) n (%)	p-value
Prior to intervention			
Knowledge score, Mean±SD	11.17±2.69	12.44±1.73	0.009[a]
Level of knowledge, n (%)			0.009[b]
• Less ≤8 points	6 (12.8)	2 (4.9)	
• Middle 9 to 11 points	18 (38.3)	6 (14.6)	
• High 12 to 15 points	23 (48.9)	33 (80.5)	
After intervention			
Knowledge score, Mean±SD	12.45±2.03	12.68±1.70	0.559[a]
Level of knowledge, n (%)			0.083[b]
• Less ≤ 8 points	5 (10.6)	1 (2.4)	
• Middle 9 to 11 points	4 (8.5)	9 (22.0)	
• High 12 to 15 points	38 (80.9)	31 (75.6)	

SD=standard deviation

[a] Student's t-test, [b] Fisher's exact test

Table 4. Comparison of knowledge about iodine deficiency disorder (IDD) prevention pre- and post-intervention

Knowledge about IDD prevention	Pre-intervention	Post-intervention	Difference	p-value
Intervention group (n = 47)				
Knowledge score, Mean±SD	11.17±2.69	12.45±2.03	1.27±3.33	0.012[a]
Level of Knowledge, n (%)				0.002[b]
• Less ≤ 8 points	6 (12.8)	5 (10.6)		
• Middle 9 to 11 points	18 (38.3)	4 (8.5)		
• High 12 to 15 points	23 (48.9)	38 (80.9)		
Control group (n = 41)				
Knowledge score, Mean±SD	12.44±1.73	12.68±1.70	0.24±1.92	0.421[a]
Level of Knowledge, n (%)				0.472[b]
• Less ≤ 8 points	2 (4.9)	1 (2.4)		
• Middle 9 to 11 points	6 (14.6)	9 (22.0)		
• High 12 to 15 points	33 (80.5)	31 (75.6)		

SD=standard deviation

[a] Paired sample t-test, [b] McNemar's test

IG and CG in other iodine contained foodstuffs such as chicken egg and seafood. Post-intervention, the IG significantly consumed iodine contained foodstuffs as chicken egg more than CG (23.9% versus 17.1%, p=0.036). ISM tablets were not significantly differently received (100% versus 92.7%, p=0.059) and taken (100% versus 92.7%, p=0.059) more by IG than CG as shown in Table 5.

Due to space limitation, the results of consumption behavior changes comparing pre- and post-intervention among both groups are presented in described information as the followings. Iodine intake of the IG was significantly found using more iodized salt (66.7% versus 89.1%, p=0.013) and iodine supplemented fish sauce (53.1% versus 77.3%, p=0.039) as food condiments. The other items such as iodine supplemented salty and soy sauce, chicken egg, seafood, and ISM tablets were not significantly different in consumption behavior among IG. Iodine intake of the CG was significantly found using more iodized salt (75.7% versus 90.0%, p=0.031). The other items such as iodine supplemented fish, salty and soy sauce, chicken egg, seafood, and ISM tablets were not significantly different in consumption behavior among CG. The above data were analyzed by using McNemar's test.

Table 5. Comparison of consumption behavior on iodine contained food items, additives, and iodine-supplemented multivitamins (ISM) tablet between intervention group (IG) and control group (CG)

Consumption behavior	Pre-intervention, n (%)			Post-intervention, n (%)		
	IG (n = 47)	CG (n = 41)	p-value*	IG (n = 47)	CG (n = 41)	p-value*
Consumption behavior to use food additives as						
Salt	42 (89.4)	37 (90.2)	0.892	46 (97.9)	40 (97.6)	0.922
Iodized salt	28 (66.7)	28 (75.7)	0.379	41 (89.1)	36 (90.0)	0.895
Fish sauce	32 (68.1)	36 (87.8)	0.028	44 (93.6)	39 (95.1)	0.761
Iodine-supplemented fish sauce	17 (53.1)	26 (72.2)	0.103	34 (77.3)	32 (82.1)	0.590
Salty sauce	4 (8.5)	7 (17.1)	0.226	5 (10.6)	5 (12.2)	0.818
Iodine-supplemented salty sauce	2 (50.0)	2 (28.6)	0.477	4 (80.0)	3 (60.0)	0.490
Soy sauce	32 (68.1)	33 (80.5)	0.187	40 (85.1)	34 (82.9)	0.780
Iodine-supplemented soy sauce	15 (46.9)	26 (78.8)	0.008	26 (65.0)	29 (85.3)	0.046
Consumption of iodine contained food items						
Chicken egg	45 (95.7)	39 (95.1)	0.889	46 (97.9)	41 (100)	0.348
• Daily	12 (26.7)	12 (30.8)	0.813	11 (23.9)	7 (17.1)	0.036
• 4 to 6 days/week	12 (26.7)	8 (20.5)		26 (56.5)	15 (36.6)	
• 1 to 3 day(s)/week	20 (44.4)	17 (43.6)		9 (19.6)	16 (39.0)	
• 2 to 3 days/month	1 (2.2)	2 (5.1)		0 (0.0)	3 (7.3)	
Sea food	44 (93.6)	36 (87.8)	0.344	43 (91.5)	38 (92.7)	0.836
• Daily	3 (6.8)	3 (8.3)	0.302	3 (7.0)	2 (5.3)	0.053
• 4 to 6 days/week	12 (27.3)	5 (13.9)		9 (20.9)	3 (7.9)	
• 1 to 3 day(s)/week	22 (50.0)	17 (47.2)		27 (62.8)	21 (55.3)	
• 2 to 3 days/month	7 (15.9)	11 (30.6)		4 (9.3)	12 (31.6)	
Iodized salt buying place						
Village shop	28 (59.6)	13 (31.7)	0.009	29 (61.7)	16 (39.0)	0.034
Peddle	1 (2.1)	2 (4.9)	0.478	1 (2.1)	2 (4.9)	0.478
Flea market	6 (12.8)	0 (0.0)	0.018	6 (12.8)	6 (14.6)	0.799
Shop in market	18 (38.3)	8 (19.5)	0.054	13 (27.7)	9 (22.0)	0.537
Department store	19 (40.4)	10 (24.4)	0.110	20 (42.6)	16 (39.0)	0.737
Other	5 (10.6)	16 (39.0)	0.001	5 (10.6)	11 (26.8)	0.049
ISM tablet intake of pregnant women (PW)						
ISM tablet provided by Health care center			0.028			0.059
• Receiving	47 (100)	37 (90.2)		47 (100)	38 (92.7)	
• Not receiving	0 (0.0)	4 (9.8)		0 (0.0)	3 (7.3)	
Trade name of ISM tablet			0.618			0.467
• Triferdine	10 (21.3)	7 (17.1)		7 (14.9)	4 (9.8)	
• Obimin	37 (78.7)	34 (82.9)		40 (85.1)	37 (90.2)	
ISM tablet intake of PW			0.836			0.344
• Daily	43 (91.5)	38 (92.7)		44 (93.6)	36 (87.8)	
• 4 to 6 days/week	4 (8.5)	3 (7.3)		3 (6.4)	5 (12.2)	
Number of ISM tablet daily intake			0.836			0.059
• 1 tablet	43 (91.5)	38 (92.7)		47 (100)	38 (92.7)	
• 2 tablets	4 (8.5)	3 (7.3)		0 (0.0)	3 (7.3)	
Initial intake of ISM tablet period			0.295			0.173
• Prior to 12 weeks of gestational age	32 (68.1)	32 (78.0)		34 (72.3)	24 (58.5)	
• 12 to 28 weeks of gestational age	15 (31.9)	9 (22.0)		13 (27.7)	17 (41.5)	

* Chi-square test

Table 6 shows that adjusted means urinary iodine concentration level post-intervention of IG was significantly more than CG [386.83 (SE 51.53) versus 254.98 (SE 38.44), p=0.047].

Other analyzed data are shown as the followings, pre-intervention, MUIC level of IG and CG was not significantly different (169.6 versus 190.7 µg/L, p=0.80). Number of iodine insufficient PW, whose MUIC level was less than 150 µg/L was not significantly different among IG and CG [42% (21/50)

Table 6. Comparison of urinary iodine concentration (UIC) between intervention group and control group

UIC (µg/ml)	Mean±SD	Adjusted means[a]	SE	95% CI	F	p-value[b]
Intervention group (n = 34)	264.65±192.50	386.83	51.53	283.57 to 490.09	4.144	0.047
Control group (n = 34)	233.03±158.94	254.98	38.44	177.94 to 332.02		

SD=standard deviation; SE=standard error; CI=confidence interval

[a] Adjusted for baseline urine iodine, knowledge, age, and occupation

[b] ANCOVA for comparison of urine iodine between intervention group and control group

Table 7. The satisfaction of project preventing and controlling iodine deficiency disorders (IDD) at community level

Satisfaction of the activities to prevent and control IDD	Intervention group (n = 47)	Control group (n = 41)	p-value
Prior to intervention			
Satisfaction score, Mean±SD	40.45±6.47	39.68±9.88	0.665[a]
Satisfaction level, n (%)			
• Must be improved (score <75%)	27 (57.4)	24 (58.5)	0.918[b]
• Well-very well (score 75% to 89%)	20 (42.6)	17 (41.5)	
Post-intervention			
Satisfaction score, Mean±SD	41.06±5.82	37.78±8.59	0.037[a]
Satisfaction level, n (%)			
• Must be improved (score <75%)	25 (53.2)	24 (58.5)	0.615[b]
• well-very we (score >75%)	22 (46.8)	17 (41.5)	

SD=standard deviation

[a] Student's t-test, [b] Chi-square test

versus 41.3% (19/46), p=0.95]. Post-intervention, MUIC level of IG and CG was not significantly different (209.2 versus 178.4 µg/L, p=0.21). Number of iodine insufficient PW was not significantly different among IG and CG [26% (13/50) versus 34.8% (16/46), p=0.35]. Mann-Whitney U test was used to analyze the differences of MUIC level. Chi-square test was used to analyze the differences of number of insufficient PW.

Comparing pre- and post-intervention, MUIC level of IG was not significantly increased (169.6 versus 209.2 µg/L, p=0.40). MUIC level of CG was not significantly decreased (190.7 versus 178.4 µg/L, p=0.71). Number of iodine insufficient PW among IG was not significantly decreased (42% versus 26%, p=0.09). Number of iodine insufficient PW among CG was not significantly decreased (41.3% versus 34.8%, p=0.62).

Post-intervention, satisfaction to IDD control and prevention project was significantly found in IG more than CG (41.06±5.82 versus 37.78±8.59, p=0.037) as shown in Table 7. However, some subjects of both groups had left during the study course due to the delivery of their offspring, migration to city for working, or incomplete information for analysis.

Discussion

The present study aimed to develop the model for modifying iodine consumption behavior of PW by means of PAR. The civil society in community collaborated in developing the program. According to Stringer[9], the action research seeks full collaboration by all participants, who are often engaged in socio-political changes similar to the present research. McTaggart[10] introduced the cycle or spiral of PAR that consists of four steps, plan, act, observe, and reflect. The goal of the acting cycle is "to create consciousness and social change by working together with the target community to address an agreed-upon goal by Kelly's suggestion[11] in step of plan. The acting step was for the participants to take their plan to practice in the community for about three weeks each cycle, and then, they met to discuss what had been done among the participants and the authors. For the observe step, the participants monitored the progression of what the plan had done in each cycle. The obstacles and opportunity to develop the plan to achieve the objective had been discussed among the group, as the reflect step. After two consecutive cycles, the iodine consumption behavior modification model was conclusively developed as the output of the study.

The results were evaluated after the second cycle at the end of the ninth week from the beginning. Characteristics of both groups were similar in some factors as educational level, family member, and household iodized salt intake but different in age and occupation; the age of IG and CG were 23.47±5.45 and 26.83±6.25 years (p=0.008) and the occupation as housewives of IG and CG were 46.8% and 63.45% (p=0.03), respectively. Knowledge about IDD prevention, Iodine intake, and satisfaction to IDD control and preventive project among the IG were significantly better. The IG had significantly gained much more knowledge during pre- and post-intervention (11.17±2.69 versus 12.45±2.03, p=0.012). The IG who had low knowledge score and high knowledge score were significantly improved (12.8% versus 10.6% and 48.9% versus 80.9%, p=0.002). According to the study of Singsena and Muktabhant[12], they showed that less knowledge was a factor affecting urinary iodine concentration (UIC). The study of Henjum et al[13] found that 40% of young women had low iodine knowledge.

Post-intervention, the IG significantly consumed iodine contained foodstuffs as chicken egg much more than CG (23.9% versus 17.1%, p=0.036). Iodized salt using (66.7% versus 89.1%, p=0.013) and iodine supplemented fish sauce (53.1% versus 77.3%, p=0.039) among IG was significantly increased comparing pre- and post-intervention. ISM tablets were not significantly received (100% versus 92.7%, p=0.059) and taken (100% versus 92.7%, p=0.059) more by IG than CG. The study of Wang et al[14] revealed that adequate nutrition of iodine associated with IDD prevention. The study of Dold et al[15] recommended that universal salt iodization (USI) achieve the goal of adequate iodine nutrition. Impact of the MICB model on knowledge and iodine contained foodstuffs intake of PW might help address IDD problems. However, the study found that some community groceries are selling only non-iodized salt. Six hundred sixty-four shops sold iodized salt and 92 shops sold non-iodized salt in Chum Phae district, while 297 shops sold iodized salt and 777 shops sold non-iodized salt in Phu Wiang district. In the applied to social exclusion address study by Teasdale[16], community (social) enterprises that sells iodized salt at IDD-risk-places helps people get easy access to iodized salt. This helps USI strategy to control iodine deficiency, which follows recommendation of Zimmerman et al[17].

A random sampling of lunch meal was done at a pre-school day care. Iodized salt [at 30 ppm (mg/kg-salt)] was used in cooking. Another random sampling of a lunch meal was done at a primary school. It was cooked with mixed non-iodized and iodized salt, of which iodine concentration was tested at level of 10 ppm, below the standard of 20 to 40 ppm. The study of Zimmermann and Andersson[18] showed that 29.8% of school-age children (246 million) are estimated to have insufficient iodine intake. According to Del Rosso and Marek[19] who summarized how better nutrition particularly iron and iodine supplements by establishing school-based nutrition and health for school-aged children in the developing world, will enhance school enrollment, attendance, and performance, as well as increase economic productivity and promote the health of future generation. A community mart was randomly visited and was found to be selling only non-iodized salt, which was preferred for cooking among local people.

According to WHO recommendation[8], PW who are at risk for iodine deficiency, have MUIC of 150 mcg/L or less. The cut-off value of iodine sufficiency is 150 to 249 μg/L. The present study showed that adjusted means of UIC level of IG was significantly more than those of CG [386.83 (SE 51.53) versus 254.98 (SE 38.44), p=0.047] post-intervention. Reduction of IDD risk in IG was 16% relatively better than 4.2% in CG. There was not significant difference in neither reduction of IDD risk among IG (42% versus 26%, p=0.09), nor reduction of IDD risk among CG (41.3% versus 34.8%, p=0.62) comparing pre- and post-intervention. In several studies, median MUIC value greater than 150 μg/L was associated with iodine supplementation[20-22]. Likewise, the present study found that there was improvement of some iodine contained food stuffs intake.

In conclusion, the present study with civil society collaborative participation resulted in developing a model on iodine consumption behavior changes among PW in the study group. Knowledge, iodine intake, and means adjusted MUIC level of PW were improved.

What is already known on this topic?

Although the project on control and prevention of IDD in Thailand has been implemented for more than 50 years, the IDD problems among PW in north-eastern and some area in the northern region are still found.

What this study adds?

The civil society collaboration in the action plan to advocate adequate iodine intake in PW should be one of the effective strategic plans to improve the IDD problems.

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Conflicts of interest

The authors declare no conflict of interest.

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