

# Environmental risks for respiratory, diarrhoeal and skin diseases in six Pohnpeian villages

JAMES YAINGELUO, DCHM&S \*

## Abstract

To explore the environmental risk factors related to respiratory, skin and diarrhoeal disease, an environmental survey was conducted between May–June 1996, in 6 small rural villages near each other in Kitti in the Federated States of Micronesia (FSM). A questionnaire was used to survey the houses and the environment around the households.

A total of 109 houses were in the study with a total population of 693 people living in this area. The following were observed: the average household had 6 people; 96 of the 693 individuals smoked cigarettes; the source of drinking water was the river for 63.3% of households, with another 18.3% from deep wells and 17.4% from roof catchment; 24-hour running water was available in 78.0% of the households; 80.7% of the households had electricity; the type of toilet facilities were 51.4% pit latrine and 37.6% water seal toilets, 67.9% of the households had a septic tank; 52.4% of houses had adequate screening; 62.4% sometimes used bug repellent with another 23.9% never using any bug repellent; and 69.7% houses had more than 5 potential mosquito breeding sites.

This study shows that a number of environmental conditions contribute to respiratory, diarrhoeal and skin diseases. Of particular concern are the high number of people in each household, the number of open pit latrines, water without boiling or chemical treatment used for drinking, and the number of households which never use bug repellent even when the houses are without screening. These results suggest that environmental risk factors may be the problem.

\* Staff Intern Physician, Pohnpei State Hospital, Kolonia, Pohnpei, Federated States of Micronesia. This article was a self directed research project when the author was a student at the Pacific Basin Medical Officers Training Program.

The results of this study are likely to be found in many of the rural areas in Pohnpei.

## Introduction

In developing countries respiratory, diarrhoeal, and skin diseases like scabies and impetigo persist, especially in children, because of poor environmental sanitation. Many human infections are spread through inadequate sanitation, where water is not boiled and toilets are open to the environment, allowing viruses, bacteria, and other pathogens to spread through direct contact or indirectly via food, water, soil or other vectors<sup>1</sup>. WHO recognizing the significance of these, through the Thirty-first World Health Assembly in May 1978, called for a concerted attack on the diarrhoeal diseases as part of a global commitment to primary health care and "health for all by the year 2000."

**"This study shows that a number of environmental conditions contribute to respiratory, diarrhoeal and skin diseases."**

The major strategies being promoted for the control of diarrhoeal diseases, are:

- maternal and child care practices for the prevention of diarrhoeal diseases; and
- better environmental health practices, especially

the proper use and maintenance of drinking water and sanitation facilities that have been designed to conform to the needs and practices of the local population.

## Problem statement

According to a previous report on infant morbidity and mortality, Kitti was a problem area without an adequate explanation<sup>2</sup>. From personal experience in Wone Dispensary and Pohnpei State Hospital, Kitti residents seem to utilize the health services more than residents from other municipalities. Respiratory, diarrhoeal and skin diseases like scabies and impetigo continue to be common complaints and are consistently represented among the five leading causes of morbidity each month within Pohnpei<sup>3</sup>. Kitti municipality is far from town where health services and stores are located and is considered to be a rural area. People in this area are considered to be of a lower economic class compared to those in Kolonia. The quality of houses are poor and most of the houses lack insect screening.

Six small villages, Kipar, Rohngkitti, Enpein Pah, Peil, Pwok and Nanmand are set in the middle of Kitti and are located between two health service sites the Wone dispensary and

the Kolonia dispensary. These 6 villages were chosen because of their poor access to health services. The living standard in this rural area is poor and government support services are negligible. In Kitti there has been no environmental study to determine the environmental risk factors for the respiratory, diarrhoeal and skin diseases.

The basic question which this study addresses is what are the major environmental risk factors that contribute to the respiratory, skin and diarrhoeal diseases seen in Kitti. The results would help improve the level of public health and sanitation activities through focused programs of prevention.

## Literature review

Health promotion and disease prevention are known to be a matter requiring participation and cooperation of the whole community, a central concept of primary health care<sup>4</sup>. If hygiene is poor (as judged by housing, water supply, and disposal of excreta and rubbish), then illness will be common in all age groups, especially among children. For example, overcrowded houses contribute to the spread of TB and other respiratory infections<sup>4</sup>.

Environmental influences on health can be classified in various ways. Some are due to problems with air, food, water and soil; or secondary to factors relating to the home environment<sup>4</sup>. Many infections in humans are spread through inadequate sanitation. Viruses, bacteria, protozoa and worms may spread through direct contact, indirectly via contaminated food, water and soil or via other vectors<sup>5</sup>.

A poor water supply results in children developing various skin diseases and diarrhea. An absence of covered pit latrines, or failure to use them means that the ground will be soiled with stool, leading to the easy spread of diseases. Poor disposal of rubbish will lead to an increased fly and mosquito population and the likelihood of the spread of diarrhoeal disease and other infections<sup>5</sup>.

WHO has as one of its goals the provision of adequate water supplies and sewage systems throughout the world by 1990<sup>7</sup>. River and lake water contaminated with raw sewage is often responsible for continuous exposure to diseases. Deep wells and roof collection, if properly maintained, are considered to be the best<sup>8</sup>. Also, an inadequate supply of fresh water for bathing will contribute to common skin diseases.

In Tahiti, mosquito breeding sites, such as empty bottles, cans, and coconut shells were cleared for about 100 feet

around every household to help prevent mosquito-borne diseases. As housing standards improve, mosquito-proofing measures such as screening on windows and doors are incorporated<sup>7</sup>.

Developing populations are young and young children are often the most exposed to the ground, the dirt, and contamination in the environment<sup>8</sup>. The building of well designed, covered pit latrines is inexpensive, efficient and acceptable. While well designed pit latrines are good, water seal toilets provide even better protection from fecal transmission by flies. The provision of properly constructed pit latrines or water seal toilets, and education in their proper usage and maintenance are crucial to the control of diseases<sup>1, 6</sup>.

**“ Respiratory, diarrhoeal and skin diseases like scabies and impetigo continue to be common complaints and are consistently represented among the five leading causes of morbidity each month within Pohnpei. ”**

In developing countries, acute respiratory infection (ARI) is the most frequent type of self-limiting childhood illness as well as a leading cause of death. It seems that factors such as indoor fire and overcrowding may play a role in the morbidity and mortality due to ARI. Smoking around children is clearly

a major risk factor contributing to ARI in children<sup>8, 15</sup>.

## Goals and objectives

The goal of this project was to determine the prevalence of environmental risk factors contributing to respiratory, skin and diarrhoeal diseases in Kitti. This study would provide information needed for the planning of prevention programs.

The specific objectives of this study were to determine within this study area:

- the village populations,
- the number of households,
- the source of water for households,
- the number of smokers per households,
- the type of toilet facilities for households,
- the availability of electricity,
- the number of households with roaming animals,
- the frequency of indoor fires used in households,
- the frequency of mosquito breeding sites, and
- the frequency of measures used in households to limit contact with mosquitos (eg. screening, insect repellent).

## Methodology

This is a descriptive cross-sectional study of six small villages in Kitti; Kapar, Pwok, Peil, Rohngkitti, Enipein Pah and Nanmand. These villages are home for a rural population of relatively low socioeconomic status. This study was conducted between May and June 1996.

**Study population:** The target population was chosen based on the high prevalence of infant morbidity and mortality user

of the local dispensary. Prior to the survey, the participants were informed about the study and given the right to withdraw from the study at any time. The participants were assured that confidentiality would be protected. Prior to the survey, mapping of the houses was updated and all vacant households were eliminated from the survey.

**Questionnaire:** The questionnaire was reviewed and approved by PBMOTP faculty and tested twice prior to the study. All questionnaires were written in English. Families who could not understand English, the author asked the questions in Pohnpeian.

**Data Collection:** The head of the household was interviewed and the investigator completed the environmental survey of the house. For some of the households, especially on weekends, the head of the household was absent during the first visit; whereupon, an appointment was made to catch them when they were home. All of the households targeted were interviewed and surveyed.

**Statistical Analysis:** Statistical analysis was performed using EPI Info (version 6) software. Two by two tables with Chi square and p-value calculations were used to demonstrate associations between certain variables. Analysis of variance (ANOVA) calculations were made to analyze differences in mean values of certain variables, and differences between proportions were analyzed with Chi square. Results were considered to be significant if the p-value was less than 0.05.

## Results

A total of 109 houses and 693 individuals were included in the environmental survey study from May-June 1996. The average number of individuals per household was 6 with a range from 1-17. Figure 1 shows the number of people per household. Figure 2 shows the age distribution.

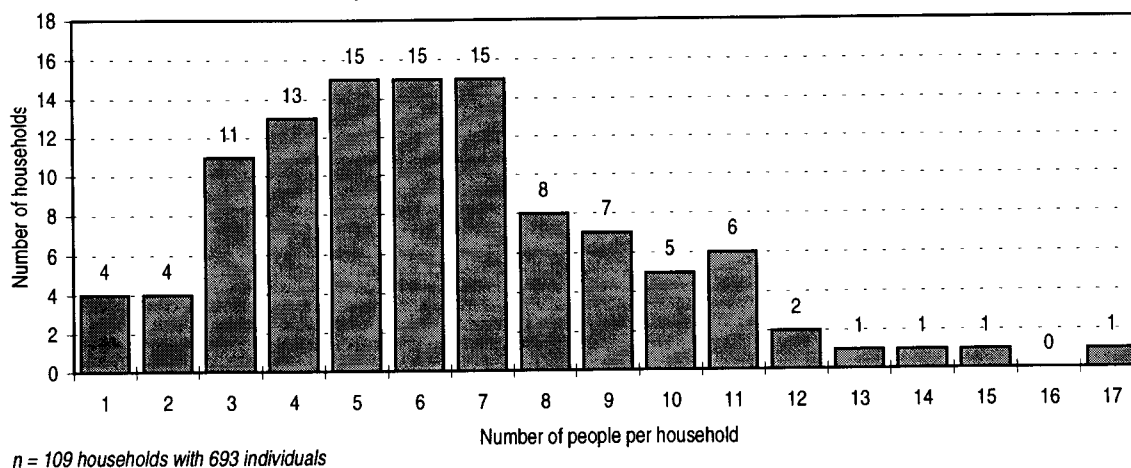
The main source of drinking water for (69) 63.3% of the households was from the rivers. These houses have a water pipe that joins them to the main pipe that comes from the river. Figures 3 and 4 shows the main source of water and the availability 24 hour running water. Households with 24-hour running water from their source (e.g. river, roof catchment) is 78%. A similar proportion of households, 80.7%, reported the availability of 24-hour electricity.

Seventy-three households (67%) reported that they never boil their drinking water and all but 1 of the 109 households reported that they never treat their drinking water with chlorine or bleach. The proportion of those with and without electricity who boiled their water for drinking was analyzed. Table 1 shows the relationship between the availability of electricity and the practice of boiling drinking water. This indicates that households who boil water have a 74% greater likelihood of having electricity as compared to households that do not boil water.

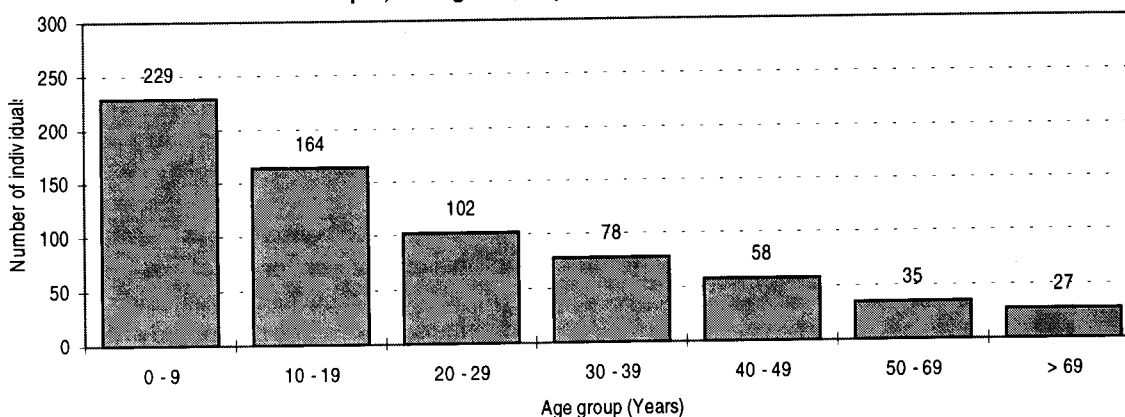
A significant relationship between the use of an indoor fire and the practice of boiling drinking water. Table 2 shows the relationship between the use of an indoor fire and the practice of boiling drinking water. The households which boil water have more than a 4 times greater likelihood of using indoor fires than do households that do not boil water. This strongly suggests that the use of an indoor fire is more likely to lead to boiling of drinking water than having electricity in the house.

Figure 4 shows the type of toilet facilities in the households surveyed. It should be noted that the majority of homes still use open pit latrines. Many of these pit latrines were open to flies, with no screen or door. About 38% of the households have a water seal toilet and 67.9% of these had septic tanks. One household reported the use of a "sewer system", this was most likely to be the use of a septic tank.

**Figure 1. Number of people in a household.**  
Kapar, Rohng Kitti, Enpein Pah, Nan Mand Kitti



**Figure 2. Number of people by age group.  
Kapar, Rohng Kitti, Enpein Pah, Nan Mand Kitti**



*n* = 109 households with 693 individuals

Indoor fires were reported to be used in 57 (52.3%) of the 109 households. Sixty-two (56.9%) of 109 households reported a total of 96 smokers, representing 13.8% of the 693 individuals. Thus, the majority of households had at least one cigarette smoker. The average number of cigarette smokers per household with any smokers was approximately 2.

It was observed that 1/2 of the households (54 of 109) had adequate screening. 85 of 109 households (78%) were observed to have the nearest body of stagnant water greater than 200 feet from the house. However, other potential breeding sites for mosquitos were quite common. Only 4 of 109 households (3.7%) had no potential mosquito breeding sites within 100 feet of the house. 29 of 109 households (26.6%) had 1 to 5 potential breeding sites, and 76 of 109 households (69.7%) had more than 5 potential breeding sites within 100 feet of the house.

Table 3 shows the number of mosquito breeding sites near the home as related to the presence of screening. Table 3 indicate that households with less than 6 potential mosquito breeding sites have a 59% greater likelihood of having screening as compared to households that have more than 5 potential mosquito breeding sites.

Another factor affecting mosquito-borne disease is the use of bug repellent. 26 of 109 households (23.9%) indicated that they never use bug repellent. Table 4 shows the data comparing the use of bug repellent relative to the presence of screening. Households which use bug repellent have over a 2 times greater likelihood of having screening as compared to households which do not use bug repellent.

In regards to the animals in this area, 69.7% of the households reported that they kept pigs and that they were almost always kept in a pen. 73.0% of the households with pigs kept them more than 20 feet from the house. Additionally, 70.0% of the households reported that they own dogs.

### Discussion

In developing countries, children's vulnerability relates to their environmental surroundings. Thus, unless environmental sanitation is adequate, disease will occur. Diseases such as respiratory tract infection, diarrhoeal and skin diseases like scabies and impetigo are among the most common causes of morbidity.

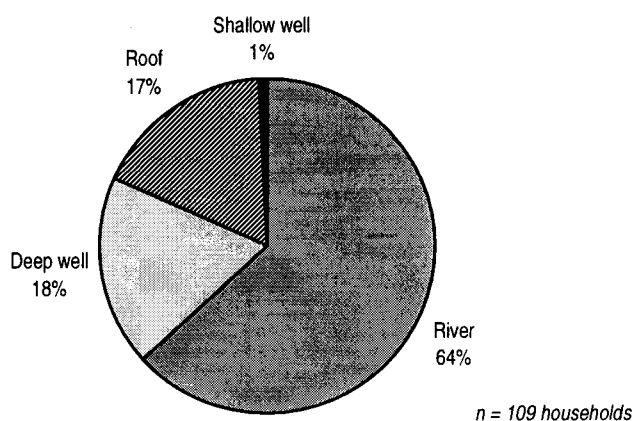
This survey attempted to look at several risk factors related to the development of respiratory, diarrhoeal and skin diseases and to determine the degree to which they existed in

**Table 1. Availability of electricity vs. boiling water for drinking**

		Boiling of water for drinking		
		Yes	No	Total
Electricity	Yes	31	57	88
	No	5	16	21
	Total	36	73	109

*Odds Ratio = 1.74, Confidence Interval = 0.53, 6.05  
Chi square = 1, p value = 0.32*

**Figure 3. Sources of drinking water.**  
**Kapar, Rohng Kitti, Enpein Pah, Nan Mand Kitti**



these 6 small rural villages in Kitti. The assumption was that poor sanitation and an over-crowded household can contribute to these environmentally related diseases.

Because of the design of this study, which does not include a control group, and does not provide for any measure of disease prevalence, it is not possible to make definitive conclusions as to cause and effect. However, knowledge regarding the impact of environmental surroundings on health, suggests that an approach of introducing primary

health preventive programs might help prevent certain health problems.

By observation, the living standards in Kitti would be considered economically poor. Many of the houses were locally made with a thatched roof. Among the few concrete houses, some of them either had broken or otherwise missing windows. All thatched roof houses were open without walls but inside they were clean and tidy. Overall a appropriately 1/2 of the houses had inadequate screening. The mean and

**Table 2. Use of an indoor fire vs. boiling water for drinking**

		Boiling of water for drinking		
		Yes	No	Total
Indoor fire	Yes	27	30	57
	No	9	43	52
Total		36	73	109

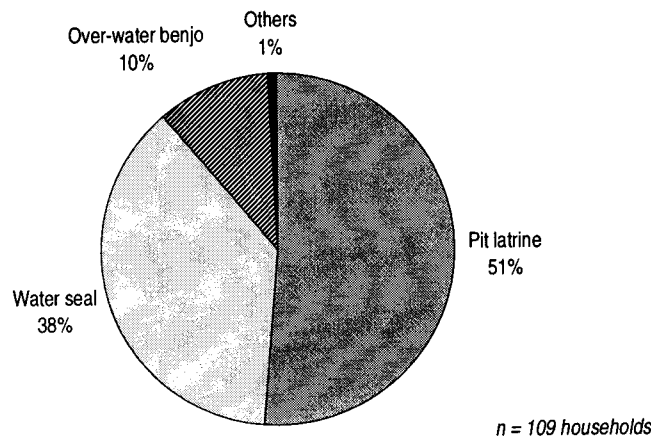
*Odds Ratio = 4.30, Confidence Interval = 1.64, 11.55*  
*Chi square = 11.11, p value = 0.0009*

**Table 3. Number of houses with screens vs presence of mosquito breeding sites**

		Number of breeding sites		
		<=5	>5	Total
Screen	Yes	19	35	54
	No	14	41	55
Total		33	76	109

*Odd Ratio=1.59, Confidence Interval = 0.65, 3.94*  
*Chi Square=1.22, p value= 0.269*

**Figure 4. Types of toilet facilities.**  
Kapar, Rohng Kitt, Enpein Pah, Nan Mand Kitt



median number of people per household was 6, with a range from 1 to 17. 24 of the 109 households (22%) had 9 or more people living in the house.

Water comes from the river to 63.3% of the households. All these houses have a 24 hour water pipe that joins with the main pipe that comes from the river. Only 18.3% of the houses relied on a deep well and 17.4% of the households depend on roof collection.

Although 80.9% of the houses have electricity either connected by extension to other houses or through direct island power, many of the houses have no appliances for cooking so open fires still remain popular in this area. 52.3% of the houses use an indoor fire. Additionally, the majority of households have at least one cigarette smoker, with an average of approximately 2 smokers per household where smokers are present. This exposure to smoke from indoor fires and from cigarette smokers is known to have an impact on respiratory disease<sup>15</sup>.

The availability of electricity apparently does not influence the practice of boiling drinking water. Table 1 shows 43

households reporting no indoor fire also reported that they never boiled their drinking water. This suggests that the use of an indoor fire is related to the more frequent boiling of drinking water. This relationship is statistically significant ( $p < 0.001$ ). In a newly electrified rural area, people are more likely to use electricity for light and entertainment than they are for a big stove. Also, electricity prices have just gone up, so people are going to be less likely to use electricity to boil water.

It was noted in the result that the majority of the homes still use open pit latrines. Covered pit latrines are highly recommended by WHO as a practical and inexpensive option for rural places with low income<sup>13</sup>. Only a little more than 1/3 of the households have a water seal toilet. The use of open drainage is problematic because open drainage areas are where the children often play, contributing to diarrhoeal and skin diseases in these areas.

Half of the houses are without adequate screening. People accept this as the part of the normal living condition. The lack of adequate screening combined with numerous potential mosquito breeding sites and failure to use bug repellent

		Use of bug repellent		
		<=5	>5	Total
House screened	Yes	45	9	54
	No	38	17	55
	Total	83	26	109

Odd Ratio=2.24, Confidence interval = 0.82,6.19  
Chi Square =3.04, p value=0.081

would contribute to the risks of diarrhoeal and skin diseases related to insects. It seems that houses with screening also had fewer potential mosquito breeding sites and used bug repellent more frequently. The associations suggest that

people who are aware of environmental risk factors for disease do several things at once:

- they screen their houses; and
- they clear potential breeding sites for mosquitoes, and
- they use bug repellent.

## Conclusion

Most illness cannot be eradicated from the population, but attempts can be made to at least prevent or diminish diseases and to limit morbidity and mortality<sup>15</sup>. Changes in the environment near households is one thing that can be readily addressed. Of the 6 small rural villages in Kittu, there were a number of potential risk factors for disease which are possible to change. The need for improving sanitation, boiling or otherwise treating water intended for drinking, and providing proper toilet facilities would be appropriate. Adding screen and windows to the homes where people sleep, especially when families cannot afford bug repellents would also be expected to decrease the incidence of diarrhoeal and skin diseases. Other important topics to be addressed are open drainage to the ground near where children play and where food is prepared.

The number of respiratory, diarrhoeal and skin diseases will remain high in these remote villages until something is done to improve their living environment. The findings from this study need to be compared to another study later in order to monitor improvements.

## Recommendations

1. Encourage the construction of larger houses or alternative living arrangements which will decrease crowding in households.
2. Provide for safe drinking water, either through appropriately designed deep wells or roof catchment systems, or through the boiling, filtering and/or chemical treatment of water from possibly contaminated sources.
3. Provide for better toilet facilities (e.g. covered, water flush pit latrines or water seal toilets)
4. Discourage open drainage from toilets through the construction of properly designed septic tanks.
5. Discourage the use of indoor fires and smoking in households.
6. Provide for adequate screening for all areas used for sleeping and the preparing or storage of food.
7. Encourage the elimination of all potential mosquito breeding sites within 100 feet of all households.
8. Encourage the appropriate use of insect repellent, especially in houses without adequate screening.
9. Work with the Division of Primary Health Care and the Environmental Protection Agency to develop an action plan to implement the above recommendations, and evaluate by conducting a repeat survey of this area.

10. Increase community-based primary health care services to these relatively isolated villages.

## Acknowledgment

I owe much to Dr. Pointer, and to my colleagues with whom I have collaborated over the years in working on various types of studies. I thank Dr. Pryor and all the PBMOTP faculty for their continuing support of my education. Special thanks go to my wife, Lolida Anson for her cheerful help in collecting the data with me. I also thank Dan Wyatt and all the people of Kittu.

## References

1. Last J M. *Public Health and Preventive Medicine*. Twelfth Edition; 1986.
2. Adelbai Ayesha. *Infant Mortality and Morbidity in Pohnpei*. SDRP Year 5 PBMOTP; 1995.
3. *Consolidated Monthly Report of all Dispensaries in Pohnpei State Primary Health Care*, May 1996.
4. Jelliffe D. B. *Child Health in the Tropics*; Fifth Edition; 1985.
5. Lilienfeld A M D. *Foundation of Epidemiology*, New York; 1976.
6. Winblade Uno and Kilama Wen. *Sanitation Without Water*. Revised and enlarged edition; 1985.
7. WHO. *Drinking water and sanitation, 1981-1990, a way to health*. A WHO contribution to the International Drinking Water Supply and Sanitation Decade. Geneva: WHO, 1981
8. Walsh J A and Warren K S. *Strategies for Primary Health Care*. 1985.
9. WHO. *Global Median Term Programme 13.7, Acute respiratory Infections*. Document TRI/ARI/MTP 83.1. Geneva: WHO, 1983.
10. Personal Interview, Siocy Soaz, Supervisor Statistician, Medical Record Room and Statistics Office, PSH Feb 19, 1996.
11. WHO. *Maintenance of Urban Water Supply and Sanitation System*; WHO, Geneva; 1994.
12. Smillie WG. Control of hook worm disease in South Alabama. *South Med J*; 1979;17:494.
13. CDC. *The Secretary's Community Health Promotion Awards*. U.S. Department of Health and Human Services; 1990.
14. WHO. *Measurement in Health Promotion and Protection*. Regional Publication, European Series No.22; 1987.
15. Malani J. *Lecture on smoking; related to respiratory disease*. PBMOTP; 1996 □