

Possible Impacts of Nanoparticles on Children of Thai Construction Industry

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Abstract. A possible impact of nanoparticles on human health becomes a concerned issue especially among children who probably lack of self protection. For Thai construction workers, their pre-school children are more likely to expose such the fine particles due to they have to spend their lives in construction site. This study points out the health problems related to nanoparticles exposition among pre-school children of Thai construction workers. The finding indicated that children who reside and play in construction site are more likely to expose to chemical particles and left behind toxic materials during pre and post construction process than others. Thus, urgent policy is strongly recommended for this vulnerable group since all children are very important as the main source of the national productivity in the future, especially in the aging society.

1 Introduction

Thailand is a developing country in which most population work in agricultural sector. Since 1962, Thailand launched the first National Economic Development Plan which provided the country and people to enjoy with economic growth. An influence of economic growth for Thailand is urbanization. The extension of cities, especially the capital; Bangkok, has pulled a lot of unskilled labors from rural areas to work in many sectors including construction sites [1]. Urban sprawl is still going along with urbanization pulling more and more number of rural people to work in construction industry. Almost 2 million rural-urban migrants in Thailand participate in the construction industry and these majority workers are unskilled

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[2]. Normally, these workers are vulnerable groups of people due to they are low or uneducated as well as having no power to ask for safe health condition in working site.

As we all know that technological change is one condition for keeping economic growth for any country. Among new technologies that is releasing from their laboratory to the market, nanotechnology is an outstanding technology that most scholar expected to change the globalized industry [3]. With technological change, a coming up of nanomaterials in Thai construction industry generates the higher quality buildings as well as the higher number of industry's benefit. The construction companies can save their cost with more powerful nanomaterials. Nowadays, there are some estimation from National Nanotechnology Center, Ministry of Science and Technology that it is about more than 100 nanoproducts in Thai construction industry [4]. Anyway, any changing of innovation is significantly needed new matching skill and proper knowledge to deal or apply with due to the new one always comes with both benefit and harmful effects, especially the very tiny particle of nanomaterials.

In fact, the terms "nanotechnology" or "nanoproduct" is known only among the well-to-do people due to they have strong potentiality to access information. But for those 2.0 million workers who are low educated and work for little earning in construction business, nanotechnology or nanoproduct is meaning nothing. The harmful effects and possible consequences of nanoparticles on biological systems are mentioned in many various forums. The very large surface area of ultra-small particles can result in the direct generation of harmful oxyradicals (ROS): these can cause cell injury by attacking DNA, proteins and membranes [5]. Furthermore, the ability of the nanoparticles to penetrate the body and cells (e.g., via skin and respiratory system) is possible. A study of T.K.Joshi in the topic on Impact of Nanotechnology on Health mentioned that nanotechnology is likely to become a source for human exposures by different routes: inhalation (respiratory tract), ingestion, dermal (skin) and injection (blood circulation) [6]. In addition, even few studies done to investigate the pulmonary toxicity of nanoparticles in rats but their result showed that lung exposures to ultrafine or nanoparticles produce greater adverse inflammatory and fibrotic responses when compared with larger-sized particles among rats [7].

As far as one concerns, there are about 200,000 workers working in construction sites in Bangkok and periphery. These workers have about 400,000 children aged 0-3 years old on average who are allowed to play and do their activities in construction sites and nearby areas. These children are accepted as one of the vulnerable groups due to they have no ability to protect themselves from unseen toxic particles. So it is believed that they have more chance to expose toxicity available in nanoproducts applied in the sites more than other children in the older ages and of other occupations.

The paper is intended to examine possible health impact of nanoparticles available in environment among pre-school age children of construction workers in construction sites in Bangkok and periphery aimed to point out the possible bad

effect to those who are vulnerable groups. Finding of the paper will be beneficial for concerned agencies to take more action for dealing with unseen upcoming toxicity. We also set up the hypothesis that there are some positive relationship of lower respiratory symptom and skin symptom that caused from unspecific particle among preschool children in construction site.

2 Methodology

As Nakorn Pathom is a one of fifth migration destination especially for Northeastern construction worker due to number of increasing in construction area. Data for analysis are collected from Puttamonthon hospital, a district hospital located in Nakornpathom province; a suburb province of Bangkok in 2007. Child patients in preschool ages (aged 0-3 years old) are studied comparing with those 4- 12 years old who face with suspected respiratory symptoms and 0-3 years old child patients are studied and compared with those aged 4-60 years old who face irritation skin. Besides, the data was selected by consideration on climate effect that all cases only selected from summer time (April to July) that will reduce some effects from patient who might get cold because of season change during rainy and winter times.

Table 1 Availability of variables

Variables	Respiratory symptom	Skin irritation
Dependent variable		
- facing with respiratory symptom	0= upper respiratory symptom 1= suspected respiratory 2= lower respiratory symptom	0= other skin symptoms 1= suspected symptoms
Independent variable		
- sex	0= female 1= male	0= female 1= male
- age	0= 4-12 years old 1= 0-3 years old	0= 4-60 years old 1= 0-3 years old
- parents' occupation	0= not work/live in construction site 1= work/live in construction site	0= not work/live in construction site 1= work/live in construction site
- medical expense for 0-99 baht	0= pay more than 99 baht 1= pay 0-99 baht	0= pay more than 99 baht 1= pay 0-99 baht
- medical expense for 100-199 baht	0= pay more 199 or lower than 100 baht 1= pay 100-199 baht	0= pay more 199 or lower than 100 baht 1= pay 100-199 baht
- medical expense more than 200 baht	0= pay less than 200 baht 1= pay more than 200 baht	0= pay less than 200 baht 1= pay more than 200 baht

For respiratory symptom, Multinomial logistic regression is employed for data analysis due to dependent variable composes of being upper respiratory symptom, suspected respiratory and lower respiratory symptom. Concept for dividing the respiratory symptoms into above 3 groups is from “type J” symptom and disease identified by International Classification of Disease (ICD-10) which shows diseases of clear cause and some unclear. For those symptoms and diseases of unclear causes, as we assume them partly occurring from nanoparticles. For skin irritation, Binary logistic regression is employed for data analysis due to dependent variable is categorized as dummy variable of 0= being other skin symptoms and 1= being suspected symptoms. As same as the respiratory grouping concept, ICD-10 in “type L” is applied for grouping vivid cause of diseases and those of unclear one. Details of variables are shown in table 1 above.

3 Results and Discussion

3.1 Respiratory Symptoms

According to the assumption that child patients who their parents are construction workers being more likely to expose toxic nanoparticles than those of other occupations. Thus, table 2 below is basically designed for expressing the number of samples identified by their parents’ occupations.

Table 2 Parents’ occupation of child patients identified by types of symptom

Symptom	Living condition		Total
	Not work/live in construction site	Work/live in construction site	
Upper respiratory	127 (29.3)	306 (70.7)	433 (100.0)
Suspected	135 (51.5)	127 (48.5)	262 (100.0)
Other lower respiratory	26 (47.3)	29 (52.7)	55 (100.0)
Total	288 (38.4)	462 (61.6)	750 (100.0)

3.2 Finding on Respiratory Symptom

Table 3 presents results from multivariate analysis, which is mainly conducted to examine parents’ occupation of construction worker on children’s respiratory problem with nanoparticles dispersed in construction site. The coefficients in the form of odds ratios are presented. An odds ratio greater than 1 indicates that the independent variable increase the log odds, all else being equal, while odds ratio less than 1 indicates that the independent variable decreases the log odds. Results are discussed as follow.

The first contrast shows the log odds of being suspected symptom relative to being upper respiratory symptom among child patients. It appears that age has positive effect to child patients' probability of being suspected respiratory symptom, given that the child is upper respiratory symptom. Compared to a child who aged 4-12, the log odds of a child aged 0-3 years old on being suspected respiratory symptom versus being upper respiratory symptom is about seven times more. Result shows that the younger children are more likely to get risk than those of older age children due to the younger they are the lower protection they have. Interestingly, compared to a child who his/her parents do not working or living in construction site, the log odds of a child whose being suspected respiratory symptom is reduced by 84 per cent, given that a child of construction-worker parents. With this finding, it means that toxicity can be found everywhere and it can expose to children no matter whether children live or play in construction site or not.

Table 3 Odd ratios of respiratory symptoms among child patients

Independent variables	Suspected symptom		Other lower respiratory		Other lower respiratory vs. Suspected symptom	
	vs. upper respiratory		vs. upper respiratory			
Age of child patients						
- Patient age 4-12 (ref.)						
- Patients age 0-3	7.360**	(0.217)	2.080*	(0.332)	0.283***	(0.340)
	*					
Sex						
-Female (ref.)						
-Male	0.751	(0.179)	3.873***	(0.384)	5.155***	(0.393)
Parents' occupation						
-Not work/live in construction site (ref.)						
-Work/live in construction site	0.160**	(0.217)	0.347**	(0.329)	2.171*	(0.338)
	*					
Medical expense						
> 200 baht (ref.)						
0-99 baht	0.669*	(0.193)	3.205**	(0.387)	4.790***	(0.402)
100-199 baht	5.344*	(0.329)	17.533***	(0.486)	3.281**	(0.460)
Constant	0.716	(0.205)	0.025***	(0.502)	0.035***	(0.510)
Model chi2	231.44					
Df	10					
N	750					
p-value	0.000					

*** p < 0.001, ** p < 0.01, * p < 0.05

For making clear of finding, simulation is employed for showing the level of being suspected respiratory symptom among child patients. In terms of parents' occupation, there are about 22% of children of construction worker being suspected respiratory symptom compared with 52% of children of other occupations. The result from simulation through adjusted proportional distribution technique shows similar finding with multinomial logistic regression technique which confirms that toxic substance can harm children even they are in construction site or not.

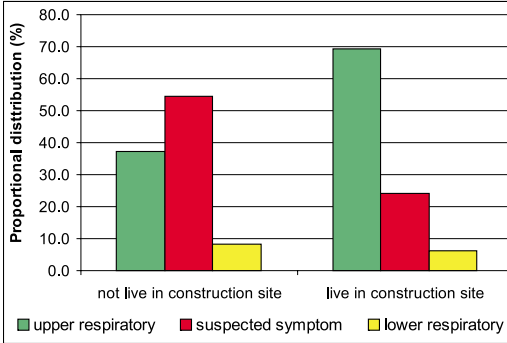


Fig. 1 Proportional distribution for being respiratory symptoms between children of construction worker and children of other occupation

3.3 Skin irritation Symptoms

This part is done under the hypothesis that child patients whose their parents are construction workers being more likely to expose toxic nanoparticles than those of other occupations. There was a study done to evaluate whether metallic nanoparticles smaller than 10 nm could penetrate and permeate the skin. This study found that nanoparticles were able to penetrate the hair follicle [8]. Thus, skin irritation from unclear cause might be one symptom relating to toxic exposing.

3.4 Finding on Skin Symptom

Table 4 presents results from binary logistic regression analysis, which is mainly conducted to examine parents' occupation of construction worker on children's skin problem with nanoparticles dispersed in construction site. *Model 1*, the first model shows that patients who live in construction site are 2.5 times more for being suspected skin symptom. In *Model 2*, two independent variables covering age of patients and sex are added into the model and finding shows that a person living/working in construction site is 2.6 times more for being suspected skin symptom. More interestingly, compared with patients aged 4-60 years old, pre-school

patients are three times more for being suspected skin symptom. The last model (*Model 3*) shows that medical expense directly relates with being suspected skin symptom as patients who pay 0-99 baht and 100-199 baht are 12 times and 4 times more for being suspected skin symptom than those who pay more than 200 baht. This finding means that suspected skin symptom is more likely to appear in low income people than those of higher income. Even this finding might be concrete, but it can tell us who are more likely to be victim if nanoparticle can generate unpredictable harmful effect.

Table 4 Odd ratios of suspected skin symptoms among patients

Variable	Model1	Model2	Model3
Constant	0.688*** (0.105)	0.909 (0.153)	0.229*** (0.238)
Not live in construction site (ref.)			
Live in construction site	2.543*** (0.164)	2.66*** (0.170)	2.774*** (0.188)
Patient age 4-60 (ref.)			
Pre-school patients (0-3)		3.092*** (0.262)	1.401 (0.294)
Female (ref.)			
Male		0.470*** (0.170)	0.557** (0.186)
Medical expense > 200 baht (ref.)			
Medical expense 0-99 baht			12.299*** (0.272)
Medical expense 100-199 baht			4.832*** (0.225)
Model chi2	33.40	77.20	183.37
Df	1	3	5
N	650	650	650
p-value	0.000	0.000	0.000

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

4 Conclusions

Even though this study is done under nano-related information constrain, but it is a starting point for the next step of studying the effect of nanotechnology on people in society, especially for vulnerable people like pre-school aged children. These children have no power to out-cry as well as no chance to protect their rights themselves. Thailand is going to be aging society which means that the number and quality of children is very important for running the country development further.

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