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Original Article

National Review of Influencing Factors on Caregivers Considerate in the Decision of Inoculating Children Under 3 Years of Age with Influenza Vaccine

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Abstract

Although government facilities made the utmost efforts to encourage influenza vaccine immunization for children less than 3 years of age in Taiwan during the flu season, due to the confidence crisis caused by the H1N1 influenza vaccine, the inoculation rate has still significantly dropped. Through this investigation, we will try to understand the vaccine information sources of caregivers, the reasons for not bringing children for vaccination, the influencing factors in the changes in inoculation willingness in the future, and plan future communication strategies accordingly.

The investigated subjects focused in this study consist of main caregivers of infants and children above 6 months of age and under 3 years of age. During the period between March 18th and 20th of 2011, random selections were made via telephone interviews, accomplishing a total of 1,090 valid samples. The results of the investigation show, at one time, 67.5% of children caregivers mainly receive vaccine-related information from “television news reports”; however, referential information that influences the decision in inoculating the children or not is mainly received by “consulting physicians” (63.5%). In the past, the main reason for not inoculating their children is due to the “fear of side effects of vaccines.” Through analysis, it was found that factors tended to “maintain inoculation” included those who show a higher cognitive towards the high susceptibility of children towards influenza, a higher level of acceptance towards the benefits of influenza vaccines, a lower level of concern towards the safety of new vaccines, a lower level of concern for side-effects of inoculation, inoculation appointments are recorded in Children Health Handbooks, physician who provide information and advice inquiry, and a higher confidence in government prevention measures.

It is recommended that first-line public health personnel use the Children Health Handbooks and make appointments for influenza vaccine inoculating, and with the professional status of physicians, provide medical information and advice in aiding children caregivers to establish correct health concepts, clarify doubts about possible side effects of vaccines.

Keywords: influenza vaccine, infants or children, risk communication, health belief model

Introduction

Influenza is an acute respiratory contagious disease transmitted through droplets. The World Health Organization (WHO) estimates over 600 million people are infected worldwide each year, causing 3 million complications, and 250 to 300 thousand deaths [1]. The complications of influenza often results in infants and children's frequent need of medical aid which has significantly increased the usage rates of emergency, outpatient, and hospitalization for infant and children [2-5]. Apart from medical and hospital expenses, parents often need to take leave of absence to care for their children which causes indirect costs [3, 6-7].

Influenza vaccine is internationally acknowledged as the best method in preventing influenza. The effectiveness of influenza vaccine, as seen in many overseas studies shows: if the composition of the community epidemic strain is commensurate with that of the vaccine, inoculating infants and children with the flu vaccine can provide good protection and effectively reduce the hospitalization rate in infants and children [8-10]. According to epidemiology, the severity of child infections, and the cost-effectiveness of inoculation, full-scale inoculation of healthy infants and children is set in action in countries such as Japan, the US, and Finland [11-13].

According to the statistical data of influenza collected through reports from member countries and the relevant data from National Influenza Centers, WHO calls for a meeting in February of each year and suggests flu vaccine strains for the northern hemisphere for that year. The seasonal flu vaccine strains for the northern hemisphere in 2010 and 2011 is the A type influenza H1N1 California strain, H3N2 Perth strain and B type influenza Brisbane strain [14]. In Taiwan, domestic procurement of publicly funded seasonal influenza vaccine is inactivated vaccine (injection) and starts on October 1st until the vaccine amount has been exhausted. If a child under (including) eight years of age first receives inoculation, the vaccine should be administered twice; if he/she has already been inoculated, inoculation once is sufficient [15].

Publicly funded flu vaccine for infants and children in Taiwan started in 2004 and was originally planned for inoculating infants and children above 6 months of age and under 2 years of age; as of 2008, the age span increased to all children under 3 years of

age, and by 2009, children above 3 years of age to the age before they start elementary school were added into the program. According to the data from Taiwan Centers for Disease Control (TCDC), the changes in inoculation rate of infants and children in the past six flu seasons (2005-2006 to 2010-2011) [16] show: the inoculation rate (receiving inoculation at least once) of the first two flu seasons reached over 60%; due to the incident of media reports of vaccines containing mercury in 2007 – 2008, the inoculation rate (receiving inoculation at least once) of the flu season dropped approximately 10%. With the crisis communication and collaboration of government facilities, the flu seasons of 2007-2008, 2008-2009, and 2009-2010 maintained an approximate 50% inoculation rate. In the past, domestic studies focused on the influence factors of children's parent in specific counties/cities, including main caregivers of children in Pingtung County [18] and parents of children in lower grades in Yunlin County [20]; however, no nationwide caregivers of infants and children investigation results have been published.

The routine measles vaccine for infants and children in the United Kingdom regrettably caused a community epidemic after media coverage of measles vaccine and autism controversy in 1998 which lead to low inoculation rates. After a decade of exploring the issue, communication efforts and continuous follow-up on parents' attitudes towards the vaccine, the negative attitude has started to turn according to observations in the past few years [19-22]. In Taiwan, both the media coverage of influenza vaccine for infants and children containing mercury in 2007-2008 and the confidence crisis which came with new H1N1 flu vaccine in 2009-2010 caused great decrease in inoculation rate of infants and children flu vaccine. We hope, through this investigation to understand influencing factors for the information sources of caregivers, the reasons for not inoculating children, and the influence factors in change of willingness for inoculation in the future. The information obtained will be used as reference in planning future communication strategies.

Materials and Methods

This investigation focuses on the main caregivers of infants and children above six months of age and under 3 years of age and who are also the person deciding to inoculate the children or not (hereby mentioned as caregivers of children under 3). Using health belief model as the base structure, a structural questionnaire was made, followed by telephone interviews conducted within the time period of March 18-20, 2011.

To increase the content validity of the telephone interview, apart from conducting expert validity, 9 main caregivers of infants and children were invited to a focused group interview (time: March 11, 19:20-21:00; participants all brought Children Health Handbook and had the handbooks checked by staff members for inoculation appointments and records) and the results of this focus group session were included in

the structural telephone questionnaire contents (the multiple choice questions, “does your physician advise inoculation” and “are your appointments made in the Children Health Handbook” were changed to two separate single-choice questions). Afterwards, pre-interviews were conducted on the 17th (a total of 21 valid questionnaires) in order to once again confirm the contents of the questionnaire can reflect the desired information for this study; slight changes in word use were made after the pre-interview.

The sample selection population for this investigation is the TCDC “National Immunization Information System (hereinafter referred to as NIIS system). The household information is directly wired into this system from the Ministry of Interior, contact telephone numbers are household numbers provided by children caregivers when bringing their children in for regular vaccination (under the reminders given by public health personnel) or cellular phone numbers which are keyed into the system and maintained by first-line public health personnel. Due to the high inoculation rates for children’s regular inoculation and the high rate (94.6%) of registered household numbers within the database, the population database is more complete than Chunghwa Telecom’s telephone directory database (the normal population used for telephone interview poll sampling).

Using the NIIS system, households with infants or children under 3 years of age and whose parents have registered contact numbers were selected, with stratified random sampling, and according to Household Registration, Minister of Interior demographic statistic information, the age levels and population of county/city ratio, sample configuration was conducted. To achieve stability in analysis for each of the levels, those counties/cities’ sample numbers under 10 were increased to a total of 10 samples, only Lienchiang County’s population number was not enough and therefore no additional samples were taken. In the process of telephone interviewing, the samples of each level were monitored through the “instant analysis system” built-in the Computer Assisted Telephone Interview system (CATI), insuring the sample structure is in line with the population structure. In addition, in order to allow the investigated samples to conform to the population structure, SPSS 12.0 version statistical software was applied with the weighting method (variables such as residential county/city, number of children within the household were weighted) to conduct follow-up statistics and analysis.

A total of 7,564 numbers were dialed in this investigation, among which successful contact was made with 3,561 sample households (a total of 47.1%, including 14.4% successful interviews, 18.4% non-qualified respondents, 8.8% of those refusing interviews from the start, and 5.5% of those who terminated interviews in the middle of the interview), 4,003 sample households that were unable to contact (a total of 59.1%, including 41.2% not answered, 6.6% non-existing numbers, 5.1% others such as busy lines or fax machines, etc.). A total of 1,090 successful interviews were made (under a 95% confidence level, and a estimated sampling error of ±3%)

Results

In this investigation, a total of 1,090 valid samples were collected. The socio-demographic characteristics of the respondents mainly consist of females (66.1%), mostly within the age spans of 30~34 years old (30.7%) and 35~39 years old (27.3%); educational levels were mostly consisted of high-school (and vocational) with 32.2%, followed by university with 25.9%; in occupation, housekeepers take up 36.7% as the most interviewed (Table 1).

Table 1.Distribution and Bivariate Tests Results of Socio-Demographic Variables of Respondents in Inoculation Willingness

Variables	Number (%)	Inoculating children intention Groups				Chi-square value
		Maintain inoculation group	Change to willing group	Change to unwilling group	Maintain non-inoculation group	
Total	1,090	477	329	77	207	
Gender						0.6
Male	369(33.9)	158(33.1)	115(35.0)	28(36.4)	68(32.9)	
Female	721(66.1)	319(66.9)	214(65.0)	49(63.6)	139(67.1)	
Age						17.7
Under 29 y	156(14.3)	66(13.9)	38(11.6)	16(20.8)	36(17.4)	
30~34 y	334(30.7)	144(30.3)	105(31.9)	23(29.9)	62(30.0)	
35~39 y	297(27.3)	118(24.8)	101(30.7)	14(18.2)	64(30.9)	
40~44 y	124(11.4)	61(12.8)	32(9.7)	10(13.0)	21(10.1)	
Above 45 y	178(16.3)	87(18.3)	53(16.1)	14(18.2)	24(11.6)	
Educational level**						29.6
Junior-high and below	159(14.6)	79(16.5)	35(10.6)	17(22.1)	28(13.5)	
High-school (vocational)	352(32.2)	160(33.5)	93(28.2)	36(46.8)	63(30.4)	
Junior college	196(17.9)	82(17.2)	66(20.0)	10(13.0)	38(18.4)	
University	283(25.9)	112(23.4)	105(31.8)	10(13.0)	56(27.1)	
Graduate school and above	102(9.3)	45(9.4)	31(9.4)	4(5.2)	22(10.6)	
Occupation						10.9
White collar	463(42.5)	192(40.3)	155(47.1)	28(36.4)	88(42.5)	
Blue collar/others	227(20.8)	104(21.8)	73(22.2)	13(16.9)	37(17.9)	
Housekeeping	400(36.7)	181(37.9)	101(30.7)	36(46.8)	82(39.6)	
Monthly Salary*						18.5
Below 20k	422(38.8)	202(42.3)	109(33.2)	40(51.9)	71(34.3)	
20-40k	316(29.0)	136(28.5)	98(29.9)	18(23.4)	64(30.9)	
40-60k	244(22.4)	100(21.0)	82(25.0)	16(20.8)	46(22.2)	
Above 60k	107(9.8)	39(8.2)	39(11.9)	3(3.9)	26(12.6)	
Region						16.6
Taipei City/New Taipei City/Keelung City	355(32.6)	144(30.2)	118(35.9)	24(30.8)	69(33.5)	
Taoyuan/Hsinchu/Maioli Counties	191(17.5)	92(19.3)	57(17.3)	12(15.4)	30 (14.6)	
Changhua County/Taichung City/Nantou County	213(19.5)	99(20.8)	55(16.7)	15(19.2)	44(21.4)	
Yunlin County/Chiayi County/Tainan City	143(13.1)	61(12.8)	40(12.2)	11(14.1)	31(15.0)	
Kaohsiung City/Pingtung County	163(15.0)	64 (13.4)	56(17.0)	15(19.2)	28(13.6)	
Hualien/Taitung Counties	25(2.3)	17(3.6)	3 (.9)	1(1.3)	4(1.9)	
Number of children aged 6 mth~3 y within household *						16.6
1 person	678 (62.1)	293(61.4)	207(62.9)	48(62.3)	130(62.5)	
2 persons	348(31.9)	147(30.8)	108(32.8)	20(26.0)	73 (35.1)	
3 or above	65(6.0)	37(7.8)	14(4.3)	9(11.7)	5 (2.4)	

Note: * P<0.05, ** P<0.01.

Households with 1 infant or child under 3 years of age total to 678 persons (62.1%), those with 2 or more total to 413 persons (37.9%). In the 2010-11 autumn-winter flu season (October of 2010 to March of 2011), the inoculation experience of households with infants or children under 3 is as following: 50.8% had been inoculated and 49.2% had not been inoculated. Looking at the future intentions for inoculating in 2011-12 autumn-winter flu season (as of October 2011), 59.4% express willingness, 22.1% express unwillingness, another 17.6% are still considering, and 0.9% will only inoculate if notified by medical personnel.120

A. Vaccine information sources of caregivers, main reference information for inoculation decision in the past

In the past year, the main sources for vaccine information are (multiple-choice) in the following order: television news coverage (66.5%), hospital/clinic public health guidance (32.6%), television commercials (23.0%), government offices (17.3%), newspapers (13.5%), webpage digital news (13.3%), television programs (10.4%), and the contact rate of other sources below 10% (Table 2).

Table 2. Main Influenza Vaccine Information Sources and Main Referential Information for Inoculation Decision for Children Under 3

Items	Number of Samples	(%)
Main source of influenza vaccine information in the past (multiple-choice)	n=1090	
Television news	736	(67.5)
Hospitals/clinics (Public health education guidance in hospitals)	356	(32.6)
Television commercials	250	(23.0)
Government facilities (Health bureau/ health education guidance)	189	(17.3)
Newspapers	147	(13.5)
Websites, digital news	145	(13.3)
Television programs	114	(10.4)
Reminders from clinical personnel	80	(7.3)
Relatives, friends, neighbors	72	(6.6)
Guidance posters, pamphlets	60	(5.5)
Radio news, commercials	53	(4.9)
Books, magazines	30	(2.8)
School/daycare/nanny system health education guidance	28	(2.6)
Do not know/no comment	6	(0.5)
Have never heard or seen any influenza vaccine related information	16	(1.5)
Main reference information sources in deciding whether to inoculate or not (multiple-choice)	n=1090	
Consulting hospital/physician	692	(63.5)
Media news coverage (including TV news/newspaper/radio news)	516	(47.3)
Health bureau staff inquiry	369	(33.9)
Information posted by government facilities	352	(32.3)
Opinions of friends and relatives	279	(25.6)
Information shared on blogs or forums	168	(15.4)
Opinions of school teachers/daycare teachers/nannies	130	(11.9)
Magazines/books	62	(5.7)
Others	9	(0.8)
Don’t know/No comment	3	(0.3)

The main reference information sources for main caregivers in deciding whether to inoculate or not (multiple-choice) are in the following order: consulting hospital/physician (63.5%), news media coverage (47.3%), public health personnel inquiry (33.9%), consulting information posted by government facilities (32.3%), referring to opinions of friends and relatives (25.6%), referring to information shared on blogs or forums on the internet (15.4%), referring to the opinions of school teachers/daycare teachers/nannies (11.9%), and other reference sources which amount to less than 10% (Table 2).

B. Main factors for not inoculating children in the past

In the 2010-11 autumn-winter flu season households with infants or children aged 6 months to 3 years of age had a 49.2% of non-inoculation. Respondents to the interview stated the direct reason for not inoculating their children is (n=536, multiple-choice) “afraid of side-effects of vaccination” 67.1%, followed by their child being constantly ill and unable to receive inoculation (25.5%), elder members of the family are against inoculation (17.2%), believe the inoculation of the flu vaccine will result in constant colds (15.3%), and feel that the contraction of influenza will not have severe results (13.7%). The other remaining reasons amount to less than 10%.

C. Situation and influence factors for future change in willingness for child inoculation

The inoculation behavior of respondents in 2010-11 autumn-winter flu season (October of 2010 to March of 2011) compared with the investigative results of inoculation willingness in the upcoming flu season (the autumn-winter season as of October 2011); the study subjects can be categorized into 4 groups. Those who were inoculated and agree to inoculate again this year (herein after referred as “maintain inoculation group”) total up to 477 persons (43.8%); those who were inoculated last year but are unwilling (or considering) this year (herein after referred as “change to unwilling group”) total to 77 persons (7.1%); those who did not receive inoculation last year and do not intend to this year (herein after referred as “maintain non-inoculation group”) total to 207 persons (19.0%); those who did not receive inoculation last year but show willingness (or considering) to inoculate this year (herein after referred as “change to willing group”) total to 329 persons (30.2%).

1. Results of bivariate analysis between change in inoculation willingness and each health belief variable

Looking that the bivariate analysis results of the related variables for each group, we can see that in socio-demographic variables, the educational level, monthly salary, and number of children within the household show significant relevance (Table 1).

Within the health belief variables, caregivers’ cognitive towards the high susceptibility of children towards influenza, awareness level of the benefits of the vaccine, the level of concern towards the safety of vaccines, and level of concern towards side effects all have significant relations with the change in inoculation intentions. Within the variables “high susceptibility of children towards influenza” and “awareness level of the benefits of the vaccine”, the highest scores were of the “maintain inoculation group” and the lowest were of the “maintain

non-inoculation group. Within the variables “concern towards the safety of vaccines” and “concern towards side effects”, the highest scores were the “maintain non-inoculation group” and the lowest were the “maintain inoculation group.” Looking at the behavioral leads, news media lead, physician consultant lead, and procedure lead (Children Health Handbook records appointment date for inoculation) all show significant relations to the change in inoculation willingness. Confidence in government prevention performance also shows significant relationship to the change in inoculation willingness; the “maintain inoculation group” showed the highest scores, whereas the “maintain non-inoculation group shows the lowest (Table 3).

Table 3. Bivariate Test Results and Distribution of Inoculation Willingness Change Group Within Health Beliefs, Behavior Leads, and Confidence in Government

Variables [a]	Group for future intentions for inoculating children under 3 y				F value/ Chi-square value Scheffe post-test
	(1) Maintain inoculation group n=477	(2) Change to willing group n=329	(3) Change to unwilling group n=77	(4) Maintain non-inoculation group n=207	
Health Beliefs					
Cognitive towards the high susceptibility of children towards influenza [b] ***	4.2 ± 1.0	4.0 ± 1.0	3.7 ± 1.1	3.7 ± 1.2	11.7 (1)>(2),(3),(4)
Cognitive towards severity of children flu contraction [b]	3.4 ± 1.3	3.3 ± 1.3	3.4 ± 1.4	3.2 ± 1.4	1.3
Level of acknowledgement towards benefits of vaccine [b] ***	4.0 ± 0.9	3.56 ± 1.0	3.3 ± 1.1	2.8 ± 1.2	71.5 (1)>(2),(3)>(4)
Level of concern towards safety of vaccine [b] ***	4.0 ± 1.1	4.2 ± 0.9	4.2 ± 0.9	4.3 ± 0.9	8.3 (2),(4)>(1)
Level of concern towards vaccine side effects [b] ***	3.1 ± 1.3	3.7 ± 1.1	3.6 ± 1.2	4.1 ± 1.0	40.4 (4)>(2),(3)>(1)
Behavior Leads					
News media lead [c] *	1.0 ± 0.9	1.1 ± 0.9	0.8 ± 0.7	1.0 ± 0.7	2.9 (2)>(3)
Physician consultant lead ***					
Physician advises inoculation	306(64.1)	147(44.8)	42(55.2)	78(37.9)	51.9
Physician does not advise inoculation	171(35.9)	182(55.2)	35(44.9)	129(62.1)	
Procedure lead ***					
Appointments in Children Handbook	322(67.4)	113(34.2)	55(70.9)	69(33.4)	127.2
No appointments in Children Handbook	155(32.6)	216(65.8)	22(29.1)	138(66.6)	
Self experience lead (self or friends and relatives)					
Has a child infected with flu and induced acute pneumonia	51(10.8)	36(11.1)	5(6.1)	20(9.6)	1.5
Has no child infected with flu and induced acute pneumonia	426(89.2)	293(89.0)	72(94.0)	187(90.4)	
Confidence in government promoted flu vaccine					
Confidence in government preventive performance ***	3.67(0.9)	3.3 ± 1.0	2.8 ± 1.1	2.7 ± 1.2	53.8 (1)>(2)>(3),(4)

[a] To describe continuous variables with mean ± SD, and F-test taken (F test excluding those who refused to answer); to describe categorical variables with number (%), and adopt chi-square test.

[b.] Cognitive towards the high susceptibility of children (1 Question), Severity (1 Question), acknowledgement towards benefits of vaccine (1 Question), Hindrance (2 Questions), Confidence in government promoted flu vaccine (originally 2 questions testing “current satisfaction” and “confidence in future”, due to the high relevancy of 0.684, the choices were combined for analysis. All questions are calculated using the Likert 5 point scale; lowest scoring 1 point and highest scoring 5 points. The higher the scores indicates: the higher level of Cognitive towards the high susceptibility of children towards influenza, the higher level of cognitive towards severity of children’s flu contraction, higher level of acknowledgement towards vaccine benefits, higher level of concern towards vaccine side effects, higher level of concern towards vaccine safety, and higher level of confidence in government overall preventive performance.

[c.] News media lead: information sources are cumulative values from sources such as television news reports, newspapers, radio news, internet, etc.

* P<0.05, ** P<0.01, *** P<0.001.

2. Results of change in inoculation intention variable analysis

According to the inoculation behavior and future intentions, caregivers are categorized into 4 groups. Using the "maintain inoculation group (those who had received inoculation last year and intend to continue inoculation in the future)" as the referenced group, the results of the multinomial logistic regression analysis show (Table 4): in comparison with "maintain inoculation group," those who had not received inoculation in the past but are considering inoculation in the future (change to willingness group) have lower cognitive towards the high susceptibility of children to influenza, lower acknowledgement towards benefits of vaccine,

Table 4. Multinomial Logistic Regression Analysis of Change in Future Inoculation Willingness (n=1,014)

Variables	Group for future intentions for inoculating children under 3 y		
	Change to willing group n=329	Change to unwilling group n=77	Maintain non-inoculation group n=207
Demographic variables			
Educational level (below junior high)			
High school (vocational)	1.21 (0.66, 2.21)	0.74 (0.34, 1.61)	0.79 (0.39, 1.59)
Junior college and above	1.39 (0.76, 2.53)	0.36 (0.15, 0.84)*	0.70 (0.35, 1.41)
Monthly salary (under 20k)			
20k-40k	1.27 (0.85, 1.92)	0.71(0.35,1.42)	1.27 (0.76, 2.11)
Above 40k	1.41 (0.92, 2.14)	1.22 (0.60, 2.49)	1.39 (0.82, 2.36)
Number of children in household (1 person)			
Over 2 persons	0.99 (0.7, 1.39)	0.81 (0.46, 1.43)	0.88 (0.58, 1.35)
Health Beliefs			
Level of cognitive towards the high susceptibility of children	0.79 (0.67, 0.94)**	0.69 (0.54, 0.90)**	0.68 (0.56, 0.83)***
Level of cognitive towards severity of children contracted with influenza	1.04 (0.92, 1.19)	1.07 (0.85, 1.35)	0.95 (0.81, 1.12)
Level of acknowledgement towards benefits of vaccine	0.75 (0.63, 0.89)**	0.67 (0.51, 0.88)**	0.43 (0.35, 0.52)***
Level of concern towards vaccine safety	1.16 (0.97, 1.39)	1.02 (0.74, 1.39)	0.97 (0.76, 1.23)
Level of concern towards vaccine side effects	1.36 (1.18, 1.57)***	1.29 (1.01, 1.64)*	1.89 (1.54, 2.32)***
Behavior leads			
News media lead [c]	1.19 (0.98, 1.46)	0.86 (0.59, 1.24)	1.04 (0.80, 1.36)
Physician consult lead (no advice given)			
Physician advises inoculation	0.67 (0.48, 0.94)*	0.86 (0.49, 1.51)	0.56(0.37,0.85)**
Procedure lead (no appointments in Children Handbook)			
Appointments in Children Handbook	0.28 (0.20, 0.39)***	1.10 (0.60, 2.00)	0.31 (0.20, 0.48)***
Self experience lead (has not contracted influenza before)			
Child has contracted influenza before	1.15 (0.68, 1.94)	0.52 (0.15, 1.76)	1.24 (0.63, 2.44)
Level of confidence in government promoted flu vaccines [b]			
(average/unsatisfied/very unsatisfied)			
Overall satisfied and confident	0.80 (0.68, 0.96)*	0.49 (0.37, 0.64)***	0.57 (0.46, 0.69)***

Note: "maintain inoculation group" as reference group (n=477).
This table shows the ORs and their 95% confidence levels.
Variables within parenthesis indicate the variables of the reference group.
* P<0.05, ** P<0.01, ***P<0.001; Pseudo R^2=0.37.

higher levels of concern for vaccine side effects, with no physician advise for inoculation, no appointments recorded on Children Health Handbook, and lower confidence in the government; the odds ratios (OR) and their 95% confidence levels are 0.79 (0.67, 0.94), 0.75 (0.63, 0.89), 1.36 (1.18, 1.57), 0.67 (0.48, 0.94), 0.28 (0.20, 0.39), and 0.80 (0.68, 0.96) respectively.

In comparison with “maintain inoculation group”, those who have received inoculation in the past, but are unwilling to or considering to do so in the future (change to unwilling group) mainly show educational levels below junior college (including), lower cognitive towards the high susceptibility of children to influenza, lower acknowledgement towards benefits of vaccine, lower level of concern towards vaccine side effects, and lower confidence in the government; the odds ratios (OR) and their 95% confidence levels are 0.36 (0.15, 0.84), 0.69 (0.54, 0.90), 0.67 (0.51, 0.88), 1.29 (1.01, 1.64), and 0.49 (0.37, 0.64) respectively.

In comparison with “maintain inoculation group,” those who had not received inoculation in the past and are unwilling to inoculate in the future (maintain non-inoculation group) show lower cognitive towards the high susceptibility of children to influenza, lower acknowledgement towards benefits of vaccine, higher level of concern towards vaccine side effects, with no physician advice for inoculation, no appointments recorded in Children Health Handbook, and lower confidence in the government; the odds ratios (OR) and their 95% confidence levels are 0.68 (0.56, 0.83), 0.43 (0.35, 0.52), 1.89 (1.54, 2.32), 0.56 (0.37, 0.85), 0.31 (0.20, 0.48), and 0.57 (0.46, 0.69) respectively.

The results of multinomial logistic regression analysis can also estimate the odds ratio (OR) between each of the different groups. For example, to understand the odds ratio of cognitive towards the high susceptibility of children to influenza of “change to willing group” and “maintain non-inoculation group”, the division of “change to willing group” and “maintain non-inoculation group” in Table 4, the OR=1.16. This shows that the “change in willingness group (has not received inoculation in the past, but will or considerate inoculation in the future) may have higher cognitive towards the high susceptibility of children to influenza. In addition, those with higher acknowledgement towards benefits of vaccine, lower level of concern towards vaccine side effects, with physician advice for inoculation, and higher confidence in government promoted flu vaccine all tend towards “change to willing group (has not inoculated in the past but will or is considering inoculation in the future)”.

D. Caregivers of infants and children’s needs for other influenza vaccine information

Based on communication practices’ needs, this investigation inquired respondents about the contents of the information they would like to understand more of during interviews; the results (multiple choice) are in the following order: “description of possible flu vaccine side effects (72.6%)” and “medical assistance and relief system upon possible occurrence of side effects after vaccination (69.1%),” followed by instructions needed for

inoculation of vaccine (62.6%), description of influenza vaccine protection effect (49.2%), description of frequency of inoculation (36.9%), and influenza vaccine inoculation location (20.3%). In addition, 14.9% of the public expressed that most of the information is clear enough and does not need any further clarification. The rest do not exceed 10%.

Discussion

This study categorized the caregivers of infants and children into 4 groups according to the results of their inoculation behavior and future intentions; also using multinomial logistic regression analysis. In comparison with the other 3 groups, “maintain inoculation group” has higher cognitive towards the high susceptibility of influenza, higher acknowledgement towards the benefits of vaccination, lower level of concern towards vaccine side effects, and higher confidence in the government. Therefore, their children have received inoculation in the past and also express willingness in inoculating their children in the future. On the other hand, the other three groups show more negative attitudes toward the variables mentioned above and therefore do not inoculate their children every year. Due to the consistent trend in statistic results of the various inoculation willingness change groups, comprehensive discussion will be held in the following part of this study.

A. Health beliefs

Those with higher cognitive towards the high susceptibility of children to influenza, higher acknowledgement towards the benefits of vaccine, lower level of concern towards safety of vaccine, and lower level of concern towards vaccine side effects are more inclined towards “maintain inoculation group” and show significant statistical relevance, which is similar to the results of past studies [18, 20-21, 26-27]. Studies abroad also indicate, the public has similar decision thought patterns when faced with seasonal influenza vaccine inoculation and H1N1 vaccine inoculation; variables such as vaccine safety, concern towards side effects, self risk of contraction, etc. all directly influence the inoculation rate [31].

In practice, the communication for influenza vaccine for infants and children holds great challenges, including: it is difficult for the public to understand the risks of contracting influenza, the chances of side effects after inoculation; the protection period of influenza vaccine which needs to be administered each year; in addition with the frequency of colds/cold symptoms that occur among infants and children in the autumn-winter season (caused by other diseases or bacteria), with the fact that infants and children have difficulty in expressing discomfort, can all easily lead to the “confusion” of caregivers in thinking that “things are fine with no inoculation, yet children fall ill after inoculation”. Apart from these situations, in this study, “child is constantly sick (25.5%)” and “afraid of blame from elderly family members “(17.2%) are both reasons for not inoculating children in the past. Only by overcoming the missed inoculation time, family and social pressures, and other obstacles, will it help in increasing the inoculation rate of infants and children.

B. Behavior leads

1. The key to caregivers inoculating children is “physician advice” and the good use of procedure leads

Among the information caregivers of infants and children refer to in “deciding” whether to inoculate or not, 63.5% express they mainly rely on “physician advice”. Through statistical analysis, the results show, “maintain non-inoculation group” and “change to willing group” (all caregivers who had not inoculated their children in the 2010-11 autumn-winter flu season) all did not receive physician advice nor have recorded appointment dates in Children Health Handbook (procedure lead), all reaching significant statistical relevance. Past studies have shown that “the attitude and opinions of physicians” is the most important factor in influencing the public to inoculate [17-18, 22, 26-27]. According to the successful experience in promoting routine infant and children vaccine in Taiwan (inoculation rate over 95%), the caregivers have high interaction with community physicians, high confidence in medical profession during routine inoculating periods; if physician can take the initiative in providing consultation and advice, it will aid caregivers in clarifying misconceptions and doubts about the side effects of vaccines. In practice, there have been some cases where first-line physicians do not advise the administration of influenza vaccine; the results of this investigation show: only very few numbers of respondents (1.5%) have expressed “their physician advises against flu inoculation for children” (this investigation did not press further for reasons), most of the respondents (41%) expressed that they have not discussed the flu vaccine issue with their physician.

Past studies have expressed the importance of procedure leads [18, 20, 28]. The newly published Children Health Handbook has included influenza inoculation on the vaccine inoculation record sheet; however, in this investigation and in-practice observation, public health personnel or nursing personnel easily overlook the use of “influenza inoculation appointment date,” and thus missed the key timing in reminding caregivers of infants and children. As for the reasons to why public health personnel and nursing personnel have overlooked the use of this procedure lead and the reasons physician have for not taking the initiative in providing consultation and advice for inoculation, all need further study for clarification.

2. News media is the main source of inoculation information for caregivers

Through this investigation, it was found that in the past, 67.5% of caregivers of infants and children received vaccine information mainly from “television news;” however the news media lead (including television news, newspaper, radio, internet, etc.) did not reach statistical significance in the change in inoculation willingness groups. The results are the same as that of the domestic study of elderly inoculation in influenza seasons [23], and similar to the results of inoculation willingness change in children’s parents in the study conducted after the mercury-consisting vaccine incident [18]; however, the study results are different from those found in the study made for the vaccine promoted and vaccine crisis during the H1N1 influenza epidemic [24-25].

The possible speculated factors are: the Taiwanese people still have doubts about the H1N1 flu vaccine, and infant/children public expense vaccines have been promoted for many years, with not big difference in government strategic information, and in practice, it is difficult to change willingness through new media (due to the limited layout and reporting time). The influence level in this situation is different from influenza epidemics when the media's high frequency reports and newest information are provided. However, this investigation has a high 66% of children caregivers who can correctly understand that "inoculation should be administered every year," and only 1.5% of the respondents indicated that they had not heard (or seen) and related information, showing the good results of that year's media communication information. The literature indicates: negative vaccine news reports are more likely to induce the attention of caregivers and leave impressions and directly lower the willingness to inoculate; despite investigative descriptions that are reported afterwards in proving the invalidity of the incident, caregiver's ideas are still difficult to change [33]. Therefore, regular communication and crisis communication with the media is taken seriously in the setting and implementation process of government policies. In addition, continuous and proactive provision of scientifically-based information and assistance in the correct explanation by the media will aid the media in providing fair and correct vaccine issue reports.

C. Confidence in government policies regarding influenza vaccine aids in maintaining caregivers' willingness in inoculation

In this investigation, 56.4% of respondents express satisfaction (or great satisfaction) in the government's performance in promoting influenza vaccine, 64.6% show confidence (or great confidence) in future promotions. Through statistical analysis of the willingness change groups, these show significant statistical relevance, showing a similar result to other studies both domestic and foreign [24-25], especially when facing external communications for new contagious diseases or vaccine confidence crisis, the level of confidence in the government is a influencing factor in the change of public behavior. In Taiwan's declining birthrate society, children are the treasures of parents. Caregivers hope for their children's protection through vaccination, yet also worry about the possible side effects after inoculation; inner conflict leaves them in a situation where the decision is hard to make. At this time, the confidence in the government's policies towards influenza vaccine and professional advice helps caregivers in making the right decision. As for the socio-demographic variables, only those with educational levels below junior college trend towards "change to unwilling group," this has been discussed in past studies [18, 26, 29].

Apart from the discussions of the various groups and reference group above, the results achieved through multinomial logistic regression analysis can be used to further calculate the odds ratios between each of the groups. In this investigation, 32% of respondents are "change to willing group," showing that their intentions of inoculating children is no longer "adhere to no inoculations," which is a window of opportunity for

preventive facilities. Through this investigation, we have observed: “change to willingness group” show higher scores in cognitive level high susceptibility of children to influenza, level of acknowledgement in the benefits of vaccine, and level of confidence in the government promoted flu vaccine than both “change to unwilling group” and “maintain non-inoculation group;” this group also shows lower levels of concern towards the side effects of vaccine than the “maintain non-inoculation group.” This shows that raising the cognitive level of high susceptibility of children to influenza and level of acknowledgement towards the benefits of vaccine, enhancing the confidence in government promoted flu vaccines, and lowering the concern of vaccine side effects of caregivers of infants and children aids in allowing those who had not inoculated in the past to change to the change to willing inoculation group; this result is similar to those of past studies [18]. On the other hand, in physician advice and appointments in children handbook, the results show higher odds ratio in “maintain inoculation group” and “change to unwilling group;” this is speculated to be related to past inoculation experiences. These two variables are behavior leads in reminding the importance of vaccination; yet enhancing correct health concepts is the true influencing factor in influencing caregivers’ willingness to inoculate their children.

Suggestions and Conclusion

Integrating the results and discussion of this investigation, to increase the influenza vaccine inoculation rate in infants and children under 3 years of age in Taiwan (seasonal flu vaccine policy goal: 5% increase in subjects each year), we advise: continuous communication with the media, announcement of vaccine-related information (including the importance, start of vaccination information, guidance, etc.). As for negative public opinion incidents, response and external communication should be addressed immediately to prevent the further spread of the crisis. It is also advised to combine the Taiwan Pediatric Association and Taiwan Nurses Association to conduct in-service training focused on the often-seen misconceptions about flu vaccines before the administration of all influenza vaccines [32]; using the professional knowledge to establish the acknowledgement and confidence of vaccine in the first-line medical personnel, and encouraging first-line public health or nursing personnel to use “appointment dates in the Children Health Handbook (procedure lead)” and provide “physician consultation and suggestions.” Upon facing caregivers with doubts, medical personnel can further clarify their concepts and provide descriptions and assistance in aiding caretakers to establish correct health concepts.

As for the knowledge and attitude of infants and children caregivers towards flu vaccines (and routine vaccines), it is beneficial to establish long-term, systematic monitoring information. This domestic information can not only provide practical communication suggestions for each year’s seasonal flu vaccine, but also has great policy planning referential value for future inoculations during large scale influenza epidemics or communications when rare or abnormal vaccine reaction incidents occur [21, 31]. Although

this investigation tries to understand the influence factors for caregivers in inoculating their infants and children with flu vaccine, the factors that influence change in public behavior are complex and varied, the decision patterns and potential hindrance factors of caregivers are also complicated; thus a great challenge for preventive facilities. At the same time, more behavioral science, mental health, public communication, and news media experts are encouraged to collaborate in study and discussion.

Study limitations

For this investigation: the ratio of those who have expressed that they have inoculated their children in 2010-11 (51%) is higher than the actual inoculation rate in infants and children (approximately 32%, with at least one dosage). The possible factors may include: A. recall bias. B.41% of the called numbers were unanswered, unable to contact due to the higher frequency of cellular phone usages than home numbers, or the interview times were during those who had not yet returned home (during Friday nights, weekends, and Sundays).C.18% of respondents were unqualified respondents, 14% refused interviews may be due to people's privacy or unwillingness to be disturbed, or are uninterested in the issue and unwilling to answer. As for those unqualified, possible reasons do not rule out the possibilities of mistakes in the completing or the keying in of the basic information, or that the caregivers have moved to another location. The possible reasons for the subjects mentioned above who were unable to contact lead to the fact that those who were interviewed were subjects with higher stability and had higher levels of cooperation which causes "non-sampling error;" this is the limitation of house number telephone interviews, and this implementation experience can provide reference for future users of this database. However, the systematic analysis and integration of inoculation willingness change in the various groups of this study still have practical implementation reference value.

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References

1. WHO Avzilable at:. http://www.who.int/vaccine_research/diseases/ari/en/index1.html

2. Neuzil KM, Zhu Y, Griffin MR, et al. Burden of interpandemic influenza in children younger than 5 years: a 25-year prospective study. J Infect Dis 2002;185:147-52.
3. Heikkinen T, Silvennoinen H , Peltola V, et al. Burden of influenza in children in the community. J Infect Dis 2004;190:1369-73.
4. O'Brien MA, Uyeki TM, Shay DK, et al. Incidence of outpatient visits and hospitalizations related to influenza infants and young children. Pediatrics 2004;113:585-98.
5. Poehling KA, Edwards KM, Weinberg GA, et al. The under recognized burden of influenza in young children. N Engl J Med 2006;355:31-40.
6. Ampofo K, Gesteland PH, Bender J, et al. Epidemiology, complications, and cost of hospitalization in children with laboratory-confirmed influenza infection. Pediatrics 2006;118(6):2409-17.
7. Heinonen S, Silvennoinen H, Lehtinen P, et al. Effectiveness of inactivated influenza in children aged 9 months to 3 years: an observational cohort study. Lancet Infectious Diseases 2011;29;23-9.
8. Katayose M, Hosoya M, Haneda T, et al. The effectiveness of trivalent inactivated influenza vaccine in children over six consecutive influenza seasons. Vaccine 2011;29;1844-9.
9. Esposito S, Marchisio P, Ansaldi F, et al. A randomized clinical trial assessing immunogenicity and safety of double dose of virosomal-adjuvanted influenza vaccine administered to unprimed children aged 6-35 months. Vaccine 2010;28(38);6137-44.
10. Hou Yiting. Effectiveness Analysis of Influenza Vaccination for Children in Taiwan. Department of Economics, National Taipei University. 2007 Master's Thesis.
11. Ministry of Health, Labour and Welfare, Avzilable at: http://www.mhlw.go.jp/shingi /2008/12/dl/s1225-14a_0003.pdf
12. USA Disease Monitor Center official website. Prevention and control of influenza with vaccines. Recommendation of ACIP, 2010. http://www.cdc.gov/mmwr/pdf/rr/rr5908. pdf
13. V Usonis, I Anca, F André, et al. Central European Vaccination Advisory Group (CEVAG) guidance statement on recommendations for influenza vaccination in children. BMC Infect Dis 2010(10);168.
14. WHO. Available at: http://www.who.int/csr/disease/influenza/recommendations2010_ 11north/en/index.html
15. Taiwan CDC. Year 99 (2010-11 autumn-winter flu season) influenza vaccine inoculating plan. Available at: http://flu.cdc.gov.tw/public/Attachment/081311193116. pdf
16. Chen CH. 2011 National Communicable Diseases Prevention and Control Conference: special report on the effectiveness of influenza control strategies and review.
17. Chen MF, Wang RH, Wu CC, et al. Factors Affecting Primary Caregivers' Attitude toward Administration of Influenza Vaccine to Young Children in the Pingtung Area. Epidemic Report:2009;12:782-94.

18. Hsu SY, Liao HE, Hurng BS, et al. A study of the changes in parental intent to approve influenza vaccine inoculation for their low-grade primary school children in Yunlin County. Taiwan Journal of Public Health 2009;29:326-35.
19. Smith A, Yarwood J, Salisbury DM. Tracking mother's attitudes to MMR immunization in 1996-2006. Vaccine 2010;25(20);3996-4002.
20. Jessopa LJ, Murrina C, Lotyaa J, et al. Social-demographic and health-related predictors of uptake of first MMR immunization in the Lifeways Cohort Study. Vaccine 2010;28(38):6338-43.
21. Pearce A, Law C, Elliman D, et al. Factors associated with uptake of measles, mumps, and rubella vaccine (MMR) and use of single antigen vaccines in a contemporary UK cohort: prospective cohort study. BMJ 2008;336:754-7.
22. Casidaya R, Cresswellb T, Wilson D, et al. A survey of UK parental attitudes to the MMR vaccine and trust in medical authority. Vaccine 2006;24(2):177-84.
23. Huang HP, Tzau WS, Ho LL, et al. Taiwan Elderly People's Willingness to Receive Government Promoted and Funded Flu Shots – Results of a 2007 telephone survey. Epidemic Report 2007; 23: 683-92.
24. Chen NT, Murphy ST. Examining the role of media coverage and trust in public health agencies in H1N1 influenza prevention. International Public Health J 2011; 3(1):45-52.
25. Ho LL, Tzau WS, Huang HP, et al. Public Perceptions, Behaviors Change and Face Masks Purchase during Early Phase of H1N1 Pandemic. Epidemic Report 2011;27:1-7.
26. Nowalk MP, Lin CJ, Zimmerman RK, et al. Changes in parents' perceptions of infant influenza vaccination over two years. J Natl Med Assoc 2007; 99(6);636-41.
27. Stefanoff P, Mamelund SE, Robinson M, et al. Tracking parental attitudes on vaccination across European countries: The Vaccine Safety, Attitudes, Training and Communication Project (VACSATC). Vaccine 2010;28;5791-37.
28. Kroneman M, Van Essen GA, John Paget W. Influenza vaccination coverage and reasons to refrain among high-risk persons in four European countries. Vaccine 2006;24;622-8.
29. Endricha MM, Blankb PR and Szucsb TD. Influenza vaccination uptake and socioeconomic determinants in 11 European countries. Vaccine 2009;27;4018-24.
30. Maurer J, Harris KM, Parker A, et al. Does receipt of seasonal influenza vaccine predict intention to receive novel H1N1 vaccine: Evidence from a nationally representative survey of U.S. adults. Vaccine 2009;27;5732-34.
31. Poland GA. The 2009-2010 influenza pandemic: effects on pandemic and seasonal vaccine uptake and lessons learned for seasonal vaccination campaigns. Vaccine 2010;28;S4;3-13.
32. Poland GA, Tosh P, Jacobson RM. Requiring influenza vaccination for health care workers:seven truths we must accept. Vaccine 2005;23;2251-5.
33. Tickner S, Leman1 PJ and Woodcock A. Factors underlying suboptimal childhood immunization. Vaccine 2006;24;7030-6.

Scrub Typhus in Taiwan from 2001 to 2010

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Abstract

Scrub typhus is an acute febrile disease caused by *Orientia tsutsugamushi*. Humans are infected through the bites of larval trombiculid mites (chiggers). The main purpose of this report is to illustrate the occurrence of scrub typhus in Taiwan from the year 2001 to 2010 through analysis of reported and confirmed case data. The results showed that the disease predominates from June to July, mostly distributed in Hualien County, Kinmen County, Taitung County, and Penghu County. The majority of clinical symptoms of the confirmed cases is fever (90.9%), followed by headache (26.9%), and eschar (26.2%). Practitioners are reminded to inquire for travel history from fever patients, to aid in early diagnosis of scrub typhus. Among imported cases, most are brought into the country from Mainland China with 31.6% (6/19). Those who travel between the two countries or to high scrub typhus risk areas are advised to be vigilant and pay attention to scrub typhus prevention to decrease the risk of infection. Summer is the season for scrub typhus epidemics; thus people should take preventive measures when participating in outdoor activities and seek medical assistance as soon as possible scrub typhus symptoms appear to avoid delay in diagnosis and treatment.

Keywords: scrub typhus, chigger, eschar

Introduction

Scrub typhus is also known as Tsutsugamushi disease, which is caused by the bite of larval trombiculid mites (chiggers) carrying pathogen. The pathogen *Orientia tsutsugamushi* belongs to the Rickettsiaceae Family and is an obligate intracellular pathogen with a basic pattern similar to gram-negative bacteria [1] or the endothelial cells, macrophages, and polymorphonuclear neutrophils (PMNs) of infected patients or laboratory animals [2].

In Taiwan, the main propagation vector of scrub typhus is the *Leptotrombidium deliense* mite with an incubation period of 9 to 12 days. The bite wound will form a unique kind of hole-like skin ulceration eschar accompanied by the local inflammation of lymph nodes and other non-specific symptoms such as fever, headaches, malaise, and conjunctival hyperemia. After about a week of fever, a dark-red rash will start to appear on the torso which will spread to the four limbs and disappear after a few days [3]. Delayed diagnosis and without proper treatment may induce myocarditis, acute

respiratory distress syndrome, disseminated intravascular coagulation, shock, multiple organ dysfunctions or failure, and other serious complications, even leading to death [4-5].

The geographical distribution of scrub typhus forms a triangular area starting from the north of Japan to northern Australian and to Pakistan, called the “tsutsugamushi triangle”; Taiwan is also located within this area [1, 6]. Records of scrub typhus in Taiwan dates back to 1915, documented by the Japanese scholar Hitori [7], and the disease was later listed as a reported infectious disease in 1955; the first epidemic of scrub typhus on Taiwan island occurred in 1970. Using the Business Objects information database system of the Centers for Disease Control (CDC), Department of Health, this report statistically analyzes the information of scrub typhus reported and confirmed cases during the years between 2001 and 2010 in order to understand the effectiveness of preventive measures taken for scrub typhus and for future monitoring of the disease and epidemic reference.

Materials and Methods

A. Definition of cases [8]

1. Definition of report

   Meets clinical criteria

2. Clinical conditions

   Acute and persistent high fever, headaches, back pain, chills, night sweat, swollen lymph nodes, painless eschar appearance at chigger bite, red skin rash appearance after 1 week, sometimes with complications such as pneumonia or abnormal liver function.

3. Confirmed cases

   Positive test results in line with any of the defined symptoms.

4. Test criteria

   Complies with any of the following test results, defined as positive test results:

   (1) Clinical samples (blood or skin wound [eschar]) isolated and *O. tsutsugamushi* detected.

   (2) Clinical samples of molecular biology *O. tsutsugamushi* nucleic acid is tested positive.

   (3) Positive serological antibody detection: through Indirect Immunofluorescene Assay (IFA), detection of *O. tsutsugamushi* antibody titers in acute and convalescent serum, either IgM or IgG antibody titers showing seroconversion or titer $\geqq$ 4-fold increase.

B. Data origin and analysis

Origin of raw data is the Business Objects information database system of CDC, Department of Health, where data is retrieved from the National Notifiable Disease Surveillance System. Search criteria set the reported disease as scrub typhus, incidentally between the years 2001 to 2010. All of the case information was analyzed in cooperation with epidemic investigation reports from each branch of CDC and using the software EXCEL.

Results

A. The statistics of reported and confirmed cases of scrub typhus in Taiwan

During the years between 2001 and 2010, a total of 21,955 cases of scrub typhus were reported in Taiwan. Confirmed cases totaled to 3,745 cases with 3,726 confirmed indigenous cases, and 3 deaths. Statistics of imported cases show 19 imported cases, among which most were infected in China (6 cases); 3 cases from Vietnam, 2 cases each from Thailand, the Philippines, and Burma, and 1 case each from Indonesia, India, Argentina, and Cambodia. If the incident rate of indigenous scrub typhus in 10 thousand people in Taiwan is analyzed, the incident rate has risen to 1.73 from 1.10 (Figure 1).

B. Monthly distribution of confirmed indigenous scrub typhus cases

The data of incident months of the confirmed cases that occurred between 2001 and 2010 show, scrub typhus cases occurs throughout the entire year with a rapid increase in numbers in April and May and reaches its peak in July (Figure 2).

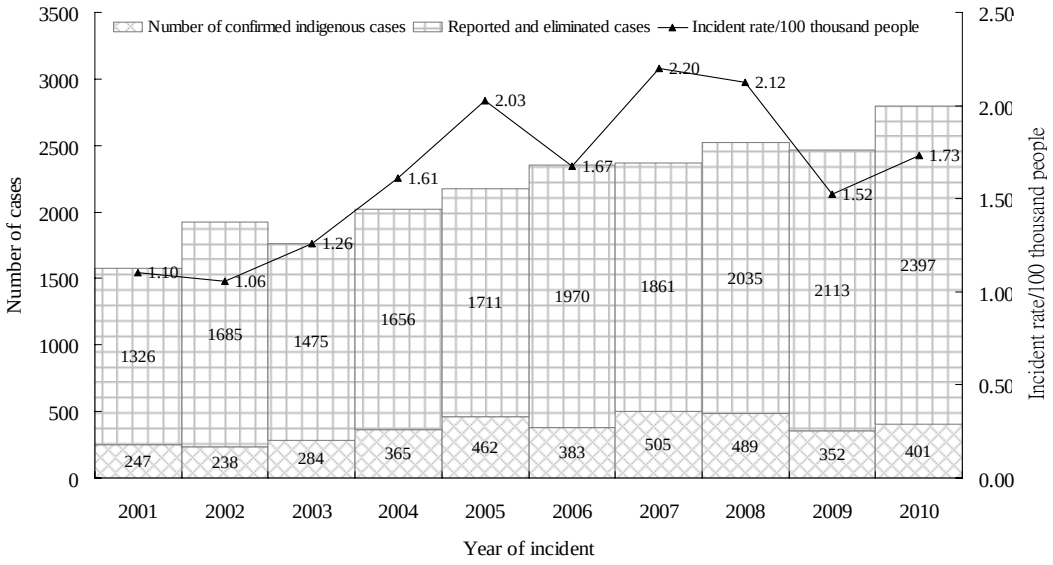

Figure 1. Tendency of Number of Scrub Typhus Cases in Taiwan, 2001 – 2010

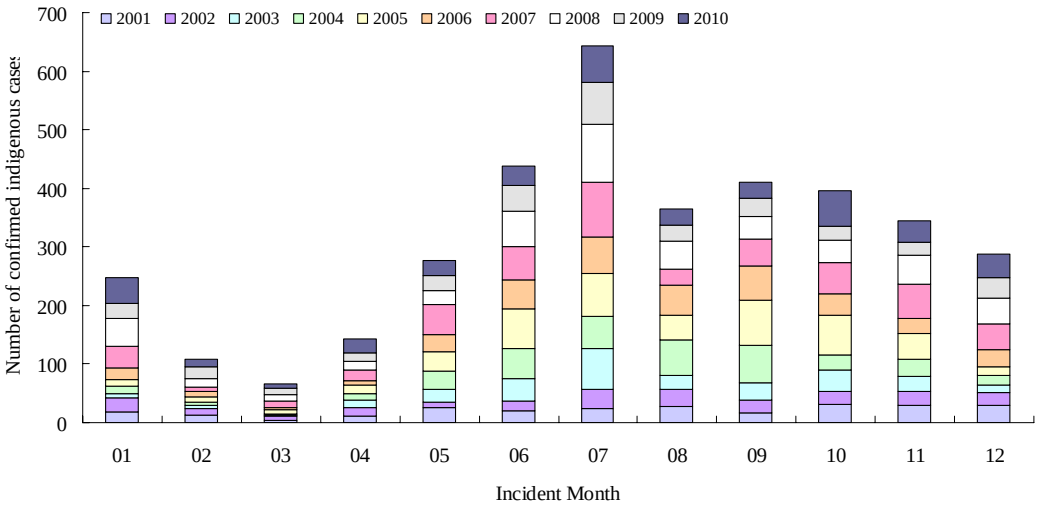

Figure 2. Monthly Distribution of Confirmed Indigenous Scrub Typhus Cases in Taiwan, 2001-2010

C.Distribution of gender and age of confirmed indigenous scrub typhus cases in Taiwan

Among the total of 3,726 indigenous cases that occurred during 2001 to 2010, male cases numbered to 2,403 (64.5%) cases and female 1,323 (35.5%) cases with a gender ratio of 1.8:1, showing a higher proportion of scrub typhus infection among males than females. The incident age of the scrub typhus cases is mainly among adults above 20 years of age with an average age of 43.1 years (standard deviation 18.5 years). The age span with more cases include 20 to 29 years, 40 to 49 years, and 50 to 59 years including 722 cases (19.4%), 681 cases (18.3%), and 736 cases (19.8%) respectively (Figure 3).

D.Distribution of residential area of Taiwan reported or confirmed indigenous scrub typhus cases, and deaths.

Focusing on residential areas, scrub typhus cases are distributed in all of the counties and cities in Taiwan. During 2001 to 2010, the county with the highest number of confirmed indigenous scrub typhus cases is Hualien county with a total of 532 cases (14.28%), followed by Kinmen county with 500 cases (13.42%), 434 cases in Taitung county (11.65%), 367 cases in Penhu county (9.85%), and also many confirmed cases in Nantou county and Kaohsiung City (including the original Kaohsiung City and Kaohsiung County) with 243 cases (6.52%) and 437 cases (11.73%). It is worth noting that, under calculation of incident rate per 10 thousand people, the counties with higher incident rate are those outlying counties, these include Lienchiang county: 121.50, Kinmen county: 67.08, and Penghu county: 39.38. On Taiwan island, Taitung and Hualien county have higher rates with 18.27 and 15.36 (Table 1).

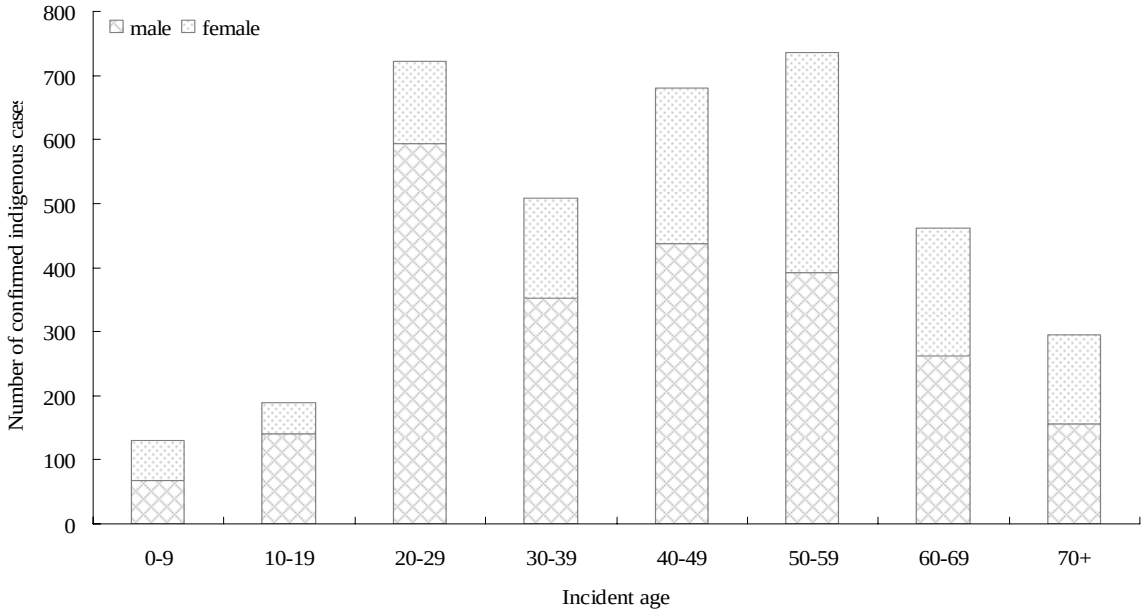

Figure 3. Age Span of Confirmed Indigenous Scrub Typhus Cases in Taiwan, 2001-2010

Table 1. Statistics of Residential Areas of Taiwan Indigenous Scrub Typhus Cases, 2001-2010

Residential County/ City	Cumulative Population of Each County/ City 2001-2010	Cumulative Reported Cases	Cumulative Confirmed Cases (%)	Cumulative Deaths	Incident Rate/100 Thousand People	
					Reported Cases	Confirmed Cases
Hualien County	3,462,693	2,883	532(14.28)	2	83.26	15.36
Kinmen County	745,369	919	500(13.42)		123.29	67.08
Kaohsiung City	27,564,699	4,709	437(11.73)		17.08	1.59
Taitung County	2,375,371	1,558	434(11.65)	1	65.59	18.27
Penghu County	931,875	670	367(9.85)		71.90	39.38
Nantou County	5,357,078	640	243(6.52)		11.95	4.54
New Taipei City	37,542,867	2,033	187(5.02)		5.42	0.50
Taipei City	26,252,277	1,241	157(4.21)		4.73	0.60
Pingtung County	8,941,907	1,544	142(3.81)		17.27	1.59
Taichung City	25,741,652	1,071	123(3.30)		4.16	0.48
Lienchiang County	95,474	256	116(3.11)		268.14	121.50
Tainan City	18,639,870	1,349	88(2.36)		7.24	0.47
Yilan City	4,620,900	328	75(2.01)		7.10	1.62
Taoyuan County	18,896,643	633	70(1.88)		3.35	0.37
Changhua County	13,141,280	914	64(1.72)		6.96	0.49
Miaoli County	5,606,154	229	47(1.26)		4.08	0.84
Yunlin County	7,315,246	345	35(0.94)		4.72	0.48
Chiayi County	5,546,054	164	35(0.94)		2.96	0.63
Hsinchu County	4,813,872	170	32(0.86)		3.53	0.66
Hsinchu City	3,938,726	113	18(0.48)		2.87	0.46
Keelung City	3,901,186	112	17(0.46)		2.87	0.44
Chiayi City	2,713,019	52	7(0.19)		1.92	0.26
Other*		3				
Total	228,144,212	21,936	3,726	3	9.61	1.63

*: 3 reported cases have incomplete data
Those counties marked with grey are outlying counties.

During the period between 2001 and 2010, a total of 3 scrub typhus death cases occurred, and were caused by organ failure or sepsis induced by the infection of scrub typhus. Two scrub typhus death cases occurred in Hualien county, one in 2004 and one in 2007. Both of the cases were male, aged between 50 to 59 years of age. 1 eight-year old indigenous girl death case occurred in Taitung county in 2005. This girl had no medical history, had barbequed and played in the stream water near her home and was bitten by an insect. After approximately a week, the child started to show symptoms of fatigue, fever, headaches, nausea, and abdominal pain, an eschar was also found on her left shoulder. Although emergency aid was administered by a hospital, the case still died. Afterward, the family agreed to an autopsy to determine the cause of death, and through tests made by CDC, it was determined that the case was infected by scrub typhus (Table 2).

E.Occupations

The majority of the confirmed cases were unemployed, accounting for 26.6% (male 23.6%, female 32.0%); For males, following were active military men with 19.5%; for

females, following were housekeepers with 17.4%; those in agriculture, forestry, fishing, and livestock account for 14.6% (male 15.7%, female 12.5%) (Table3).

F.Clinical symptoms

Among the main symptoms shown in the confirmed cases, the most prevalent is fever, accounting for 90.9%, followed by headaches with 26.8%, and eschars with 26.2% (Table 4).

Table 2. Taiwan Death Incidents of Scrub Typhus, 2001-2010

Year of Incident	2004	2005	2007
Residential County/City	Hualien County	Taitung County	Hualien county
Onset Date	2004/7/13	2005/7/25	2007/5/02
Date of Death	2004/8/24	2005/8/04	2007/5/11
Case Information	The case is a 54- year-old male. X medical hospital reported scrub typhus in July of 2004 with endemic typhus and Q fever. The CDC test results showed positive for scrub typhus. The case died in August of the same year.	The case is an 8-year-old indigenous female child. Y medical hospital reported scrub typhus in August of 2005 with endemic typhus and Q fever. The case died a day after the report.	The case is a 58-year-old male who died in May of 2007 and was reported by X medical hospital for scrub typhus on the same day with endemic typhus and Q fever. The CDC test results showed positive for scrub typhus.
Note	Cause of death was direct plus indirect; the death note included liver abscess.	Cause of death was direct plus indirect; the death noted heart and lung failure.	Cause of death was direct due to B (Scrub Typhus); the other cause of death is A—sepsis.

Table 3. Statistics of Occupations of Taiwan Confirmed Scrub Typhus Cases, 2005-2010

Occupation	2005		2006		2007		2008		2009		2010		Total		
	Male	female	male	female	male	female	male	female	male	female	male	female	male	female	Total
None	68	44	55	57	83	60	82	61	49	32	54	48	391	302	693
	21.9%	28.9%	23.1%	39.0%	25.9%	31.7%	25.2%	36.5%	22.0%	24.6%	22.4%	29.8%	23.6%	32.0%	26.6%
Other	54	35	58	30	78	31	55	24	51	33	56	30	352	183	535
	17.4%	23.0%	24.4%	20.5%	24.3%	16.4%	16.9%	14.4%	22.9%	25.4%	23.2%	18.6%	21.2%	19.4%	20.6%
Agriculture, forestry, fishing, and livestock	40	21	27	8	52	19	54	22	46	25	42	23	261	118	379
	12.9%	13.8%	11.3%	5.5%	16.2%	10.1%	16.6%	13.2%	20.6%	19.2%	17.4%	14.3%	15.7%	12.5%	14.6%
Military service	96	0	57	0	43	0	59	2	37	0	32	0	324	2	326
	31.0%	0.0%	23.9%	0.0%	13.4%	0.0%	18.2%	1.2%	16.6%	0.0%	13.3%	0.0%	19.5%	0.2%	12.5%
Housekeeping	2	23	0	26	0	43	0	32	0	23	0	17	2	164	166
	0.6%	15.1%	0.0%	17.8%	0.0%	22.8%	0.0%	19.2%	0.0%	17.7%	0.0%	10.6%	0.1%	17.4%	6.4%
Other service industry	21	10	11	7	16	13	14	6	8	3	13	14	83	53	136
	6.8%	6.6%	4.6%	4.8%	5.0%	6.9%	4.3%	3.6%	3.6%	2.3%	5.4%	8.7%	5.0%	5.6%	5.2%
Students	11	12	6	10	7	11	25	6	7	6	7	11	63	56	119
	3.5%	7.9%	2.5%	6.8%	2.2%	5.8%	7.7%	3.6%	3.1%	4.6%	2.9%	6.8%	3.8%	5.9%	4.6%
Confirmed Cases	310	152	238	146	321	189	325	167	223	130	241	161	1658	945	2603

Note: the occupational data of confirmed cases within 2001 to 2004 is incomplete and therefore not included.

Table 4. Statistics of Main Clinical Symptoms of Confirmed Taiwan Scrub Typhus Cases, 2004-2010

Main Symptoms	2004	2005	2006	2007	2008	2009	2010	Total
Fever	314 (85.1%)	414 (89.6%)	343 (89.3%)	471 (92.4%)	467 (94.9%)	320 (90.7%)	373 (92.8%)	2702 (90.9%)
Headache	80 (21.7%)	104 (22.5%)	71 (18.5%)	142 (27.8%)	143 (29.1%)	117 (33.1%)	140 (34.8%)	797 (26.8%)
Eschar	37 (10.0%)	56 (12.1%)	75 (19.5%)	130 (25.5%)	191 (38.8%)	132 (37.4%)	157 (39.1%)	778 (26.2%)
Red rash	51 (13.8%)	56 (12.1%)	57 (14.8%)	84 (16.5%)	100 (20.3%)	66 (18.7%)	106 (26.4%)	520 (17.5%)
Lymphadenopathy	20 (5.4%)	20 (4.3%)	24 (6.3%)	26 (5.1%)	52 (10.6%)	34 (9.6%)	36 (9.0%)	212 (7.1%)
Fatigue	2 (0.5%)	2 (0.4%)	0 (0.0%)	11 (2.2%)	18 (3.7%)	11 (3.1%)	17 (4.2%)	61 (2.1%)
Rash	8 (2.2%)	9 (1.9%)	5 (1.3%)	13 (2.5%)	13 (2.6%)	3 (0.8%)	3 (0.7%)	54 (1.8%)
Body Pain	6 (1.6%)	8 (1.7%)	5 (1.3%)	9 (1.8%)	4 (0.8%)	3 (0.8%)	3 (0.7%)	38 (1.3%)
Chills	5 (1.4%)	4 (0.9%)	5 (1.3%)	5 (1.0%)	10 (2.0%)	2 (0.6%)	4 (1.0%)	35 (1.2%)
Abdominal Pain	3 (0.8%)	1 (0.2%)	1 (0.3%)	5 (1.0%)	5 (1.0%)	5 (1.4%)	9 (2.2%)	29 (1.0%)
Number of Confirmed Cases	369	462	384	510	492	353	402	2972

Note: the main clinical symptoms data of confirmed cases within 2001 to 2003 is incomplete and therefore not included.

Discussion

Statistic data shows, the number of reported scrub typhus cases, confirmed cases, and incident rate per 10 thousand has increase during the years between 2001 and 2010. This may be due to the preventive efforts of health units in enhancing public health knowledge, issuing warnings before trend seasons, and holding scrub typhus diagnosis and treatment training for practitioners, which has lead to the elevated awareness of physicians and public to scrub typhus.

During the years between 2001 and 2010, the majority of scrub typhus onset months were concentrated in the months between May and November. In April and May, the number of cases starts to show rapid increase and reach its peak in July; a second peak is reached in September and October. The activity of chiggers is related to the temperature and humidity of its environment, with temperature as the main factor [9]. This may be due to the high temperatures in July and August which reach approximately 29℃, leading to the decrease in chigger activity; whereas the temperature starts to decline in September and October, which is more suitable for the chigger growth [10]. The majority of the cases were distributed in outlying counties or the Eastern area of Taiwan where the population is sparse; it is worth noting that, under calculation of incident rate per 10 thousand people, the counties with higher incident rate are those outlying counties, these include Lienchiang county, Kinmen county, and Penghu county, whereas on Taiwan island,

Taitung and Hualien county has higher rates; showing not much difference from the early 1990s [7]. Due to the fact that chiggers appear throughout the year in Taiwan and reach its peak in the summer season [11], engaging in outdoor activities in high scrub typhus areas, may lead to a risk of being bitten by a chigger and contracting this acute jungle fever. Scrub typhus and chiggers have a distinct relevance; therefore, changes in environment or climate usually has a significant impact on vector transmitted diseases [12-13]. There are many factors that affect the number of scrub typhus cases, yet the main four factors that cause scrub typhus are as following: suitable environment, *O. tsutsugamushi*, the coexistence of chiggers and rodents, among these, the environment factor is most relevant in the numbers and distribution of chiggers and rodents [13].

Infection of scrub typhus is not limited to any certain gender or age, and according to the data from 2001 to 2010, the number of males infected is approximately twice of females; the incident age spans are mostly concentrated in adults above 20 years of age with the majority within the age spans of 20 to 29, 40 to 49, and 50 to 59 years of age; male cases within this age span account for 66.5%, among of which military service men account for 17.8%, this may be due to the fact that most of the men in this age span often engage in military service, outdoor, or mountainous work. In addition, statistics of the occupations of confirmed cases show those in military service or engaged in agriculture-related fields of work which come in more contact with bushes and shrubbery have higher infection numbers.

In 2005, an 8-year-old aboriginal girl’s death occurred in Taitung. This case sought medical assistance twice during the onset of the disease at a clinic, however, the symptoms persisted and she was sent to Y hospital, but was misdiagnosed with appendicitis, and had her appendix removed. After the surgery, eschars were found on her body and she was emergently transferred to X general hospital where the case was reported as scrub typhus, yet the case died the following day. If diagnosis of scrub typhus is delayed with unsuitable treatment, it may lead to serious complications and death; therefore, it is extremely important to remind the public to seek medical assistance as soon as possible after possible scrub typhus symptoms appear and report medical history to practitioners for diagnosis reference. Practitioners should also be alert to suspicious scrub typhus symptoms shown in patient, for early detection and treatment in time.

For clinical symptoms of confirmed scrub typhus case investigation, 28.6% showed headaches and 26.2% showed eschars. In addition, according to articles by Lai, C.H. and Jim, W.T., headaches account for approximately 62-80% of clinical symptoms shown in Taiwan scrub typhus cases, whereas eschars account for approximately 23-67% [14-15]; the difference in the numbers may due to clinical experience of practitioners or the completeness of related epidemic investigation data. In addition, eschars are not unique clinical symptoms of scrub typhus; diseases such as ecthyma gangrenosum may also show eschars. According to the data of reported cases, reports of scrub typhus by practitioners has

significant increase; however, eschars are hard to discover and clinical diagnosis is difficult; thus, strengthening the education and training of physicians and asking them to ask for travel histories from fever patients will aid in early diagnosis of scrub typhus.

Among imported cases, most are brought into the country from Mainland China with 31.6% (6/19). Those who travel between the two countries or to high scrub typhus risk areas are advised to be vigilant and pay attention to scrub typhus prevention. Countryside or mountainous regions are grassy environments where chiggers are likely to grow, and when entering such areas for travel or engaging in activities, it is advised to wear long sleeved clothing, pants, high boots, gloves, and other such protective garments, applying Department of Health approved repellent agents, shower as soon as possible after leaving the area, and changing all of the clothing can reduce the chance of contracting scrub typhus.

Summer is the epidemic season for scrub typhus; humans infected with scrub typhus may show mild symptoms or may delay treatment and lead to death. People should take protective measures when engaging in outdoor activities and should seek medical attention as soon as possible scrub typhus symptoms appear. Practitioners should also inquire the travel history of fever patients to assist with early diagnosis of scrub typhus and avoid delaying treatment in time.

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References

1. Seong SY, Choi MS, Kim IS. Orientia tsutsugamushi infection:Overview and immune responses. Microbes and Infection 2001;3(1):11-21.
2. Cho NH, Seong SY, Huh MS, et al. Expression of chemokine genes in murine macrophages infected with Orientia tsutsugamushi. Infect Immun 2000;68(2):594-602.
3. Chinese Society of Comparative Pathology, the Infectious Diseases Society of Taiwan, Infection Control Society of Taiwan, et al. A Clinical Guide to Zoonoses. Second Edition. Taipei: Taiwan CDC,2009;192-4.
4. Chen CC, Juan CJ, Juan CW, et al. Multi-organ dysfunction caused by scrub typhus initially misinterpreted as acute tonsillitis. Journal of Emergency and Critical Care Medicine 2007;18(4):161-6.
5. Wang CC, Liu SF, Liu JW, et al. Acute respiratory distress syndrome in scrub typhus. Am J Trop Med Hyg 2007;76(6):1148-52.
6. Yang SH, Ho YH, Chu CH, et al. Childhood scrub typhus in eastern Taiwan: Ten-year experience from a medical center. Acta Paediatrica Taiwanica 2007; 48(6): 332-6.

7. Lee SF, Tsai SF, Shih CH, et al. Tsutsugamushi Disease in Taiwan, 1993. Taiwan J Public Health 1995;14 (4):334-41.
8. Taiwan CDC. Quarantine zone - definition of cases of infectious diseases - scrub typhus. Available at: http://www.Cdc.Gov.Tw/lp.Asp?Ctnode=2415&ctunit=1404&basedsd=7&mp=1.
9. Kuo CC, Huang JL, Ko CY, et al. Spatial analysis of scrub typhus infection and its association with environmental and socioeconomic factors in Taiwan. Acta Trop 2011; 120(1-2):52-8.
10. Van Peenen PF, Lien JC, et al. Correlation of chigger abundance with temperature at a hyperendemic focus of scrub typhus. J Parasitol 1976;62(4):653-4.
11. Lu HY, Tsai KH, Yu SK, et al. Phylogenetic analysis of 56-kda type-specific antigen gene of Orientia tsutsugamushi isolates in Taiwan. Am J Trop Med Hyg 2010;83(3):658-63.
12. Patz JA, Daszak P, Tabor GM, et al. Unhealthy landscapes: Policy recommendations on land use change and infectious disease emergence. Environmental Health Perspectives 2004; 112(10):1092-8.
13. Wang HC, Kuo CC. Ecological determinants of distribution and abundance of larval trombiculid mites, and establishment of mathematical models to predict scrub typhus incidence. Centers for Disease Control: 2007 Technology Research and Development Program Annual Report.
14. Lai CH, Huang CK, Weng HC, et al. The difference in clinical characteristics between acute Q fever and scrub typhus in southern Taiwan. Int J Infect Dis 2009;13(3):387-93.
15. Jim WT, Chiu NC, Chan WT, et al. Clinical manifestations, laboratory findings and complications of pediatric scrub typhus in eastern Taiwan. Pediatr Neonatol 2009;50(3):96-101.

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