THE THIRD
NATIONAL HEALTH AND MORBIDITY SURVEY
2006
(NHMS III)

ASTHMA

INSTITUTE FOR PUBLIC HEALTH
NATIONAL INSTITUTES OF HEALTH
MINISTRY OF HEALTH
MALAYSIA
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THE THIRD NATIONAL HEALTH AND MORBIDITY SURVEY 2006 (NHMS III)

ASTHMA

CHAPTER I: Asthma Children (Aged Below than 18 Years)

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Institute for Public Health,
Ministry of Health Malaysia

MESSAGE FROM THE DIRECTOR GENERAL OF HEALTH MALAYSIA

Since independence, Malaysia has achieved remarkable progress economically and socially, notably in the health sector, through a well planned and comprehensive health care delivery system. However, Malaysia's health care system still has to grapple with many challenges, particularly the rising costs of health care and the increasing demands and expectations for quality care by our consumers. In this respect, the Ministry of Health formed the 'National Institutes of Health' to spearhead health research that will provide the body of evidence to help formulate health policies and create new tools to measure health impacts arising from the series of interventions made in the provision of health care. This will lead to an environment of better governance.

The first National Health & Morbidity Survey (NHMS) was conducted in 1986 by the Institute for Public Health (IPH) which is currently one of the research organizations under the umbrella of the National Institutes of Health (NIH). IPH was also given the task of conducting the second NHMS II in 1996 and the current NHMS III in 2006. Data and information gathered by these surveys are consistently and extensively been used by the Ministry of Health in formulating the Malaysian Health Plans and evaluating the intervention programmes.

The publication of the current NHMS III report would generate much interest amongst of all health care stakeholders in the country as well as international health organizations. It is my sincere wish that the data and information generated by NHMS III be fully distributed, discussed and utilized to enhance further the provision of health care in this country. The date generated on the national health and health- related prevalence would be useful in assessing the national health burden as well as allowing for international comparison of health systems achievements.

I would like to take this opportunity to congratulate all those directly involved in the conduct of the survey, namely members of the National Steering Committee, the Advisory Committee, Research Groups and the Working Committee for their untiring efforts in the planning and conduct of the survey as well as publication of the reports. I would like to specially place on record the Ministry's appreciation of the excellent work done by the Principal Investigator and his team and for their dedication and tenacious efforts in spearheading this project to fruition. The Ministry of Health is committed to conduct these National Health and Morbidity Surveys on a regular basis and hope that IPH will continue to provide the leadership in conducting future National Health and Morbidity Surveys in this country.

Thank you.

Tan Sri Datuk Dr Hj. Mohd Ismail Merican
Director General of Health, Malaysia.

MESSAGE FROM THE DEPUTY DIRECTOR GENERAL OF HEALTH (RESEARCH AND TECHNICAL SUPPORT)

The Research and Technical Support Programme of the Ministry of Health emphasizes the need for research in supporting decision making and planning the activities in the Ministry. Only then can we ensure that every decision made either in planning resources or providing services to the people is supported by evidence based information and ensuring better results and outcome. We would certainly prefer local expertise rather than depend on foreign experts to carry out local research.

Under the umbrella of the National Institutes of Health, the Institute for Public Health has actively been involved in conducting research in public health and the National Health and Morbidity Survey is one of the major research conducted by IKU. This is the third time IKU has been given the responsibility to conduct such a mammoth task. I am very pleased that a lot of improvement have been made in the way this survey was conducted based on the experience learnt during the first and second surveys. However, due to the nature of the community survey, not all diseases and health issues were able to be covered in this survey. The research teams had to conduct an extensive literature reviews for relevant and up to date information on the health status of the Malaysian population.

I believe that the information in these reports are extremely valuable to all decision makers at the National State and district levels as well as those interested in the health of the Malaysian population. It can be a tool in providing guidance in developing and implementing strategies for the disease prevention and control programme in Malaysia.

I would like to take this opportunity to congratulate the research team members who have successfully undertaken and completed this survey. I would also like to thank all individuals and agencies who directly or indirectly made the completion of this survey possible.

The Institute for Public Health again gained a feather in its cap by successfully completing the Third National Health and Morbidity Survey.

Datuk Ir. Dr. M. S. Pillay,
Deputy Director General of Health (Research and Technical Support).

MESSAGE FROM THE DIRECTOR OF INSTITUTE FOR PUBLIC HEALTH

This is the third time the Institute for Public Health (IPH) was given the task to conduct the National Health and Morbidity Survey. The frequency of the study is every 10 years and I am proud that the Institute is able to conduct the surveys successfully since it was first initiated in 1986.

I would like to take this opportunity to thank the Director-General of Health Malaysia, Tan Sri Datuk Dr. Hj. Mohd Ismail Merican, and the Deputy-Director General of Health (Research and Technical Support), Datuk Ir Dr.M.S. Pillay, whose invaluable support and guidance were instrumental in the successful completion of the third National Health and Morbidity Survey (NHMS III). Our appreciations are also extended to all members of the Steering Committee and the Advisory Committee of NHMS III.

I would like also to take this opportunity to congratulate the Principal Investigator and his Project Team Members in completing the NHMS III study and the publication of its report. The NHMS III was made possible through the collaboration of all agencies. The meetings, workshops and conferences that were organised, met their intended objectives and the hard work put up by the field staffs, ensured the three months data collection productive and successful.

My sincere gratitude also goes to Dr.Nirmal Singh, the former Director of the Institute for Public Health, Chairman of the Advisory Committee for his continuous support and guidance which contributed towards the successful completion of the study.

I hope the documentation of this report will be beneficial for future reference.

Finally, I would like to thank all those involved in the survey for a job well done, in making the NHMS III a success and finally producing the national report of this survey.

Dr. Yahya Baba,
Director, Institute for Public Health.

MESSAGE FROM THE PRINCIPAL INVESTIGATOR NHMS III

It is indeed a challenging task when the responsibility was given to me to conduct this survey. I learned the hard way and gained a lot of valuable experience in leading the survey. The survey also taught me lots of new techniques and how it should be addressed which is not available in the textbook. In doing so, I also learned the meaning of friendship and honesty, how to manage people involved and manage properly the given budget.

I would like to take this golden opportunity to thank the Director General of Health Malaysia, Tan Sri Datuk Dr. Hj. Mohd Ismail Merican, Chairman of the Steering Committee for giving me the confidence, valuable support and guidance for the success of this survey.

I would also like to thank the Deputy Director General of Health Malaysia (Research & Technical Support), Datuk Ir. Dr. M.S. Pillay as Co-chairman of the Steering Committee for his patience in seeing through the survey until its completion the production of the national report.

My sincere appreciation to current Director of Institute for Public Health (IPH), Dr.Yahya Baba and former Directors of IPH, Dr.Nirmal Singh, Dr.Sivashamugam and Dr.Sulaiman Che Rus for their trust in me to carried out this survey. Their support for the survey has resulted the smooth conduct and success of the survey.

Special thanks to all State Directors, State Liaison Officers, Field supervisors, Scouts, Data Collection Team members for their full cooperation and efforts to ensure the success of the data collection. My appreciation is also extended to the Assistant Principal Investigator, Dr.Mohd Azahadi Omar, Main Research Group members, members of the Working Committee, Data Management group members, Statistics Consultant, Research group members , Research Officers and Research Assistants for their patience and tolerance of my behaviour to ensure the success of the study. Nevertheless I acknowledge a lot more can be done in strengthening the study.

I believe this report will serve as a useful reference for future surveys and helps in improving the local data sources and also add new valuable information for the Ministry of Health to use in the planning process. I also would like to encourage all research members to participate in further analysis of the data and publish the findings in peer review journals.

Thanks to everyone.

Dr. Hj. Ahmad Faudzi Hj. Yusoff,
Principal Investigator, The Third National Health and Morbidity Survey,
Institute for Public Health.

AUTHOR'S STATEMENT

Chapter I:

The NHMS III report on childhood asthma has been produced through sheer commitment and dedication of the authors from several institutions such as Institut Pediatrik of Hospital Kuala Lumpur, Hospital Serdang, Hospital Pulau Pinang, Disease Control Division, Ministry of Health Malaysia and Kulliyyah of Medicine, International Islamic University Malaysia

This survey is part of the national health morbidity survey that is conducted every ten years. This volume is the culmination of several years of collaborative work that involved questionnaires development to the actual field work and analysis of the data and the final report writing. The findings of this survey have been adjusted for the national level of strata and states.

We hope that the results of this survey will benefit policy makers in development of future programmes for childhood asthma in Malaysia.

Chapter II:

This volume is the culmination of several months of collaborative effort by the authors who have striven to ensure the integrity of this work.

In the process of preparing this volume, close collaboration was also established between the authors and the relevant Health Programmes Managers to optimize the use of the research findings.

Findings in this volume have not adjusted for the differences in population composition of the survey sample and the 2006 population in Malaysia.

The authors welcome any enquiries, comments and suggestions for further improvement of this volume.

ACKNOWLEDGEMENT

Chapter I:

The authors wish to express sincere gratitude and appreciation to the National Health and Morbidity Survey Steering Committee and the Advisory Group for their continuous guidance and support, from the preparation of this survey till the production of this final report.

We would like to extend our gratitude and appreciation to the Director of Hospital Kuala Lumpur, Director of Hospital Serdang, Director of Hospital Pulau Pinang, Director of Disease Control Division, Ministry of Health Malaysia and Rector of Kulliyyah of Medicine, International Islamic University of Malaysia that had supported our active participations in this research group.

Special appreciation is extended to all research team members, working group members, field support group members, data processing members and other individuals for their dedicated effort and commitment in preparing for the survey, collecting the data, and processing the information. Without their earnest effort and patience this survey could not have been successfully carried out and the report produced and presented as scheduled.

Last but not least we would like to convey our special thanks and sincere appreciation to all those who have reviewed, edited and checked this report whose names are too many to mention.

Chapter II:

We, the researcher, wish to express sincere gratitude and appreciation to the National and Morbidity Survey Steering Committee and the Advisory Group for their guidance and support in the preparation and implementation of this survey.

We would like to record our appreciation to Dr Jamalludin Ab Rahman, Associate Professor in Epidemiology and Biostatistic, Malaysian International Islamic University for his assistance in the analysis of this survey data and developing the chart for this report. Special appreciation also goes to Dr Ahmad Faudzi Yusoff for reviewing the manuscript.

We would like to thank those who were directly or indirectly involved in the data collection as well as the data editing process for their invaluable input. Without them this report would not have been possible.

Last but not least, our thanks to the IRPA panel, Ministry of Science, Technology and Environment for funding this project.

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ABBREVIATIONS

AIA	Asthma in America
AIRE	Asthma Insights and Reality in Europe
AIRIAP	Asthma Insights and Reality in Asia-Pacific
AIRJ	Asthma Insights and Reality in Japan
BAL	Bonchoalveolar Lavage
CI	Confidence Interval
ISAAC	Survey of Asthma and Allergy in Children
LRI	Lower Respiratory Illness
NGO	Non-Governmental Organization
NHMS III	The Third National Health and Morbidity Survey (2006)
RSV	Respiratory Syncytial Virus
WHO	World Health Organization

CHAPTER I

ASTHMA CHILDREN (AGED BELOW 18 YEARS OLD)

ABSTRACT

Asthma is a chronic inflammatory lung disease affecting all age groups. It has experienced a sharp increase in the global prevalence, morbidity, mortality and economic burden over the last 40 years, particularly in children. The increase in prevalence of asthma has been reported in the United Kingdom (Martinez et al. 1995; Masoli et al. 2004), New Zealand (Luyt et al. 1993; ISAAC 1998), United States (Williams & McNicol 1969) and Australia (Woolcock & Peat 1997). Compared to the West and Asia Pacific Region, the prevalence of asthma in South-East Asian populations is lower (Burr et al. 1989; Mitchell 1983), but an increasing trend has also been reported in Taiwan and Japan (Mitchell 1983).

Recent surveys as reported by Asthma in America (AIA) (Anderson 1989), Asthma Insights and Reality in Europe (AIRE) (Mitchell et al. 1990; Halfots & Newacheck 1986), Asthma Insights and Reality in Asia-Pacific (AIRIAP) (Bauntan et al. 1990) and Asthma Insights and Reality in Japan (AIRJ) (Viegi et al. 1994) highlighted the fact that asthma is under-diagnosed and under-treated. AIRIAP study conducted in eight areas including China, Hong Kong, Korea, Malaysia, Philippines, Singapore, Taiwan, and Vietnam reported daytime symptoms of 51.4%. About 43.6% of asthmatics had been hospitalized, attended a hospital emergency department, or made unscheduled emergency visits to other health care facilities for treatment of asthma during the previous 12 months. Current use of an inhaled corticosteroid was reported by only 13.6% of asthmatics and 56.3% used quick-relief bronchodilators. Absence from school and work in the past year was reported by 36.5% of children and 26.5% of the adults.

The National Health and Morbidity Survey III (NHMS III) 2006 was conducted with the main objective of determining the prevalence of asthma among children and adults in Malaysia. The specific objectives were to determine the impact of disease due to asthma among adults and children, the correlation between asthma and obesity, to determine the pattern of health utilization and to determine the percentage of asthmatics on preventive medications.

The data was collected using pre-coded questionnaires by trained interviewers through interviewing all household members in the selected living quarters. The prevalence of asthma in children was based on part of the International Survey of Asthma and Allergy in Children (ISAAC) questionnaire, which was previously used in 1995 and 2001 in an international survey involving school children 6-7 years old and 13-14 years old in Kuala Lumpur. The impacts of asthma in children were determined by using the Asthma Insight and Reality in Asia Pacific (AIRIAP) questionnaire. This questionnaire was previously used in an international survey involving countries in the Asia-Pacific including Malaysia in 2000.

The NHMS III showed that the total prevalence of asthma was 7.1% (CI: 6.7 - 7.6). The prevalence of ever asthma was 6.5% (CI: 6.1 - 6.9), current asthma 5.4% (CI: 5.1 - 5.9) and the prevalence of exercised–induced asthma was 2.9% (CI 2.7 - 3.2). It is difficult to compare the prevalence between NHMS II survey since the questionnaire used was different. The total prevalence of asthma was more prevalent among Malays [8.1% (CI: 7.5 - 8.7)] and Indians [7.4% (CI: 6.1 - 8.9)]. Chinese has the lowest asthma prevalence [4.3% (CI: 3.6 - 5.2)]. By states, Johor [9.2% (CI: 7.9 - 10.6)], Kedah [8.6% (CI: 7.1 - 10.5)], Malacca [8.4% (CI: 5.8 – 12.0)] and Kuala Lumpur [8.3% (CI: 6.5 - 10.6)] had the highest prevalence of asthma. The results showed that males reported significantly higher prevalence of asthma [7.7% (CI: 7.1 - 8.3)] with a male to female ratio of 1.16:1. The prevalence of asthma is highest in children aged 15-18 yrs old [8.3% (CI: 7.3 - 9.4)]. The prevalence of asthma was higher in the urban population although not significant. There was no significant difference in the prevalence between education levels

and parental income. Based on asthma severity, the prevalence of intermittent asthma was 34.8% (CI: 31.4 - 38.3) and 65.2% (CI: 61.7 - 68.6) was classified as persistent asthma. This was based on day and night time symptoms as well as sleep disturbances due to cough or breathlessness. There was no significant different of asthma severity between different socio-demographic characteristics.

The survey showed that 69% of asthmatics did not have any long term asthma follow-up. The asthmatic from the rural area had the highest percentage of non follow-ups [71.3% (CI: 66.1 - 76.0)]. About 32.1% of asthmatics had visited the emergency department for asthma exacerbation, 14.0% was hospitalized and 81.7% of them had unscheduled visit to the doctor's due to asthma exacerbation. The Indians had the highest utilization of acute care services. The children in the age group 0-4 years olds was the highest user of acute care services. In terms of morbidity, 52.8% of children missed schools due to asthma with an average days loss of 3.6 (CI: 3.0 - 4.2) days. About 18.4% of children were affected by physical activities, 16.3% was affected in terms of social activities, 25.3% was affected during sleep and 21.8% was affected in sport and recreational activities.

The majority of the children (85.4%) were treated by doctors and paramedics. About 5.0% went to the pharmacy using old prescriptions, 5.4% sought traditional treatment and 4.2% went to the pharmacy without prescription. The percentage of asthmatics not on any medications was 66.7%. Only 13.3% was on short acting β_2 agonist, 6.2% was on inhaled corticosteroids, 4.7% was on combination therapy, 3.5% was on anti–leukotrienes and 5.2% was on long acting β_2 agonist only. The highest user of inhaled cortcicosteroid was in the older age groups (10-18 years).

In conclusion, this survey showed that the prevalence of asthma in children was comparable to other countries in Singapore, Thailand and Hong Kong. The morbidity of asthma was still significant as in the previous AIRIAP survey. Under-utilisation of the preventer medications was still high hence two third of asthmatics still had persistent asthma.

1. INTRODUCTION

Bronchial asthma continues to be one of the most common chronic diseases in both adults and children worldwide, imposing a huge burden on the patients, their family and society and a significant burden to health services and healthcare costs. It is a major cause of morbidity in children in developed country. Childhood asthma has variable expression between countries and between different populations. It is a dynamic and heterogenous respiratory disease especially in children that presents as distinct phenotypes at different ages and with different clinical presentations. The clinical evaluation of a child with possible asthma requires a careful and comprehensive medical history. There is now convincing evidence that childhood asthma is a spectrum of different conditions that manifest by recurrent symptoms of bronchial obstruction which is reversible spontaneously or with medications. The most significant symptoms of asthma in children are wheezing, shortness of breath, cough and chest tightness that are associated with widespread but variable airflow obstruction. In a relevant number of children, chronic cough is the main symptom of the disease.

During the last few decades, wheezing has become one of the most frequent cause of children seeing general practitioners and hospitalisation. The epidemiological studies have suggested that up to 30% of all three year old children have had at least one acute episode of wheezing as ascertained by auscultation of the chest by physician (Martinez et al. 1995). Half of all children have had wheezing reported by their parents by the age of six years (Luyt et al. 1993). Within Europe, the prevalence of physician-diagnosed asthma has been reported to be 10.9% in United Kingdom, 3.9% in Germany, 6.2% in France and 4.7% in Italy (Masoli et al. 2004). In Malaysia, physician diagnosed asthma in children aged 13-14 years old was 10.7% (ISAAC 1998). The long-term prognosis of childhood asthma is now of major concern. It has often been suggested that asthma in childhood will disappear when the patient reaches adulthood. It has been estimated that asthma disappears in 30 to 50 percent of children at puberty, but often reappears in adult life (Williams & McNicol 1969). Up to two-thirds of children with asthma continue to suffer from the disorder through puberty and adulthood. They will be at risk from the long-term effects of the disease throughout life if untreated. However, the social and economic burden of asthma can be alleviated through appropriate asthma prevention and management strategies. Although asthma cannot be cured, it can be controlled.

2. LITERATURE REVIEW

2.1 Prevalence of Childhood Asthma

The prevalence of childhood asthma varies among different populations and countries throughout the world. There is considerable evidence that the prevalence of childhood asthma had increased over the last decades (Woolcock & Peat 1997). It has experienced a sharp increase in the global prevalence, morbidity, mortality and economic burden over the last 40 years, particularly in children. The increase in prevalence of asthma had been reported in the United Kingdom (Burr et al. 1989; Anderson 1989), New Zealand (Mitchell 1983; Mitchell et al. 1990), United States (Halfots & Newacheck 1986) and Australia (Bauntan et al. 1990). In Australia, one child out of every six aged less than 16 suffered from asthma. Asthma is not an exclusive public health problem for developed countries only. The World Health

Organisation (WHO) estimated in the January 2000 report that 100-150 million individuals all over the world suffered from asthma and the number is increasing every year. In Brazil, Costa Rica, Panama, Peru and Uruguay the prevalence of asthmatic symptoms in children ranged from 20-30%. In Kenya it approached 20%. In India, the prevalence of children aged 5-11 years with asthma was estimated to be between 10-15%.

In industrialized and Anglo-Saxon countries, asthma prevalence is increasing especially in the younger age groups (Viegi et al. 1994; Seaton et al. 1994). There had been an increased in the prevalence in both rural and urban areas with substantial differences among urban (high) and rural (low) African countries (Weinberg 2000). Compared to the West and Asia Pacific Region, the prevalence of asthma in South-East Asian populations was lower (Leung et al. 1994). The overall prevalence of childhood asthma in Malaysia was 10.4% and 10.9% in the 6-7 and 13-14 years old respectively (ISAAC 1998). MZ Norzila et al. 2000 reported that the prevalence of ever wheeze, wheeze in the last 12 months, ever asthma and wheeze with exercise in the last 12 months among 7-12 years old Malay school children living in an inner city of Kuala Lumpur was 12.5%, 6.6%, 10.3% and 5.9% respectively. Evidence also showed that the prevalence was higher among the urban and inner-city children i.e. 7.3% in Muar to 13.9% in Kuala Lumpur (ISAAC 1998; Norzila et al. 2000; Azizi 1990). In the UK, there was consistent evidence of an increase in the prevalence of asthma and wheezing among school children by almost 50% over the period of 25 years (Anderson 1993). However, in country like Netherlands, there was persistently decreasing trend in the prevalence of asthma symptoms in Dutch school children aged 8-9 years since1989 (Mommers et al. 2005).

2.2 Childhood Asthma Morbidity

Asthma is a treatable disease. However with the advancement and considerable progress in knowledge and the availability of effective medications for asthma, it continues to constitute a significant burden for health services and greater expenditure on health. Prevalence alone does not portray the morbid condition of asthma in children. Asthma is a chronic disorder that can cause considerable restrictions on the physical, emotional, and social well being of the patients and may have an impact on their school performance. There are several outcome measures used to determine asthma morbidity. Amongst the many outcomes used to indirectly measure asthma morbidity are asthma severity (levels of persistent symptoms), healthcare utilisation (unscheduled visits to doctors, hospitalisation, emergency room visits and other urgent care for asthma) and the loss of work or school days as a result of asthma. However, many asthmatic patients may not completely appreciate the impact of their asthma on their social life. Most of them readily accepted the limitations on their lifestyles and make some adjustments to their daily activities based on the perceived control of their asthma.

Asthma together with respiratory infections contributes one-half of all hospitalisations in children 1-4 years of age and one third of children 5-9 years of age (Cormick et al. 2000). The trend of paediatric asthma admissions in US peaked in the mid-1990s, reached a plateau, and has remained stable since then. More so, several studies reported that annual childhood asthma hospitalisation rates have stabilized among many geographic areas and socio-demographic groups (Mannino et al. 1998). However, other studies at the same time reported that the severity of acute asthma has increased significantly (Russo et al. 1999). Asthma alone accounts for 1% of all healthcare expenditures which mostly derived from inpatient care in the US (more than USD 10 billion per year) of which 54% of the medical direct expenditures was mainly for asthmatic children 17 years and younger (Mannino et al.

1998; Weiss et al. 1992). Asthmatic children make more than 13 million visits to physician compared with healthy children (Haflon & Newacheck 1993). In seven European Union countries, the average annual per patient cost was €789 for patients aged 0-4 years, €463 for patients aged 5-15 years and €566 for adults. The unscheduled care accounted for 47% of total cost in infants, 45% in children and 56% in adults regardless of the symptoms severity (Williams et al. 2006). In Asthma Insights and Reality in Asia-Pacific (AIRIAP) study, the burden of asthma in eight countries in the Asia-Pacific region showed that annual per-patient direct costs ranged from USD108 for Malaysia to USD1010 for Hong Kong. Urgent care costs were responsible for 18-90% of total per-patient direct costs where extremes of age, greater asthma severity, and poorer general health status were predictive of high cost (Lai et al. 2006). Poorer asthma control was associated with an increased frequency of all unscheduled healthcare and elevated cost in European countries and Asia-Pacific regions (Vervloet et al. 2006; Lai et al. 2006). Recent surveys as reported by Asthma in America (AIA) (AIA 1998). Asthma Insights and Reality in Europe (AIRE) (AIRE n.d.; Rabe et al. 2000), Asthma Insights and Reality in Asia-Pacific (AIRIAP) (Lai et al. 2003) and Asthma Insights and Reality in Japan (AIRJ) (Adachi et al. 2002) highlighted the fact that asthma is under-diagnosed and under-treated.

2.3 Childhood Asthma Mortality

Deaths due to asthma are rare and should be avoidable. However, some preventable asthma deaths still occur particularly in relation to inadequate treatment. A Kimbami LJ et al reported that among US children aged 0-17 years from 1980 to 1998, asthma death rate increased by 3.4% per year. Children aged 0-4 years had the largest increased in prevalence and had greater healthcare use, but adolescents had the highest mortality. He also observed that racial disparities were largest among black and white children for asthma hospitalisation and mortality. Black children were three times more likely to be hospitalised and four times more likely to die from asthma compared to white children (Akinbami & Schoendorf 2002). Among Black Americans asthma deaths from 1991-1996 were associated independently with low income and low education. An increasing trend of asthma mortality has also been confirmed in developing countries like Brazil where asthma mortality is still considered low. However, it rose significantly in those aged 5-19 years ranging from 0.04-0.39 per 100,000 population with a total increase of 352% between 1970 and 1992 (Chatkin et al. 1999). Similarly in Singapore, there was a significant increase in asthma mortality in children aged 5-14 years from 0.21 per 100,000 in 1976-80 to 0.72 per 100,000 in 1991-1995. The mortality rates were higher in the older age groups and males. There was marked ethnic differences for mortality rates noted in the study: 2.5 in Malays, 1.3 in Indians and 0.5/100,000 in Chinese (Ng & Tan 1999).

In Australia, the prevalence of persistent asthma in children has increased from 5% to 9% in the past 20 years. Asthma deaths in Australia have fallen 28% since peaking in 1989 but the mortality rate is still twice that of England (Woolcock et al. 2001). Since the introduction of inhaled corticosteroids in the management of childhood asthma, there appears to have been a reduction in asthma morbidity and mortality due to better control of asthma symptoms. The rate of death from asthma decreased by 21% with each additional canister of inhaled corticosteroids used in the previous years (Suissa et al. 2000). The regular use of inhaled corticosteroid is associated with a decreased risk of asthma mortality but an excessive use of short acting beta2 agonist is associated with a markedly increased risk of asthma deaths (Lanes et al. 2002). In England and Wales, the asthma deaths in the 5-14 years age group showed an irregular downward trend about 6% in 1983-1995 due to increased use of prophylactic treatment such as inhaled corticosteroids.

2.4 Risk Factors of Childhood Asthma

The aetiology of childhood asthma is not fully understood. Studies have identified risk factors for asthma such as male sex, low birth weight, preterm birth, young maternal age, maternal asthma, parental smoking and exposure to high levels of inhalant allergens during infancy. Therefore, the expression of asthma phenotype is likely to be determined and influenced by multiple factors including host characteristics such as sex, race, atopy and extrinsic environmental factors which may interact at different levels. The genetic mechanisms involved in the development of asthma remained to be elucidated, as more and more candidate genes are being identified and screened for polymorphisms. Many regions of the genome have been found to have linkage with the phenotypes of asthma and atopy. Over 70 variants in candidate genes have been reported to be associated with asthma and atopy phenotypes. They should be tested in case-control studies involving patients with different manifestations and disease severity in order to determine the clinical relevance of these polymorphisms (Malcolm 2005).

The factors affecting the onset of asthma and allergies are complex and it is not well understood. It involves the inter-phase of common genetic background with exposures to allergens and airborne irritants. The rapid rise in asthma over the past three decades in Western societies had been attributed to numerous diverse factors, including increased awareness of the disease, altered lifestyle and activity patterns, and ill-defined changes in environmental exposures. There is enough evidence that exposure to environmental tobacco smoke increased the risk of asthma in both children and adults. Experimental evidence suggests that complex organic molecules from diesel exhaust may act as an allergic adjuvant through the production of oxidative stress in airway cells. It has also been demonstrated that outdoor air pollution and climate change may act as environmental risk factors for the development or severity of asthma (Ian Gilmour et al. 2006).

Understanding the aetiology of childhood wheeze and asthma remains an area of extensive ongoing research. Hassan Arshad et al. 2005 reported that significant independent associations for current wheeze in children were found with maternal asthma (OR 2.08), paternal asthma (OR 2.12), recurrent chest infections at two years (OR 3.98), atopy at four years of age (OR 3.69), eczema at four years of age (OR 2.15) and parental smoking (OR 2.18 with 95% confidence interval). However, for currently diagnosed asthma, the significant factors were maternal asthma, paternal asthma, sibling asthma, recurrent chest infections at one year and two years of age and male gender. It was concluded in this study that asthmatic heredity, predisposition to early life atopy, plus early passive cigarette smoke exposure and recurrent chest infections are important influences for the occurrence of wheeze and asthma at 10 years of age (Hasan Arshad et al. 2005). 12 years prospective follow-up study of 983 children and adolescents living in Copenhagen, Denmark reported that new onset of asthma was independently predicted by the presence of airway hyperresponsiveness allergic sensitization to house dust mites and dermatitis. These predictors also increased the risk of developing asthma in adulthood, whereas the absence of these manifestations predicted a very low risk for future asthma (Celeste et al. 2006).

Respiratory infections play an important role in the development of atopy and childhood asthma. However, there is still an ongoing debate about the potential causal role of viral infections mainly respiratory syncytial virus (RSV), for the subsequent development of childhood wheezing illness, asthma and atopy. Many recent studies substantiated the potential of RSV lower respiratory tract illness in association with an increased risk of recurrent wheezing and risk of a child subsequent developing asthma (Long et al. 1995; Sims et al. 1978; Pullen & Hey 1982; Stein et al. 1999). It has been well

documented in both retrospective and prospective studies that RSV bronchiolitis in infancy was strongly associated with both asthma as well as other forms of bronchial obstructive disease and allergy in children (Pullen & Hey 1982; Carlsen et al. 1987; Murray et al. 1992; Noble et al. 1997; Sigurs et al. 1995; Sigurs et al. 2000). Recent population-based birth cohort study of 150 infants admitted to hospital within 12 months of birth with RSV bronchiolitis confirmed a positive association of RSV bronchiolitis with subsequent wheezing and asthma but not with the development of atopy by age 7 years (Henderson et al. 2005).

Smoking during pregnancy is a well-established determinant of fetal growth and risk of low birth weight. It may also influence the development of the foetal respiratory system, as suggested by findings of a relationship between maternal smoking in pregnancy and lung function impairment in newborns. However, little is known about the causal pathway between maternal smoking and the risk of childhood asthma. The findings of a population-based cohort study of 58841 singleton births by Jouni & Mika 2004 summarised the harmful effects of maternal smoking both on foetal development and for development of asthma in children during the first seven years of life. A prospective cohort study of 2,602 Western Australian children showed that wheezing lower respiratory illness (LRI) in the first year of life, particularly multiple episodes of wheezing LRI increased the risk for current asthma in both non-atopic and atopic children but did not increase the risk for atopy. Exclusive breastfeeding for more than four months was a significant protective factor for wheezing LRI, current asthma and atopy (Oddy et al. 2002).

2.5 Diagnostic Issues in Childhood Asthma

Asthma is defined as a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role such as mast cells, eosinophils, macrophages, neutrophils, T lymphocytes and epithelial cells. This chronic inflammation leads to an increase in bronchial hyperresponsiveness to a variety of stimuli causing recurrent episodes of breathlessness, wheezing, cough and chest tightness that are associated with widespread but variable airflow obstruction. In children, it is difficult to evaluate the evidence of chronic inflammation in the airway because it involves invasive procedures such as bronchoscopy and biopsy. Therefore, the knowledge regarding the pathophysiology of asthma in children is derived from the studies performed in young adults as the invasive methods used in adults to evaluate the evidence of chronic inflammation in the airway have limitation in children due to ethical reasons. However, from the available studies of bonchoalveolar lavage (BAL) (Ferguson & Wong 1989; Ferguson et al. 1992), induced sputum (Twaddell et al. 1996) and exhaled nitric oxide (Nelson et al. 1997), the pathological findings of inflammation in the airway of asthmatic children appears to be similar to that in adults.

Wheezing is a common nonspecific sign and symptom in infants and young children who develop airflow restriction due to variety of conditions. In preschool children, the anatomical abnormalities such as reduced airway caliber may be the main reason for recurrent wheezing especially following viral respiratory infections. Furthermore, wheezing illnesses in early childhood commonly present as phenotypes with similar symptoms of asthma such as wheezing, cough and difficulty in breathing but the underlying causes, prognosis and response to therapy are different (Boner & Martinati 1997; Martinati & Boner 1995). In children under two years of age, it is even more difficult to diagnose asthma with certainty. In preschool children, the diagnosis is often made on reported symptoms by parents without any objective testing. One of the most common challenges in diagnosing asthma is to distinguish it from isolated cough. There are problems of under-diagnosis and over-diagnosis of asthma in young children.

One of the criteria for diagnosing asthma is the demonstration of the reversibility of the airway obstruction as observed after administration of bronchodilator. A 15% increase in FEV1 or 20% in peak expiratory flow can be considered to be demonstrative of a reversible airway obstruction and diagnostic of asthma. Spirometry is a simple, robust and a widely available tool for investigating lung function but this is only applicable to the older children who are able to perform the test (Isobel & Sheila 2006).

Therefore, the clinical evaluation of a child with possible asthma requires a careful and comprehensive medical history on the onset of wheezing illnesses, personal atopic morbidity, family history of asthma, atopic dermatitis, sinusitis and other allergy diseases, the trigger factors and response to asthma therapy as well as thorough physical examination.

2.6 Treatment

The aims of asthma treatment are to control symptoms and to reduce the risk of future complications such as asthma exacerbations, emergency visits, hospitalization, frequent used of bronchodilator as well as to prevent death. In order to ensure success in the management of asthma, the treatment packages should include educating the parents and patients in all aspects of the disease, promoting good control of the symptoms, trigger factors avoidance and the appropriate use of pharmacological agents. The guidelines for the management of childhood asthma in Malaysia was first developed in 1998 and updated in 2004. The asthma medications are divided into two categories which are preventer and reliever medications. As asthma is an inflammatory disorder, the management should emphasize on anti inflammatory therapy as preventer group of medications. Bronchodilators are being used for acute exacerbation of asthma as rescue medications or reliever. Management will be affected by severity and the age of the child. Inhaled corticosteroids are the main stay of anti inflammatory agent used in the treatment. The addition of long-acting beta2 agonists or leukotriene receptor antagonist drugs appear to be the most promising options for better asthma control particularly in those patients who cannot be controlled even at a high dose of inhaled steroids. The preferred route for drug delivery is by inhalation where possible. In children below six years of age, spacer devices with masks are preferred. Children as young as six months may use these spacer effectively provided that there is a good seal of the mask on the child's face and the child is capable of inhaling fast enough to open the valve.

Asthma changes over time as well as the control, depending on multiple factors affecting the patients such as environmental condition, life style, activity levels and acute respiratory illness in the family. Maintenance of asthma therapy is a continuous process with frequent reevaluation and medical treatment adjustment by step up or step down method.

3. OBJECTIVES

3.1 General Objective

The National Health and Morbidity Survey III (NHMS III) 2006 was conducted with the main objectives of determining the prevalence of asthma among children and adults in Malaysia among different geographic and socioeconomic subgroups in Malaysia.

3.2 Specific Objectives

3.2.1 To determine the impact of disease due to asthma among children.
3.2.2 To determine the relation between asthma and weight to height.
3.2.3 To determine the pattern of health utilization for asthma.
3.2.4 To determine the percentage of asthmatics on inhaled preventive medications.

4. METHODOLOGY

4.1 Scope of the Study

Research problems, scopes and main issues to be included in NHMS III were obtained from discussions and feedbacks from Ministry of Health state health managers, as well as experts from the local universities and individuals. The main research team members of the NHMS III reviewed and studied closely the feasibility and practicality of the suggested research topics for this community-based household survey. Extensive literature review was initiated. Technical and research experts in relation to the identified research areas were consulted for further advise and comments. The main research group used the following criteria in considering the suggested scopes for this survey:

a) The issue/problem is of current or potential high prevalence
b) The issue/problem is focusing on disease/disorders associated with affluence, lifestyle, environment and demographic changes.
c) The issue/problem is causing physical, mental or social disability
d) The issue/problem has important economic implications
e) It is feasible to implement interventions to reduce the problem
f) The information required related to the issue/problem is not available through the routine monitoring system or other sources.
g) The information is more appropriately obtained through a nation-wide community survey, and
h) It is feasible to obtain through a nation-wide community-based survey.

The short-listed research topics then presented to the Advisory Group Members for further deliberation and decisions. These topics were later refined by the research team members based on the decisions made at the Advisory Committee meeting. It was tabled to the Steering Committee and 18 research topics were approved to be included in the NHMS III.

4.2 Sampling Design and Sample Size

In calculating the sample size, stratification and sampling design, advice was sought from the Methodology Division Department of Statistics Malaysia as well as from several other biostatistics consultants.

4.2.1 Sampling frame

The sampling frame for this survey was updated until 2004; an effort undertaken prior to the implementation of Labor Force Survey (LFS) 2004. In general, each selected Enumeration Blocks (EB) comprised of 8 sampled Living Quarters (LQ). The EBs was geographically contiguous areas of land with identifiable boundaries. Each contains about 80-120 LQs with about 600 persons. Generally, all EBs are formed within gazette boundaries.

The EBs in the sampling frame was also classified by urban and rural areas. The classification into these strata was made up in terms of population of gazette and built-up areas as follows:

Stratum	Population of gazette areas and built-up
Metropolitan	75,000 and above
Urban Large	10,000 to 74,999
Urban Small	1,000 to 9,999
Rural	The rest of the country

For sampling purposes, the above broad classification was found to be adequate for all states in Peninsular Malaysia and the Federal Territories of Kuala Lumpur and Labuan. However, for Sabah and Sarawak, due to problems of accessibility, the rural stratum had to be further sub-stratified based on the time taken to reach the area from the nearest urban centre.

For the purpose of urban and rural analysis, Metropolitan and Urban Large strata are combined together thus referred to as 'urban' stratum, while for Urban Small and the various sub-divisions of the rural areas they are combined together to form to a 'rural' stratum.

4.2.2 Sampling design

A two stage stratified sampling design with proportionate allocation was adopted in this survey. The first stage sampling unit was the EB and within each sampled EB, the LQs were selected as second stage unit. One LQ was estimated to comprise of 4.4 individuals. All households (HH) and persons within a selected LQ were studied.

4.2.3 Sample size

The sample size was determined based on 95% Confidence Interval (CI) and the following factors were taken into consideration:

a) Expected prevalence rate

The prevalence rate of the health problems for Malaysia obtained from the National Health and Morbidity Survey II (NHMS II) were used to estimate the overall sample size. Using the previous finding of 10% prevalence rate, the initial sample size at the state level was calculated in order to come up with overall sample size. The size was further apportioned for each state using the probability proportionate to size (PPS) method.

b) Response rate of the NHMS II

The response rates, which ranged from 83 to 97% for the NHMS II of each state, were taken into consideration in the course of the determination of sample size.

c) Margin of error and design effect

As the factors of precision and efficient of the survey are paramount, the decision reached for the targeted margin of error is 1.2 and the design effect valued at 2. These values were used at the initial stage of the calculation of the sample size of each state.

The survey findings addressing the specific objectives of this survey are expected to be used for state level programmed planning. Thus, the calculation for the sample size has taken into consideration that the data is to be analyzed at the state level.

In addition to the major factors mentioned earlier, the availability of resources, namely, financial and human resources, and the time taken to conduct this survey also becomes part of the process of the determination of sample size.

4.3 Preparation of Field Areas and Logistic Support

A number of state liaison officers were recruited in preparation for the survey proper. Strong networking with state liaison officers and District Health Officers (MOH and local authorities) from the areas sampled for the survey was established. Field scouts were mobilized from these areas to identify and tag the LQ's selected for the survey, as well as to inform the community and related government agencies of the importance and schedule of the planned survey. State liaison officers were also assisting Field Supervisors in the arrangement of transportation, accommodation and other logistics for the survey teams.

4.4 Method of Data Collection

4.4.1 The questionnaire

A bi-lingual (Bahasa Malaysia and English) pre-coded questionnaire was designed, pre-tested and piloted prior to the survey.

Certain terminology and items in the questionnaire were also made available in the dialects or languages of the main ethnic groups in Malaysia, such as Hokkien and Cantonese for the Chinese and Tamil for the Indians. The local dialects of Sabah and Sarawak were also considered. These pronunciations were recorded on tape with an accompanying 'romanised' version of the script. All versions were back translated into English by independent reviewers to ensure the accuracy of the translations.

The face to face interview questionnaires consisted of 2 subtypes, i.e., the household questionnaire (orange) to be answered by the head of the household of the LQ selected, and the individual questionnaire, to be answered by each member of the household. Three types of individual FI

questionnaires were developed, to cater to the different age groups of less than 2 years old (pink), 2 to less than 13 years old (blue) and 13 to less than18 years old (yellow).

All the FI questionnaires have a consent form to be read and signed by the respondent. The outside cover of all questionnaires had to be filled with a unique individual identification (ID) number by the enumerator. The enumerator also had to fill his or her ID as well as the code for the outcome of the interview as part of the quality assurance process.

4.4.2 The interview

As far as possible, all adult members who qualify from the selected LQ's were interviewed by the data collection team members. Parents or guardians were expected to provide information for their children aged 12 years and below (primary school). Interviews commenced early in the morning and lasted till late in the evening. A trained non-medical or paramedical interviewer conducted the interview. Where an interview had been unsuccessful due to the absence of the respondent at the selected LQ, repeat visits were conducted after leaving messages with neighbours or by other means for an appointment at a later date. A household member can only be classified as a non-responded after 3 unsuccessful visits.

4.5 Field Preparations

Two main survey implementation groups had been formed: the Central Coordinating Team (CCT) and the field team. The CCT's main role was to monitor and coordinate the progress of implementation and provide administrative support in terms of financial and logistic arrangement for the field survey. The Field Teams were responsible to oversee and manage the field data collection process as well as undertake quality control.

The field data collection was conducted throughout Malaysia simultaneously, spanning within a continuous period of 4 months starting from April 2006. Teams were organized to move into 5 regions in Peninsular Malaysia, 2 regions in Sabah and 4 regions in Sarawak for data collections.

4.5.1 Pilot study

A pilot study was conducted on a sample of EB's (not included in the NHMS III) about 2 months prior to the actual nationwide survey. It was conducted in three different areas in and around the Klang Valley, namely Sepang, Klang and Bangsar. The population in these locations comprised of three distinct socio-demographic strata that are rural, semi-urban and urban respectively. The pilot study focused on the following aspects of the survey such as testing of the questionnaire, testing of the field logistic preparation, testing of the scouting activities and testing of the central monitoring and logistic support.

4.5.2 Training of data collection teams

A two weeks training course was held for field supervisors, team leaders, nurses and interviewers to familiarize them with the questionnaire, develop their interpersonal communication skills and appreciate the need for good teamwork. Briefing on the questionnaire, mock interview in the classroom and individual practice under supervision was conducted during the training.

4.6 Quality Control

Quality control procedures for the data collection were done at two stages, field and central. Detail description of quality control process has been described in NHMS III protocol.

4.7 Data Management

4.7.1 Data screening

The following data screening exercises had been conducted at field and central levels prior to data entry:

a) Field data screen by each interviewers at the end of his/her interview.
b) Field data screen of each question by peer interviewers through exchanging questionnaire booklets.
c) Field data screen by team leaders and field supervisors.
d) Central data screening of the questionnaire by the quality control team.

4.7.2 Data entry

The data entry system was developed to record the information collected during the data collection phase. It is a web based system that allows multiple simultaneous accesses to the database. The NHMS III used a double manual data entry method and any discrepancy between both entries was verified by the supervisors. The data entry started simultaneously with data collection (first week of April 2006) and was completed at the end of January 2007. The data entered was stored in the database according to the module. The databases were designed using Structured Query Language (SQL) which is a standard language for relational database management system.

4.7.3 Data analysis

Data analysis was done by exporting the data into other analysis tools such as Microsoft Excel, SPSS and STATA. The data in database (text form) was exported to the Microsoft Excel form then to the SPSS and STATA. The raw data was cleaned and analysed according to the terms, working definition and dummy table prepared by the research groups. All the analysis process were monitored and advised by the NHMS III Statistics Consultant.

4.8 Definition of Terms / Variables

Data on asthma were obtained using Module G of the questionnaire booklets by trained interviewers. All household members in the selected LQs were interviewed. The questionnaire use to determine the prevalence of asthma was based on the International Survey of Asthma and Allergy in Children (ISAAC) questionnaire, which was previously used in 1995 and 2001 in an international survey involving school children 6-7 years old and 13-14 years old in Kuala Lumpur and other major cities in Malaysia. The questionnaire used to study the impact of asthma in adult and children was based on the Asthma Insight and Reality in Asia Pacific (AIRIAP) questionnaire previously used in an international survey involving countries in the Asia-Pacific including Malaysia in 2000.

Those who answered positively to any episodes of wheeze or breathlessness at any time or history of breathlessness at any time or episodes of cough at night without any associated URTI were considered to have asthma. Those who responded positively to any episodes of wheeze or breathlessness in the past 12 months were further questioned on episodes of exacerbations, visits to the ER or unscheduled visit and admission to the ward due to asthma exacerbation. They were also interviewed about limitation of activities and life style changes due to the asthma as well as number of school days loss. They were interviewed regarding place they sought treatment and types of medications used. These were identified from a picture book which illustrated the different types of medications. These included bronchodilator, preventer medications such as inhaled steroids, combination therapy and anti leukotrienes.

Childhood asthma is asthma in children aged 0 to 18 years old. Asthma severity was classified as intermittent or persistent based on the question of history of sleep disturbances due to breathlessness or wheezing and on the frequency of wheeze or breathlessness in the past 12 months

Estimates of the parameters from this survey were derived using a complex estimation procedure which ensured that the survey estimates conformed to an independently estimated distribution of the total population by state and strata. The data analysis, population estimates were expressed in rates, proportions and ratios.

5. FINDINGS

A total of 22,112 paediatric respondents were studied in this NHMS III 2006. The response rate for Module "G" was 99.3%. The distribution of ethnic composition comprised of 13,483 (61%) Malays, 3,223 (15%) Chinese, 1565 (7%) Indians, 3134 (14%) Other Bumiputra which included Orang Asli, Melanau, Kadazan etc, and 707 (3%) were categorized as others. By residence, 12,208 (55%) of the respondents were in the urban and 9904 (45%) in the rural areas.

5.1 Prevalence of Asthma

5.1.1 Total prevalence of asthma

From the survey, the total prevalence of childhood asthma is 7.1% (CI: 6.7 - 7.6). The lowest prevalence was among the 0-4 years old [5.9% (CI: 5.3 - 6.6)]. Males reported a higher prevalence of asthma [7.7% (CI: 7.1 - 8.3)]. By ethnicity, Malays has the highest prevalence [8.08% (CI: 7.52 - 8.67)] followed by Indians [7.4% (CI: 6.0 - 8.9)]. There was no significant difference in the prevalence between urban or rural population. Johor [9.2% (CI: 7.9 - 10.6)], Kedah [8.6% (CI: 7.1 - 10.5)], Melaka [8.4% (CI: 5.8 - 12.0)] and Kuala Lumpur [8.3% (CI: 6.5 - 10.6)] had the highest asthma prevalence. Pulau Pinang recoded the lowest prevalence of asthma in Malaysia [3.6% (CI: 2.3 - 5.7)]. There was no significant difference in the prevalence between different levels of education and household income **(Refer Appendix: Table 1 and Figure 5.1 - 5.7).**

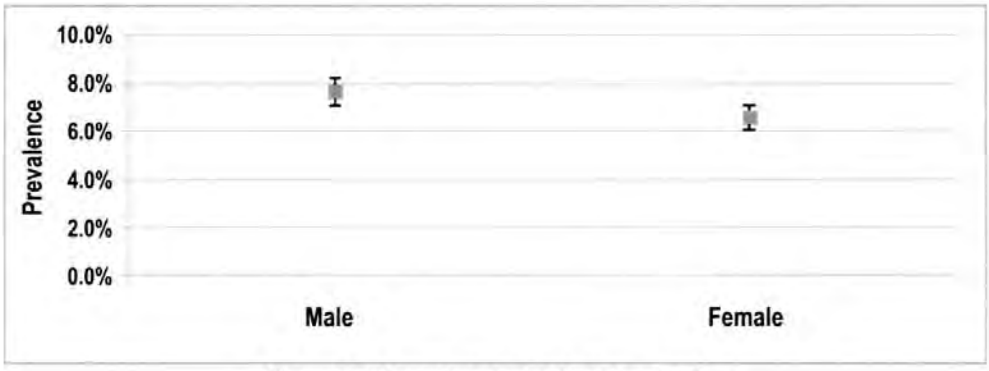

Figure 5.1: Prevalence of asthma by gender

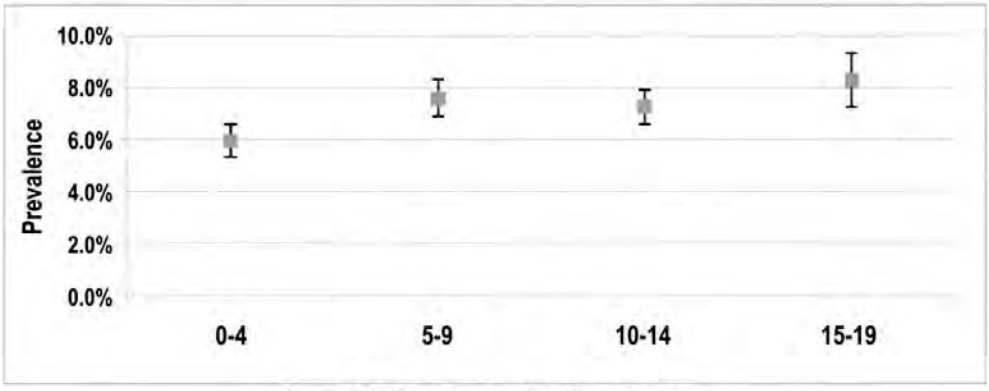

Figure 5.2: Prevalence of asthma by age

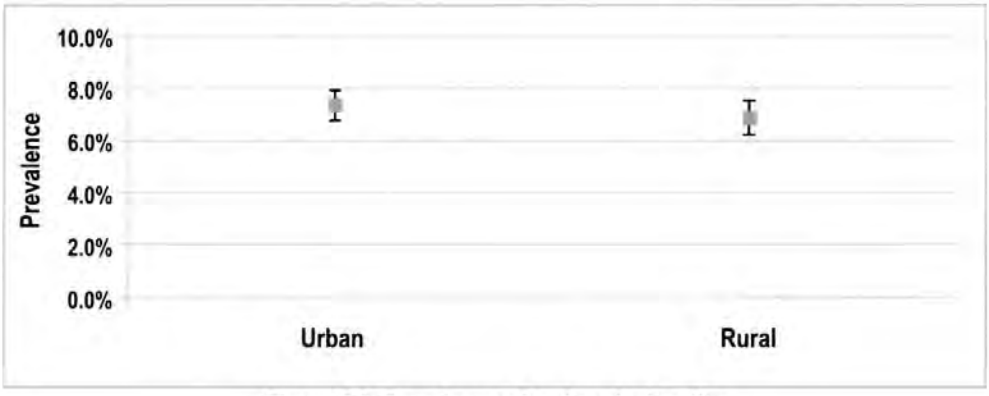

Figure 5.3: Prevalence of asthma by locality

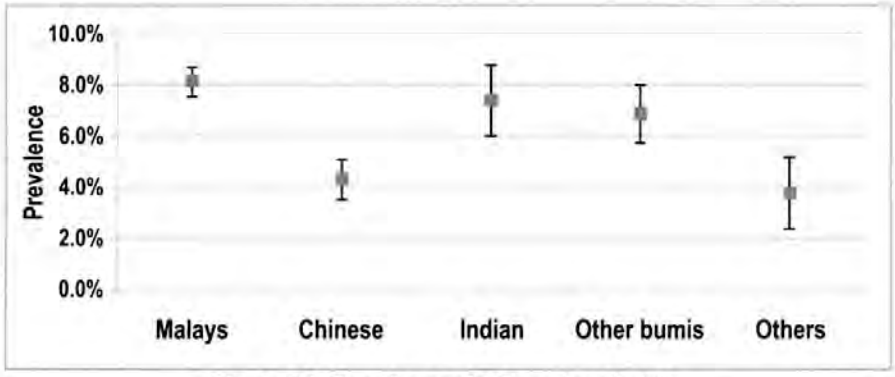

Figure 5.4: Prevalence of asthma by ethnicity

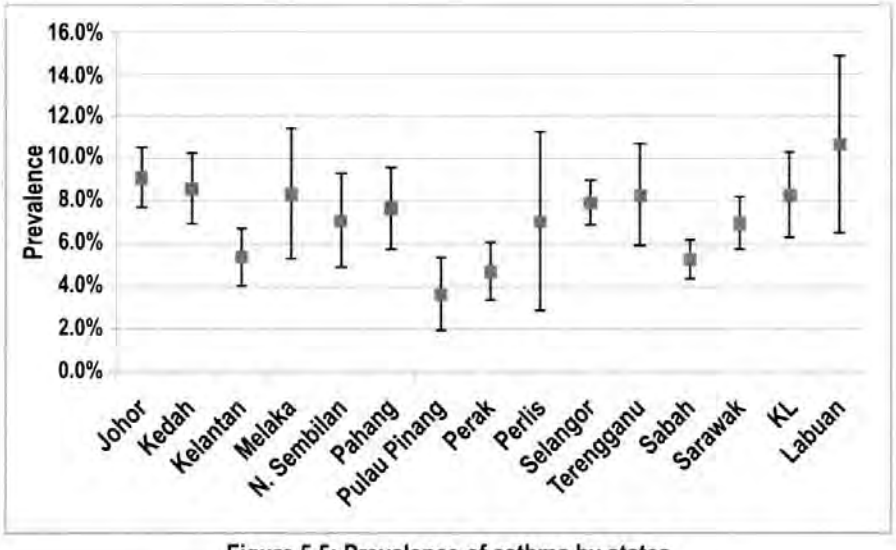

Figure 5.5: Prevalence of asthma by states

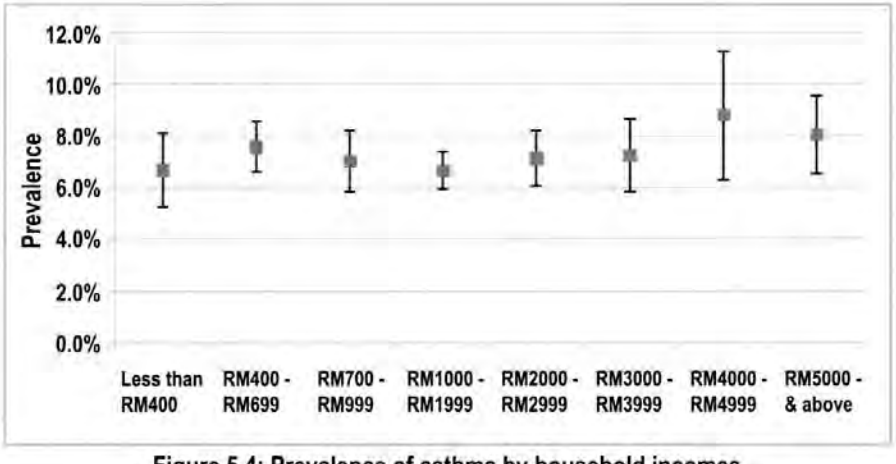

Figure 5.4: Prevalence of asthma by household incomes

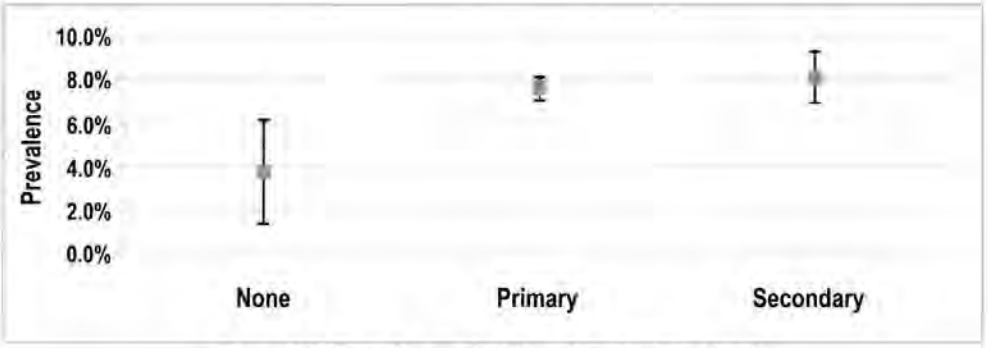

Figure 5.7: Prevalence of asthma by education levels

5.1.2 Prevalence of ever asthma

The prevalence of ever asthma was 6.4% (CI: 6.1 - 6.9). The lowest prevalence was among the 0-4 years old [5.6% (CI: 5.0 - 6.2)]. There was a significantly higher prevalence of ever asthma in males [7.0% (CI: 6.6 - 7.6)]. By ethnicity, Malays had the highest prevalence of ever asthma [7.4% (CI: 6.8 - 7.9)] followed by Indians [6.9% (CI: 5.7 - 8.3). The prevalence was significantly higher in children living in urban area [6.9% (CI: 6.4 - 7.4)]. By states, Melaka [8.4% (CI: 5.8 - 12.0)], Johor [8.2% (CI: 7.0 - 9.5)] and Kuala Lumpur [8.3% (CI: 6.5 - 10.6)] had the highest prevalence of ever asthma. Pulau Pinang recoded the lowest prevalence of asthma [3.2% (CI: 2.2 - 4.6)]. The prevalence of asthma is significantly lower in those with lower education levels i.e. no education [2.8% (CI: 1.4 - 5.5)] and with primary education [6.9% (CI: 6.4 - 7.5)]. However there was no significant difference in the asthma prevalence between different levels of household income. **(Refer Appendix: Table 1)**

5.1.3 Prevalence of current asthma

The prevalence of current asthma which was defined as recurrent wheeze or breathlessness in the past 12 months was 5.4 % (CI: 5.1 - 5.9). The prevalence was lowest in children aged 0-4 years old [4.8% (CI: 4.3 - 5.4)]. The survey showed that males seemed to report a higher prevalence [5.9% (CI: 5.5 - 6.5)]. Malay children recorded the highest prevalence [6.5% (CI: 6.0 - 7.1)] followed by Indians [6.1% (CI: 4.9 - 7.5)]. There was no significant difference in the prevalence between urban and rural areas. Johor [8.2% (CI: 6.9 - 9.7)], Perlis [6.6% (CI: 3.6 - 11.9)] and Selangor [6.6% (CI: 5.8 - 7.6)] had the highest prevalence of current asthma. Pulau Pinang recorded the lowest prevalence [2.4% (CI: 1.4 - 4.2)]. Current asthma was more prevalent in children with higher parental education level. **(Refer Appendix: Table 1)**

5.1.4 Prevalence of current wheeze

The prevalence of current wheeze was 4.0% (CI: 3.8 - 4.4). The prevalence was higher in children aged 5-9 years old [4.4% (CI: 3.9 - 4.9)] and among the 0-4 years old [4.1% (CI: 3.6% - 4.6)]. Current wheezers were higher in males as compared to females [4.5% (CI: 4.1 - 4.9)]. The prevalence was higher among Malays [4.9% (CI: 4.5 - 5.3)] and Indians [4.7% (CI: 3.7 - 6.0)]. The prevalence was higher amongst urban children [4.3% (CI: 4.0 - 4.8)]. By states, Johor had the highest prevalence of current wheeze [5.8% (CI: 4.8 - 6.9)] followed by Perlis [5.6% (CI: 3.0 - 10.4)] and Terengganu [5.4% (CI: 3.9 - 7.5)]. The prevalence of current wheeze was lowest in children whose parents have the lowest education level. **(Refer Appendix: Table 1)**

5.1.5 Prevalence of exercise induced asthma

Prevalence of exercise-induced asthma was 2.8% (CI: 2.6 - 3.2). The prevalence was reported to be higher in the older age groups 10-14 years old [3.2% (CI: 2.8 - 3.6)] and 15-18 years old [4.3% (CI: 3.6 - 5.1)]. The prevalence was higher in males [3.2% (CI: 2.9 - 3.6)]. The prevalence of exercise-induced asthma was significantly higher among the Indian population [3.7% (CI: 2.9 - 4.8)] and among the Malays [3.4% (CI: 3.1 - 3.8)].The prevalence was increased in urban area [3.0% (CI: 2.7 - 3.4)] compared to the rural area. The prevalence was significantly reported to be highest in Johor [4.5% (CI: 3.7 - 5.4)] followed by Terengganu [4.1% (CI: 2.8 - 6.0)] and Selangor [3.6% (CI: 3.0 - 4.4)]. The prevalence was significantly higher in children with higher parental education level [4.2% (CI: 3.4 - 5.1)]. **(Refer Appendix: Table 1)**

5.1.6 Prevalence of asthma in association with obesity

The prevalence of asthma was 8.2% (CI: 6.6 - 10.1) in children categorized as overweight. This was higher compared to children with normal weight [6.8% (CI: 6.3 - 7.4)] and in children who was defined as wasted [5.3% (CI: 4.2 - 6.7). **(Refer Appendix: Table 2 and Figure 5.8)**

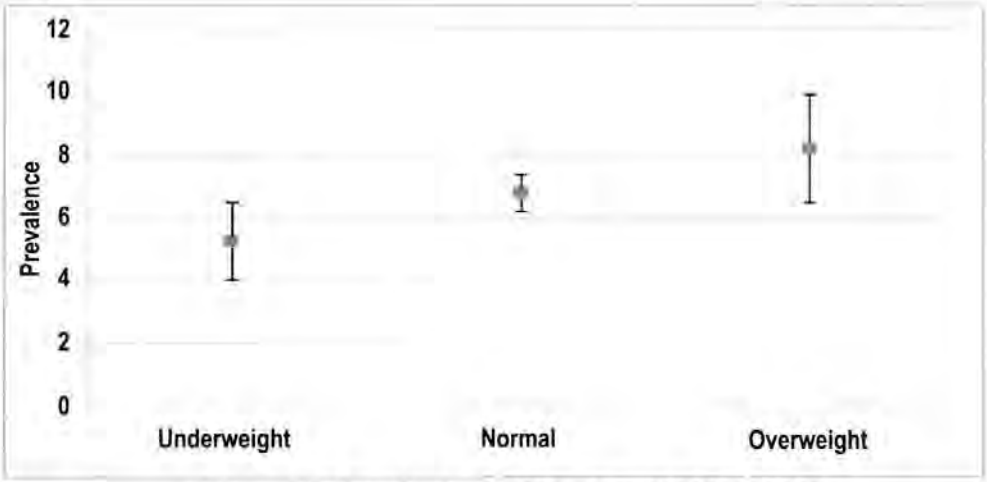

Figure 5.8: Prevalence of asthma by weight for height

5.2 Background Asthma Severity

5.2.1 Background asthma severity based On day symptoms

The background asthma severity is based on the frequency of breathlessness or wheezing in the past 12 months defined as intermittent or persistent. The prevalence of current asthmatics who reported frequency of symptoms 1-3 times in the past 12 months was 76.2% (CI: 73.0 - 79.2), 17.1% (CI: 14.5 - 20.0) reported frequency of symptoms 4-12 times and 6.5% (CI: 4.8 - 8.6) reported symptoms >12 times. **(Refer Appendix: Table 3)**

When asthma severity was sub-classified into intermittent and persistent group (based on day symptoms), 76.2% (CI: 73.0 - 79.2) was classified as intermittent and 23.5% (CI: 20.6 - 26.8) as

persistent group. Persistent asthma was higher among the 15-18 years old [26.7% (CI: 19.4 - 35.6)] and in the age group 10-14 years old [19.3% (CI: 14.7 - 25.0)]. There was no difference in severity pattern between males and females. Persistent asthma was highest in the Indian population [36.6% (CI: 25.9 - 48.9)], followed by Malays [23.8% (CI: 20.2 - 27.8)]. The lowest prevalence was among the ethnic group categorised as others [8.3% (CI: 1.1 - 41.3)]. Pulau Pinang had the highest group of persistent asthmatics being [44.4% (CI: 19.9 - 71.9)] followed by Perak [43.1% (CI: 28.8 - 58.6)] and Labuan [32.8% (CI: 11.0 - 65.8)]. The lowest prevalence of persistent asthma was in Johor [14.7% (CI: 9.8- 21.5)]. Persistent asthma is highest in children whose parents has no education [51.4% (CI: 17.3 - 84.2)] and unclassified [43.3% (CI: 16.7 - 74.4)] although statistically not significant. Parental income had no influence in determining asthma severity. **(Refer Appendix: Table 5)**

5.2.2 Background asthma severity based on sleep disturbance

The percentage of children who did not have any sleep disturbances was 40.1% (CI: 36.6 - 43.8) while 36.0% (CI: 32.7 - 39.5) of them had less than 1 night per week of sleep disturbance and 23.7% (CI: 20.8 - 26.) had one or more nights of sleep disturbances. The ethnic group categorized as Others [65.6% (CI: 36.0 - 86.6)] and Indians [60.6% (CI: 47.5 - 72.3)] were found to have the highest prevalence of sleep disturbances. When severity was categorised based on sleep disturbances, 40.1% fell in the intermittent group (CI: 36.6 - 43.8) and 59.7% (CI: 56.1 - 63.3) in persistent group. Children in the younger age groups 0-4 years old, [62.3% (CI: 55.5 - 68.7)] and 5-9 years old [66.0% (CI: 59.8 - 71.7)] were found to have higher proportion of persistent asthma. Although female had more persistent asthma [61.7% (CI: 56.4 - 66.6)], it is not significantly different from the males. Persistent asthma was higher in the Others ethnic group [65.6% (CI: 36.1 - 86.6)], Other Bumis [66.1% (CI: 54.5 - 76.0)] and the Indians [60.6% (CI: 47.5 - 72.3)] although it was not statistically significant. Rural children had more persistent asthma [62.9% (CI: 57.0 - 68.5)] compared to urban children. Persistent asthma was higher among children in Labuan [82.4% (CI: 52.0 - 95.3)] followed by Sarawak [75.0% (CI: 61.9 - 84.7)] and Terengganu [71.8% (CI: 59.7 - 81.4)]. Parental income has no influence in determining asthma severity. **(Refer Appendix: Table 5)**

5.2.3 Overall asthma severity in children

Overall asthma severity was classified into intermittent or severe asthma based on either day symptoms, night symptoms or sleep disturbances. Of all children with asthma, 34.8% (CI: 31.4 - 38.3) was classified as intermittent and 65.2% (CI: 61.7 - 68.6) as persistent asthma severity. **(Refer Appendix: Table 4)**

5.3 Frequency of Asthma Exacerbations

Among current asthmatics, 17.9% (CI: 15.4 - 20.8) did not have any asthma exacerbations. One to three exacerbations per year were present in 65.8% (CI: 62.3 - 69.1), 12.9% (CI: 10.5 - 15.6) had 4-12 exacerbations and 3.5% (CI: 2.3 - 5.2) has more than 12 exacerbations per year. The highest frequency of exacerbations were observed among the 0-4 years old of which 19.0% (CI: 14.1 - 25.2) had 4-12 exacerbations and 4.3% (CI: 2.1 - 8.4) had more than 12 exacerbations per year. While among the 5-9 years old, 15.4% (CI: 11.4 - 20.4) had 4-12 exacerbations and 3.6% (CI: 2.0 - 6.5) had more than 12 exacerbations. There was no significant difference between males and females. The Chinese had the highest percentage of asthma without exacerbations [22.6% (CI: 13.7 - 34.8)]. The Indians had the highest percentage of asthma exacerbations with [25.0% (CI: 15.8 - 37.2)] having 4-12 exacerbations and [8.1% (CI: 3.8 - 16.6)] with more than 12 exacerbations.

The children in the urban area had more exacerbations with 67.1% (CI: 62.6 - 71.3) having 1-3 exacerbations, 13.5% (CI: 10.4 - 17.3) having 4-12 exacerbations and 3.6% (CI: 2.1 - 6.0) having more than 12 exacerbations in a year although statistically not significant. Perak had the highest prevalence of exacerbations of which 26.8% (CI: 13.7 - 45.8) had 4-12 exacerbations, followed by Selangor [14.9% (CI: 10.3 - 21.0)]. Selangor had the highest exacerbation rates of more than 12 times [5.1% (CI: 2.2 - 11.4)] followed by Johor [3.8% (CI: 1.6 - 8.8)]. The exacerbations were significantly higher among parents with lower education level. There was no significant difference in exacerbations rates with parental household income. **(Refer Appendix: Table 6)**

5.4 Long Term Asthma Follow-Ups

The survey showed that 68.87% had no follow-up in the last one year, 23.92% (CI: 20.9 - 27.3) had 1-3 follow–up, 5.84% (CI: 4.3 - 7.8) had 4-12 follow-up and 1.15% (CI: 0.6 - 2.2) had more than 12 follow–ups. With regards to age groups, children between 10-14 years old [73.7% (CI: 67.2 - 79.4)] and 15-19 years old [83.8% (CI: 75.5 - 89.6)] had the highest prevalence of no follow-up. There was no significant difference in the follow up rates between males and females in urban and rural areas and between the different ethnic groups. Malays had the highest percentage of no follow-up [71.3% (CI: 67.1 - 75.2)]. The rural area had the highest population of asthmatics with no follow-up [71.3% (CI: 66.1 - 76.0)]. Pahang had the highest population of asthmatics with no follow-up [92.4% (CI: 76.0 - 97.9)], followed by Melaka [85.3% (CI: 61.2 - 95.5)] and Pulau Pinang [78.5% (CI: 49.5 - 93.1)]. In terms of education level, parents with secondary education had the highest prevalence of no follow-up [85.1% (CI: 75.4 - 91.5)]. There was no significant difference in follow-up rate between different levels of parental income. **(Refer Appendix: Table 7)**

5.5 Utilisation of Acute Care Service

5.5.1 Visits to the emergency department

The results showed that 15.6% (CI: 13.2 - 18.4) of asthmatics visited the emergency department once, 8.5% (CI: 6.8 - 10.6) twice and 8.1% (CI: 6.2 - 10.5) three or more times. The younger age group 0-4 years old and 5-9 years old significantly visited the emergency department more due to asthma exacerbations. Higher utilization of the emergency department was seen in males of which 10.2% (CI: 7.8 - 13.4) visited twice and 8.5% (CI: 5.9 - 12.0) visited three or more times in a year. There was no significant difference in the frequency of visits to the emergency department between different ethnic groups. Asthmatics from the rural area had the highest frequency of visits to the emergency department, 6.8% (CI: 13.6 - 20.6) had one visit, 8.6% (CI: 6.4 - 11.5) had two visits and 7.7% (CI: 15.4 - 10.9) had three or more visits although it was not statistically significant.

The survey showed there was a significant difference in the frequency of visits to the emergency department when comparing among the different states. Kelantan had the highest percentage of three or more visits to the emergency department [17.1% (CI: 8.5 - 31.3)]. Perlis documented the highest percentage of two visits in a year [17.7% (CI: 5.3 - 45.2) and Pahang documented the highest percentage of one visit to the emergency department [37.0% (CI: 20.4 - 57.4)]. The highest utilization of emergency department (three visits in a year) was among children whose parental education was unclassified and

with primary education. However, parental education did not play a significant role in the number of visits to the emergency department. **(Refer Appendix: Table 8)**

5.5.2 Admission to the ward due to asthma exacerbation

In term of admissions, 9.4% of asthmatic (CI: 97.5 - 11.7) had one admission, 2.9% (CI: 2.0 - 4.3) had two admissions and 2.0% (CI: 1.0 - 3.9) had three or more admissions per year. Children in the younger age groups 0-9 years old tend to have more admissions. Three or more admissions were seen in 4.7% (CI: 2.3 - 9.4) of children in the age group of 0-4 years old and 1.6% (CI: 0.5 - 5.0) was in the age group of 5-9 years old. Males were admitted more frequently than females of which 10.7% (CI: 8.1 - 13.9) had one admission, 2.8% (CI: 1.7 - 4.7) had two admissions and 2.5% (CI: 12.4 - 4.9) had three or more admissions. Ethnic groups categorised under Others had the highest percentage of admission of which 16.8% (CI: 4.2 - 48.5) had one ward admission and 8.4% (CI: 1.2 - 42.0) had two admissions. The Indians had the highest percentage of three or more admissions per year [5.9% (CI: 2.3 - 14.7)]. Sarawak had the highest admission for one admission per year [14.5% (CI: 6.0 - 31.0)]. Pulau Pinang had the highest percentage of two admissions per year [7.1% (CI: 1.0 - 37.1)] whereas Kedah had the highest percentage of three or more admissions per year [6.9% (CI: 1.0 - 34.5)]. **(Refer Appendix: Table 8)**

5.6 Morbidity of Asthma

5.6.1 School day loss

The percentage of children missing school due to asthma was 53.0% (CI: 49.0 – 58.0). The highest percentage of children missing school was in the age range of 5-9 years old [63.8% (CI: 55.8 - 71.1)]. Males tend to miss schools more than the females [56.7% (CI: 50.5 - 62.7)]. Ethnic group categorized as Others had the highest percentage of missing schools [74.4% (CI: 23.1 - 96.6)] followed by Indians [63.3% (CI: 48.8 - 75.7)] and Malays [55.1% (CI: 49.8 - 60.2)]. Children living in the urban area tend to miss schools [56.2% (CI: 50.5 - 61.7)] due to asthma. In term of states, Perlis had the highest percentage of missing schools [81.1% (CI: 32.1 - 97.5)], followed by Johor [67.7% (CI: 57.0 - 76.9)] and Terengganu [67.3% (CI: 48.6 - 81.8)]. Asthmatics with low parental education level [54.1% (CI: 49.0 - 59.0)] and parents with no education (100%) tend to miss schools due to asthma. **(Refer Appendix: Table 9)**

The mean number of days of missing schools was 3.6 days (CI: 3.1 - 4.2). The Indian children missed more school days [4.7 days (CI: 2.6 - 6.9)] compared to other ethnic groups. The asthmatics from the urban population tend to miss more school days [3.9 days (CI: 3.1 - 4.6)] as compared to the rural area [2.9 days (CI: 2.4 - 3.5)]. In term of states, Selangor had the highest percentage of school days lost [5.1 days (CI: 3.6 - 6.6)]. Comparing the different levels of parental education in asthmatic children, the longest days of school lost was among children whose parents had no education [6.2 days (CI: 0.0 - 12.3)].

5.6.2 Limitation of activities

Among the asthmatic children, 18.4% and 16.3% of them were affected by physical and social activities respectively. Sleep was affected in 25.3% of asthmatic children and 21.8% of the children were affected in sports and recreational activities. Both sexes were equally affected in their normal physical activities.

social activities, sleep disturbances and sports and recreational activities. The younger age group (5-9 years old) was more affected by their asthma in terms of sleep disturbances (29.7%). The older children were more affected in sports and recreational activities (25%). All ethnic groups were equally affected by their asthma in terms of sleep, sport and recreational activities. The asthmatics from the urban area were more affected in terms of all four activities except sleep which was more among asthmatics in rural area. **(Refer Appendix: Table 11)**

5.7 Management of Asthma

5.7.1 Pattern of Asthma treatment

The percentage of asthmatics not on any medications was 66.7%. Those who were on treatment, 13.1% was on short acting β_2 agonist alone, 6.2% on inhaled corticosteroids, 4.7% on combination therapy, 3.5% on anti–leukotrienes and 5.2% was on long acting β_2 agonist **(Refer Appendix: Table 12).**

Preventer therapy was prescribed in only a small percentage of persistent asthmatics (22.0%). However, a high proportion of intermittent asthmatics (17.1%) were also being prescribed preventer medications. Majority of children with persistent asthma was not on any medications (68.3%). Prescription of short acting beta 2 agonist was also low in all asthmatic children (10.1%). **(Refer Appendix: Table 13).**

The majority of the children (85.4%) were treated by doctors and paramedics, 5.0% went to the pharmacy using old prescriptions, 5.4% sought traditional treatment and 4.2% went to pharmacy without prescription. There was no difference in the pattern of seeking treatment between urban and rural areas. Overall, most patients in all states sought medical treatment from the doctors (more than 85%); Malacca and Pahang being the highest, 100% and 93.1% respectively. Negeri Sembilan had the highest percentage of asthmatics using traditional complementary medicine (22.0%). A higher proportion of asthmatic patients in states like Perlis, Terengganu, Labuan and Kedah went to the pharmacy with or without prescription for their asthma medications.

The parents of asthmatic children in all ages tend to bring their children to the doctor for treatment of asthma. However, among those who sought traditional complementary medicine, it was higher among parents of children age 15-18 years old. All ethnic groups visited the doctors for their asthma treatment however Indians had the highest percentage of seeking traditional complimentary medicine (10.5%). Parents with no education had the lowest percentage seeking treatment from the doctor instead they tend to seek treatment from the pharmacy or traditional complimentary medicine. **(Refer Appendix: Table 14)**

The highest percentage of children not on any form of medication was in the age group of 0-4 years old (81.3%) followed by those of 5-9 years old (72.2%). The highest use of preventer medications was by children 15-18 years old (25.5%) and 10-14 years old (24.8%). Ethnic group categorized as Others had the highest percentage of not being on any treatment (82.3%). In term of states, Pahang had the highest percentage of asthmatics not on any form of treatment (84.2%). Selangor and Perak had the highest percentage of using preventer medications, 29.5% and 26.7% respectively. Children whose parents had no education had the highest percentage of not using any form of medications (81.0%). **(Refer Appendix: Table 15).**

6. DISCUSSION

6.1 Asthma Prevalence

This survey showed that the total prevalence of childhood asthma in Malaysia was 7.1%. The prevalence of current asthma as defined as wheezing in the past 12 months was 5.1%. The prevalence of childhood asthma in the NHMS II in 1996 was only 4%. It was not possible to compare the prevalence in these two surveys as different questionnaires were used. In this survey, several relevant items from the International Asthma and Allergy in Childhood (ISAAC) questionnaires were used to measure the asthma prevalence in children. Part I of the ISAAC study was carried out in 1994 and 1995 using the standard questionnaires to assess the prevalence of asthma in schoolchildren of two age groups, 6-7 years and 13-14 years old from many regions of Asia. In general the prevalence rates of asthma in Asia were lower compared to UK and Australia. The regional average of asthma prevalence in Asia based on history of current wheezing in the past 12 months on the written questionnaire was 8%. Our survey showed that the prevalence of current wheezing in the past 12 months was 4%. This was much lower when compared to that of Asia. The highest reported prevalence of current wheezing was in Japan (13.4%) and Thailand (13%).

Previous data has shown that the prevalence of ever asthma which was defined as "have you ever had asthma" in Malaysia was 8.7% in 1990 among 7-12 years old and 10.3% in 2000.This survey showed that the prevalence of ever asthma was 6.4% in the age group of 0-18 years old. As compared to previous studies, one cannot be sure whether there is a true reduction in the asthma prevalence. There are few possible reasons for these findings. In many populations based studies, patients' or parents responses to the questionnaires depend on their level of understanding. The other possible reason is under diagnosis or over diagnosis due to the difficulty in understanding the word "wheeze" which is an important surrogate word used. This may be wrongly judged by the respondents as there is no equivalent word in Malay, Chinese or Tamil to translate the word wheeze. This may be much more obvious in East Malaysia with more ethnic groups (Wong et al. 2004).

The prevalence of asthma in children is higher in the urban area compared to the rural area. This is seen in the different states, where the prevalence in states such as Johor, Kuala Lumpur, and Selangor are among the highest. The common factor of the three states is that they are among the most urbanized states in Malaysia. This association indicate common factors such as allergen exposure and air pollution. In addition, there are many other risk factors of asthma that are associated with urbanization. The German Multicentre Atopy study and The Camp study showed that factors such as house dust mite, cat allergen and cockroaches are strongly associated with atopic sensitization and childhood asthma development (Wahn et al. 1997; Huss et al. 2001).

In states such as Sabah and Sarawak, the prevalence is lower compared to the total prevalence. These states are the less developed states in Malaysia with more agricultural activities. Strachan described the phenomenon of infections in early childhood or transmission of infections by unhygienic contact with older siblings may reduce asthma prevalence (Strachan 2000). Recent studies have confirmed the protective role of farming environment against the development of asthma and related atopic diseases. A study from Switzerland has shown that school children raised in farms had a lower rate of seasonal rhinitis symptoms and atopic sensitization. This was also seen in a German study of children aged 5-7 years,

farmers children had a lower prevalence of hay fever [OR 0.52 (95% CI: 0.28 - 0.99)], asthma [OR 0.65 (95% CI: 0.39 - 1.09)] and wheeze symptoms [OR 0.55 (95% CI: 0.36 - 0.86)] than peers living in non-agricultural environment. These factors may be reasons why the prevalence in these two states is lower.

The prevalence in Labuan is high (10.71%), however this may not be a true measured prevalence due to small sample size (n = 360) resulting in a wide confidence interval (7.22 - 15.60).

The prevalence of childhood asthma in the northern two states i.e. Kedah and Perlis is high 8.63% and 7.03% respectively, although both states may be considered as rural with farming community as compared to Kuala Lumpur. The reasons for the higher prevalence in these states may be due to the nature of farming activities. In these two states, rice farming and sugar cane plantation are the main activities. During paddy harvesting there may be more paddy husks particulates in the environment that may be inhaled into the respiratory system. The open burning that emits particulate matters in the environment may be a major contributor to pollutions on environment. However, this hypothesis requires further confirmation (Von-Ehrenstein et al. 2000; Braun et al. 1999).

In this study the prevalence of asthma is higher among Malays followed by Indians and Chinese. The prevalence of adult asthma in Singapore was found to be higher in Indians and Malays followed by Chinese. In this study it was reported that the risk factors identified in the Singapore population was the ownership of cats and rugs in the Malay and Indian populations. Smoking was also noted to be higher in the Malay and Indian population in Singapore. There may be a genetic influence that resulted in a higher prevalence of asthma in this population. At present there is no study in Malaysia investigating the genetic influence on ethnic differences. A study among the Singapore populations showed that ILe50/Ile50 was more prevalent in higher total serum IgE group in Malay (IgE >100 IU/ml). The prevalence of Ile50/R576 haplotype was lower in asthmatics than the control group of Chinese population.

The prevalence of asthma is higher in the higher economic status as seen in this survey. This is also the case in affluent Western countries compared to developing countries. A British study has shown higher risk of atopy in higher social class. This may indicate that socio-economic status is a surrogate for living conditions and life style rather than a risk factor by itself. Lifestyle may influence the availability of access to health care, nutrition, physical exercise, housing size, family size and housing conditions (Ng et al. 1994; Zhang et al. 2007; Silva et al. 1987).

In this study, there is a higher proportion of asthmatic children who are overweight compared to normal and wasted children (8.2% vs. 6.8%, 5.3%). However, it is not statistically significant. Studies on the association between asthma and overweight in children have shown conflicting results due to different methodology. Most of the studies did not perform objective measurement of lung function except one study done by Rashed AH et al. 2006. In his study of 109 children, 58 (53%) children were overweight. He found that 12 of the children who met the criteria of asthma based on the lung function test, 9 (75%) were overweight which resulted in a relative risk of 1.5 (Rashed et al. 2006). Further study is required investigate into the association between asthma and obesity.

6.2 Background Asthma Severity

Asthma severity in children is categorized as intermittent, mild persistent, moderate persistent and severe persistent. In this survey, the background asthma severity was based on day time symptoms and night time symptoms. The prevalence of persistent asthma based on daytime symptoms in this study was 23.5% and the nighttime symptoms were 59.7%. Further analysis of asthma severity based on day or night symptoms or sleep disturbances showed an overall prevalence for persistent asthma increased to 65.2% (CI: 61.7 - 68.6). The younger age group tends to have more nocturnal symptoms. In our culture, the younger children tend to co-sleep with their parents hence the higher reporting of nocturnal symptoms in this particular age group. This survey has shown that if asthma severity was classified only based on day symptoms, would be missed 30-40% of the population with asthma who may have night time symptoms. Therefore, it is important to include both day and night symptoms in assessment of asthma severity in children. In the New GINA guidelines, assessment of severity and asthma control, nocturnal symptoms and night awakening is one of the parameter incorporated in the assessment. The Chinese has the lowest percentage of persistent asthma severity and this is comparable to Singapore study (Ng & Tan 1999).

The asthma was found to be more severe in the Indian population based on the day time symptoms, hospitalization and acute health care utilisation. It is postulated that the asthma severity may be influenced by genetic and environmental factors.

6.3 Asthma Control

6.3.1 Acute utilization of health care due to asthma

The percentage of asthmatics who visited the ER department due to acute asthma exacerbation was 32.1%, 15.0% had at least one admission to the ward and 81.7% of them had unscheduled visit to the doctors. In contrast to the 2002 ARIAP survey in Malaysia, lower percentage of visits to the emergency department (19%), and unscheduled visits (30%) were observed. A similar percentage of respondents (15%) were hospitalized in the past 12 months. Overall, the acute health care utilization for asthma was still high especially in the younger age group reflecting the ongoing poor control of asthma in children. It might also reflect better accessibility to health care system and awareness of early symptoms of exacerbation. Acute health care utilization was higher among Indians in this survey foilowed by Malays. In a longitudinal study among the Singaporean, Indian ethnicity was also found to be associated with higher acute health care utilization followed by Malays (Ng et al. 2006). There is no difference in acute health care utilization between the urban and rural population suggesting that asthma control was not influenced by the urbanization. However, the environmental risk factors between urban and rural areas were not studied in this survey to determine their influences to the asthma control in children.

6.3.2 Asthma morbidity

In this study more than half of the children missed schools within the past one year due to asthma symptoms. In the AIRIAP study the percentage of respondents that missed schools was 36.5%. This showed that the children were still suffering from significant morbidity from asthma. Again looking at asthma severity, the Indian children had the highest percentage of missed schools days compared to

other ethnic groups. Consistently, the Indian population had more significant morbidity. In GINA, the goal of asthma therapy is to ensure that all asthmatics had no limitation of activities. This survey showed high percentages of asthmatic children who had limitations in sports and recreational as well as normal physical activities. This was comparable to the 2002 AIRIAP survey. It was also found a higher percentage of respondents had sleep disturbances namely 25.3%. This result suggested that the asthmatic children had poor asthma control.

6.3.3 Asthma treatment

Although preventive anti-inflammatory is recognized worldwide in the treatment of persistent asthma, only 21.8% of respondents in this survey were on preventer medications. Usage of preventive medications is significantly higher in urban population. Inhaled steroid was prescribed in 6.2% asthmatic while 4.7% was on combination therapy. The AIRIAP survey showed 13.6% of the sample reported current use of inhaled corticosteroids. In other regions such as Europe the use of inhaled corticosteroids was 23% and in the United States 15%. Preventive medication used among the younger age group was significantly lower despite higher asthma severity in this age group. The reasons of the low usage of inhaled corticosteroids might be attributed to many factors such as concern of long term use of steroids and lack of effectiveness over time or prescribing pattern of practitioners. In Malaysia, inhaled steroids are readily available nation wide and that availability may not be a reason for underused of steroids. However, these factors were not investigated in this survey.

Higher percentage of high income group was prescribed preventive medication compared to lower income group. In our survey, 68% of those earning more than RM2000 per month lived in the urban area. This could have explained the higher prescription of preventer medications due to better health care access. Respondents in the state of Kelantan had the lowest numbers on preventers. However this was statistically not significant.

Most of the asthmatic respondents in this study sought treatment from doctor (85.4%). Despite that only a small proportion of them were treated according to the guidelines. This finding may reflect that the medical practitioners might had under diagnosed, under assessed asthma severity or showed a lack of knowledge among the clinicians. There could be due to the possibility of the asthmatic patients being prescribed oral asthma medications such as ventolin, zaditen or theophylline which are not studied in this survey.

Majority of the respondents had no follow up for their asthma (69%) especially in the adolescence age group (83.8%). The reasons for no follow up in this particular age group could be due to lesser asthma severity, attitude towards the disease and the hectic life style. The middle class income group between RM4000-5000 had the highest follow-up treatment compared to the lower and higher income group. The higher income respondents tend to reside in urban areas. However, due to the sample size, this survey was unable to make any conclusion from the figures. Further study need to be conducted to verify the differences and patterns.

7. CONCLUSION

The prevalence of asthma in Malaysia is comparable to other neighbouring countries such as Singapore and Thailand. Despite the wide availability of medication, the utilization of inhaled steroids in the management of persistent asthma is low. As a result the asthma morbidity is high. This is reflected by the high number of asthmatics being admitted to the ward or using the emergency services due to asthma exacerbations. It is vital to address this issue, to increase awareness among general practitioners regarding asthma management and health education among asthmatic sufferers.

8. RECOMMENDATION

In NHMS III, the questionnaires used for asthma in children was a modified version of ISAAC and AIRIAP survey. This was different from the questionnaire used in NHMS II survey. The present set of questionnaires should be used in future surveys in order to compare the data locally and internationally.

The survey confirms the under-diagnosed and the under-treatment of asthma in children. Based on our survey, more than 80% of the asthmatics sought treatment from doctors. However, only a small proportions of them was given proper treatment. It is a great concern that our medical practitioners failed to manage asthmatic patients according to the clinical practice guidelines. This could be due to lack of understanding of the clinical practice guidelines resulting in failure of implementation. More effort should be put in improving the knowledge of asthma management among the medical practitioners by well structured asthma educational program which include theory and practical aspects such as asthma education workshops. This program should be targeted towards all levels of staffs involved in asthma management at primary and secondary care. The program should be incorporated into the clinical professional development to ensure all medical practitioners will be well verse in asthma management.

More than 80% of asthmatic patients utilized the acute health care services in rural and urban areas. However, only a small percentage of them are being followed up for their asthma. The importance of long term follow up should be emphasized to the primary care staffs and patients. Mechanism must be established to ensure all asthmatic patients are given a follow up for further evaluation of their asthma severity and long term management.

A Structured Asthma Program should be established at the ministry level such as programme for diabetes, hypertension and cardiovascular diseases. the program, should have a designated budget, human resources, training activities and services that can be implemented systematically throughout the country. The Ministry of Health should involve the non-governmental organization (NGOs) such as the Asthma Council of Malaysia, Malaysian Thoracic Society and Lung Foundation of Malaysia to increase public awareness and community participation. Establishment of this program will ensure a proper overall management of asthmatic children.

This survey has identified a few areas that need further research. There are striking differences in asthma severity and acute health care utilization among ethnic groups in Malaysia that need further clarification. Another concern is the prescribing pattern of medical practitioners in treating asthmatic children. Further study need to be carried out to look into environmental risk factors to explain the variation in prevalence of asthma in different geographical areas in Malaysia.

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APPENDIX

APPENDIX

Table 1: Prevalence of childhood asthma according to socio-demographic

	Asthma	Ever asthma	Current asthma	Current wheeze	Exercise induced asthma
Total prevalence	**7.1**	**6.4**	**5.4**	**4.0**	**2.8**
Age group					
0 - 4	5.9	5.6	4.8	4.1	1.8
5 - 9	7.6	7.0	5.6	4.4	3.0
10 - 14	7.3	6.5	5.5	3.8	3.2
15 - 18	8.3	7.4	6.6	4.0	4.3
Gender					
Male	7.7	7.1	5.9	4.5	3.2
Female	6.6	6.0	5.0	3.7	2.6
Race					
Malay	8.1	7.4	7.4	4.5	3.4
Chinese	4.3	4.0	4.0	2.0	1.6
Indian	7.4	6.9	6.9	4.7	3.7
Other bumi	6.8	6.3	6.3	3.1	1.9
Others	3.8	3.1	3.1	1.6	1.0
Strata					
Urban	7.3	6.9	6.9	4.3	3.0
Rural	6.8	6.0	6.0	3.7	2.7
State					
Johor	9.2	8.2	8.2	5.8	4.5
Kedah	8.6	7.6	6.1	3.9	2.8
Kelantan	5.4	5.3	4.2	3.7	2.5
Melaka	8.4	8.4	5.8	4.4	3.3
N. Sembilan	7.1	6.5	6.2	4.6	2.4
Pahang	7.7	5.6	6.0	2.8	2.7
Penang	3.6	3.2	2.4	1.7	1.0
Perak	4.7	4.5	4.2	3.4	2.6
Perlis	7.1	6.5	6.6	5.6	2.5
Selangor	8.0	7.6	6.7	5.3	3.6
Terengganu	7.0	7.8	5.1	5.4	4.1
Sabah	5.3	5.0	3.2	2.5	1.6
Sarawak	7.0	6.0	6.6	3.5	2.8
K L	8.3	8.3	6.6	4.0	2.1
Labuan	10.7	8.3	4.6	3.8	0.8
Household Income					
RM <400	6.7	6.0	5.4	3.7	2.6
RM 400 - <700	7.6	6.9	5.7	4.5	3.0
RM 700 - <1000	7.0	6.5	5.2	3.7	2.7
RM 1000 - <2000	6.7	6.0	5.2	3.8	2.8
RM 2000 - <3000	7.1	6.5	5.9	4.3	3.2
RM 3000 - 4000	7.2	6.7	5.5	4.2	2.6
RM 4000 - 5000	8.8	8.8	5.4	4.9	3.2
RM >5000	8.0	7.6	6.1	4.7	3.4
Educational Level					
None	3.8	2.8	3.1	2.1	1.7
Primary	7.6	6.9	5.7	4.1	3.2
Secondary	8.1	7.2	6.4	3.8	4.2

Table 2: Prevalence of asthma in relation to weight for height

Weight for height	Asthma	No asthma
Wasted	5.3	94.7
Normal	6.8	93.2
Overweight	8.2	91.8

Table 3: Background asthma severity based on Day symptoms

Frequency of symptoms		
1-3 times	**4-12 times**	**> 12 times**
76.2% (CI: 73.0 - 79.2)	17.1% (CI: 14.5 – 20.0)	6.5% (CI: 4.8 - 8.6)

Table 4: Overall asthma severity

Asthma Severity n=862	
Intermittent n=296	**Persistent n=566**
34.8% (CI 31.4 - 38.3)	65.2% (CI 61.7 - 68.6)

Table 5: Background asthma severity based on symptoms

	Severity based on day symptoms		Severity based on nocturnal symptoms	
	Intermittent	Persistent	Intermittent	Persistent
Total prevalence	**76.4 (73.3 - 79.4)**	**23.5 (20.6 - 26.8)**	**40.1 (36.6 - 43.8)**	**59.8 (56.2 - 63.3)**
Age group				
0 - 4	76.0	24.0	37.7	62.3
5 - 9	74.7	25.3	34.0	66.0
10 - 14	79.8	19.3	48.7	50.8
15 - 18	73.3	26.7	43.0	57.0
Gender				
Male	76.0	23.7	41.5	58.2
Female	76.1	23.3	38.4	61.7
Race				
Malay	75.9	23.8	40.2	59.6
Chinese	83.3	16.7	49.4	50.6
Indians	63.4	36.7	39.4	60.6
Other Bumis	83.0	17.0	33.9	66.1
Others	91.7	8.3	34.4	65.6
Strata				
Urban	75.8	24.0	41.9	57.9
Rural	77.0	22.7	37.1	62.9
State				
Johor	85.3	14.7	48.1	51.9
Kedah	77.2	22.8	32.6	67.4
Kelantan	77.2	22.8	37.7	62.3
Melaka	83.6	16.4	63.7	36.3
N.Sembilan	86.9	13.1	39.7	60.3
Pahang	80.4	16.1	43.5	53.0
P.Pinang	55.6	44.4	40.4	59.6
Perak	56.9	43.1	42.8	57.2
Perlis	76.2	23.9	50.0	50.0
Selangor	70.9	29.1	42.2	57.8
Terengganu	81.1	18.9	28.2	71.8
Sabah	75.3	24.7	36.4	63.6
Sarawak	76.6	23.4	25.0	75.0
KL	84.6	15.4	50.0	50.0
Labuan	59.2	32.8	17.6	82.4
Household Income				
RM <400	74.1	25.9	42.6	57.4
RM 400 - <700	76.2	23.0	33.0	66.2
RM 700 - <1000	75.9	24.2	42.3	57.7
RM 1000 - <2000	80.0	20.0	38.4	61.6
RM 2000 - <3000	74.6	25.5	46.3	53.7
RM 3000 - 4000	76.6	23.4	50.6	49.4
RM 4000 - 5000	63.3	36.7	37.2	62.8
RM >5000	77.7	22.3	38.3	61.7
Educational level				
None	48.7	51.4	1.7	98.3
Primary	77.3	22.3	3.2	96.8
Secondary	74.9	25.2	4.2	95.8

Table 6: Frequency of asthma exacerbation

	Frequency of asthma exacerbation			
	0	1 - 3	4 – 12	>12
	%	%	%	%
Total prevalence	**17.9 (15.4 - 20.8)**	**65.8 (62.3 - 69.1)**	**12.9 (10.5 - 15.6)**	**3.5 (2.3 - 5.2)**
Age group				
0 - 4	10.3	66.5	19.0	4.3
5 - 9	10.7	70.3	15.4	3.6
10 - 14	27.3	64.0	6.4	2.3
15 - 18	32.4	57.1	6.9	3.6
Gender				
Male	17.6	64.1	15.0	3.3
Female	18.4	67.9	10.1	3.6
Race				
Malay	18.7	66.2	12.4	2.7
Chinese	22.6	66.4	7.7	3.4
Indians	7.3	59.6	25.0	8.1
Other Bumis	19.0	65.9	9.7	5.4
Others	8.4	82.2	9.3	0.0
Strata				
Urban	15.9	67.1	13.5	3.6
Rural	21.7	63.4	11.7	3.2
State				
Johor	15.2	69.0	12.0	3.8
Kedah	15.9	58.4	25.7	0.0
Kelantan	20.4	68.7	7.7	3.2
Melaka	19.4	75.1	5.5	0.0
N.Sembilan	25.5	63.3	8.1	3.0
Pahang	17.3	79.5	3.2	0.0
P.Pinang	21.5	70.9	7.6	0.0
Perak	20.4	50.8	26.8	2.0
Perlis	8.9	73.4	8.9	8.9
Selangor	16.3	63.8	14.9	5.1
Terengganu	25.1	65.4	6.5	3.1
Sabah	13.5	72.8	8.7	5.0
Sarawak	19.9	67.2	9.9	3.1
KL	15.0	70.0	12.5	2.5
Labuan	36.3	43.2	6.8	13.7
Household income				
RM <400	22.6	58.3	14.1	5.1
RM 400 - <700	23.6	61.5	13.0	2.0
RM 700 - <1000	19.7	67.4	9.7	3.3
RM 1000 - <2000	18.4	67.4	12.6	1.6
RM 2000 - <3000	16.3	68.3	9.3	6.1
RM 3000 - 4000	12.5	66.5	17.6	3.5
RM 4000 - 5000	16.9	50.9	23.9	8.4
RM >5000	8.2	79.7	10.7	1.5
Educational level				
None	44.7	36.3	19.1	0.0
Primary	21.4	64.2	11.5	2.9
Secondary	31.8	60.0	4.7	3.6

Table 7: Distribution of asthmatic children by frequency of follow-up

	Follow Up Treatment			
	0	1 - 3	4 - 12	>12
	%	%	%	%
Total prevalence	**69.0 (65.0 - 72.0)**	**24.0 (21.0 - 27.0)**	**6.0 (4.0 - 8.0)**	**1.0 (1.0 - 2.0)**
Age group				
0 - 4	60.0	28.0	10.1	1.9
5 - 9	66.3	26.5	6.4	0.8
10 - 14	74.0	22.6	2.9	0.4
15 - 18	83.8	12.5	1.7	2.0
Gender				
Male	66.8	26.1	5.8	1.3
Female	71.8	21.1	5.9	1.0
Race				
Malay	71.4	22.3	5.2	1.1
Chinese	63.8	28.2	8.0	0.0
Indians	61.5	26.6	10.3	1.5
Other Bumis	64.1	29.0	4.3	2.6
Others	54.1	36.6	9.3	0.0
Strata				
Urban	67.7	25.6	5.3	1.5
Rural	71.3	21.0	6.8	0.6
State				
Johor	67.0	27.6	5.4	0.0
Kedah	61.2	27.4	9.7	1.8
Kelantan	75.8	19.2	3.4	1.7
Melaka	85.3	8.9	5.8	0.0
N.Sembilan	82.8	17.2	0.0	0.0
Pahang	92.4	7.7	0.0	0.0
P.Pinang	78.5	13.9	7.6	0.0
Perak	55.0	31.1	11.7	2.2
Perlis	73.4	8.9	17.7	0.0
Selangor	70.0	21.7	6.5	1.8
Terengganu	73.4	23.6	3.1	0.0
Sabah	75.2	23.5	0.0	1.3
Sarawak	49.7	41.0	6.1	3.2
KL	67.5	25.0	7.5	0.0
Labuan	70.7	7.3	22.0	0.0
Household income				
RM <400	76.6	14.6	7.2	1.6
RM 400 - <700	74.8	19.5	5.7	0.0
RM 700 - <1000	72.6	25.1	2.3	0.0
RM 1000 - <2000	71.7	20.4	7.0	1.0
RM 2000 - <3000	69.9	20.5	7.8	1.7
RM 3000 - 4000	66.5	23.4	10.1	0.0
RM 4000 - 5000	35.7	52.1	3.3	9.0
RM >5000	60.6	39.4	0.0	0.0
Educational level				
None	81.0	19.1	0.0	0.0
Primary	71.4	23.3	4.5	0.8
Secondary	85.1	12.5	2.4	0.0

Table 8: Health utilisation of acute care services during asthma exacerbations

	Unscheduled Visit to Doctor				Visit to Emergency Department				Ward Admission			
	0	1 - 3	4 - 12	>12	0	1	2	>3	0	1	2	>3
Total prevalence	**18.3**	**65.7**	**12.5**	**3.5**	**67.9**	**15.4**	**8.6**	**8.1**	**86.0**	**9.3**	**2.9**	**1.9**
Age group												
0 - 4	10.3	66.5	19.0	4.3	60.5	19.8	9.7	10.1	75.0	16.2	4.2	4.7
5 - 9	10.7	70.3	15.4	3.6	63.0	16.2	10.4	10.5	86.8	18.5	3.2	1.6
10 - 14	27.3	64.0	6.4	2.3	75.6	11.6	8.0	4.8	90.4	7.1	2.1	0.4
15 - 18	32.4	57.1	6.9	3.6	78.8	13.7	2.7	4.9	95.4	2.6	1.1	1.0
Gender												
Male	17.6	64.1	15.0	3.3	65.9	15.4	10.2	8.5	84.1	10.7	2.8	2.5
Female	18.4	67.9	10.1	3.6	70.2	15.9	6.3	7.6	87.8	7.8	3.0	1.4
Race												
Malay	18.7	66.2	12.4	2.7	68.1	15.9	7.9	8.0	86.0	9.2	2.9	1.9
Chinese	22.6	66.4	7.7	3.4	76.6	10.0	8.2	5.2	90.0	8.3	1.7	0.0
Indians	7.3	59.6	25.0	8.1	66.2	15.3	7.2	11.3	83.0	9.5	1.5	5.9
Other Bumis	19.0	65.9	9.7	5.4	59.2	17.3	14.5	9.0	83.8	11.1	4.2	1.0
Others	9.4	82.2	9.3	0.0	66.3	25.3	8.4	0.0	74.7	16.8	8.4	0.0
Strata												
Urban	15.9	67.1	13.5	3.6	66.9	16.8	8.6	7.7	84.4	9.8	2.9	2.8
Rural	21.7	63.4	11.7	3.2	69.5	13.4	8.4	8.8	88.1	8.6	2.8	0.6
State												
Johor	15.2	69.0	12.0	3.8	72.2	17.5	5.7	4.6	83.6	12.5	2.3	1.7
Kedah	15.9	58.4	25.7	0.0	74.6	9.5	5.8	10.1	80.4	11.3	1.5	6.9
Kelantan	20.4	68.7	7.7	3.2	68.6	11.3	3.0	17.1	95.3	4.7	0.0	0.0
Melaka	19.4	75.1	5.5	0.0	85.3	5.8	3.1	5.8	94.5	0.0	5.5	0.0
N.Sembilan	25.5	63.3	8.1	3.0	84.2	5.6	5.1	5.1	97.5	2.6	0.0	0.0
Pahang	17.3	79.5	3.2	0.0	49.4	37.0	6.2	7.4	86.4	13.6	0.0	0.0
Penang	21.5	70.9	7.6	0.0	64.6	7.1	14.2	14.2	85.8	7.1	7.1	0.0
Perak	20.4	50.8	26.8	2.0	56.9	15.4	6.1	21.6	83.4	9.3	3.6	3.6
Perlis	8.9	73.4	8.9	8.9	26.6	38.0	17.7	17.7	100.0	0.0	0.0	0.0
Selangor	16.3	63.8	14.9	5.1	77.1	11.7	7.2	3.9	87.2	7.7	2.8	2.4
Terengganu	25.1	65.4	6.5	3.1	56.3	21.3	16.3	6.1	87.1	9.1	3.8	0.0
Sabah	13.5	72.8	8.7	5.0	61.8	17.2	13.4	7.5	84.2	11.0	4.8	0.0
Sarawak	19.9	67.2	9.9	3.1	56.0	19.0	14.5	10.5	81.0	14.5	2.8	1.8
K L	15.0	70.0	12.5	2.5	57.5	25.0	15.0	2.5	75.0	12.5	7.5	5.0
Labuan	36.3	43.2	6.8	13.7	71.9	7.6	6.8	13.7	78.8	7.6	6.8	6.8
Household income												
RM <400	22.6	58.3	1.1	5.1	66.1	18.6	5.4	9.9	82.9	10.0	7.1	0.0
RM 400 - <700	23.6	61.5	13.0	2.0	66.0	19.5	8.4	6.1	84.0	12.1	2.1	1.7
RM 700 - <1000	19.7	67.4	9.7	3.3	72.6	16.1	6.2	5.1	89.2	7.6	3.2	0.0
RM 1000 - <2000	18.4	67.4	12.6	1.6	69.7	15.1	8.6	6.7	88.1	8.3	1.8	1.8
RM 2000 - <3000	16.3	68.3	9.3	6.1	68.8	10.7	15.2	5.3	86.6	7.9	3.2	2.3
RM 3000 - 4000	12.5	66.5	17.6	4.4	58.9	19.2	7.0	14.8	82.6	9.8	6.1	1.5
RM 4000 - 5000	16.9	50.9	23.9	8.4	68.1	12.2	2.7	17.0	75.9	9.5	3.1	11.5
RM >5000	8.2	79.7	10.7	1.5	68.7	11.9	6.7	12.8	88.4	10.1	0.0	1.5
Educational level												
None	44.7	36.3	19.1	0.0	63.7	0.0	36.3	0.0	100.0	0.0	0.0	0.0
Primary	21.4	64.2	11.5	2.9	72.0	13.1	7.7	7.2	89.5	8.0	1.8	1.2
Secondary	31.8	60.0	4.7	3.6	80.3	17.1	0.0	2.5	94.9	3.6	1.5	0.0

Table 9: Percentage asthmatic children with school day loss

Independent Variables	Day loss	
	Yes	No
	%	%
Age group		
0 - 4	0.0	0.0
5 - 9	63.8	36.2
10 - 14	49.6	50.4
15 - 18	44.6	55.4
Gender		
Male	56.7	43.3
Female	49.1	50.9
Race		
Malay	55.1	44.9
Chinese	41.8	58.2
Indians	63.3	36.7
Other Bumis	29.3	70.7
Others	74.4	25.6
Strata		
Urban	56.2	43.8
Rural	46.2	53.8
State		
Johor	67.7	32.3
Kedah	60.1	39.9
Kelantan	47.3	52.7
Melaka	57.3	42.7
N.Sembilan	45.0	55.0
Pahang	63.1	36.9
P.Pinang	34.7	65.3
Perak	42.6	57.4
Perlis	81.1	18.9
Selangor	47.9	52.1
Terengganu	67.3	32.7
Sabah	48.0	52.0
Sarawak	36.8	63.3
KL	57.7	42.3
Labuan	0.0	100.0
Household income		
RM <400	44.3	55.7
RM 400 - <700	57.2	42.8
RM 700 - <1000	39.8	60.2
RM 1000 - <2000	57.7	42.3
RM 2000 - <3000	52.3	47.8
RM 3000 - 4000	66.1	34.0
RM 4000 - 5000	29.2	70.8
RM >5000	47.4	52.6
Educational level		
None	100.0	0.0
Primary	54.1	45.9
Secondary	42.5	57.5

Table 10: Mean days of missing schools

	Mean	95% Confidence Interval	
Total prevalence	**3.6**	**3.1**	**4.2**
Age group			
5 - 9	4.0	2.8	5.1
10 - 14	3.2	2.6	3.7
15 - 18	3.9	2.7	5.0
Gender			
Male	3.5	2.8	4.3
Female	3.8	2.9	4.6
Race			
Malay	3.6	3.0	4.2
Chinese	2.8	1.8	3.8
Indian	4.7	2.6	6.9
Other bumi	1.9	1.3	2.6
Others	3.6	1.0	6.2
Strata			
Urban	3.9	3.1	4.6
Rural	2.9	2.4	3.5
State			
Johor	2.8	2.1	3.5
Kedah	4.9	3.1	6.7
Kelantan	3.1	2.1	4.1
Melaka	5.9	< 0.1	12.5
N. Sembilan	2.4	1.5	3.3
Pahang	1.9	1.3	2.5
Penang	4.5	1.0	8.0
Perak	5.1	0.4	9.8
Perlis	1.9	1.0	2.9
Selangor	5.1	3.7	6.6
Terengganu	2.6	1.7	3.4
Sabah	3.0	2.0	4.0
Sarawak	1.9	1.5	2.3
K L	3.0	1.8	4.2
Household income			
RM <400	4.6	1.8	7.3
RM 400 - <700	3.3	2.1	4.6
RM 700 - <1000	2.6	1.5	3.8
RM 1000 - <2000	3.8	2.5	5.1
RM 2000 - <3000	3.1	2.2	4.0
RM 3000 - 4000	4.0	2.0	6.0
RM 4000 - 5000	4.7	0.6	8.8
RM >5000	3.4	2.4	4.5
Educational level			
None	6.2	0.0	12.3
Primary	3.5	2.9	4.1
Secondary	3.7	2.3	5.2

Table 11: Percentage of asthmatic children with limitation of activities

Independent Variables	Activities						
	Normal physical exertion	Choice of job / career	Social activities	Sleeping	Life style	Housekeeping chores	Sport & recreation
	%	%	%	%	%	%	%
Total (1948)	**18.4**	**0.6**	**16.3**	**25.3**	**14.1**	**3.5**	**21.8**
Age group							
0 - 4	19.2	0.0	17.0	29.7	15.7	0.0	18.3
5 - 9	19.0	0.0	18.3	25.6	15.5	0.0	21.6
10 - 14	19.0	0.6	14.9	21.8	12.8	6.0	25.0
15 -18	13.9	3.5	12.7	23.9	10.4	13.9	21.6
Gender							
Male	18.2	0.5	16.4	25.9	13.9	2.9	22.2
Female	18.6	0.8	16.2	24.7	14.3	4.2	21.2
Race							
Malay	18.3	0.5	16.8	24.3	14.5	3.7	21.9
Chinese	15.7	1.0	14.7	29.4	10.8	2.9	25.5
Indians	18.8	1.6	17.2	24.0	12.5	3.1	22.9
Other Bumis	19.9	0.7	11.4	34.8	14.9	2.1	16.3
Others	21.8	0.0	15.6	25.0	12.5	3.1	21.9
Strata							
Urban	18.6	0.9	17.1	23.3	14.2	3.7	22.2
Rural	18.1	0.3	15.1	28.4	13.9	3.1	21.1
State							
Johor	17.7	0.0	17.0	26.2	12.6	3.3	23.3
Kedah	20.8	0.0	16.2	24.8	12.8	2.7	24.8
Kelantan	18.3	0.0	17.8	23.3	13.3	5.0	22.2
Melaka	24.3	2.7	16.2	27.0	10.8	0.0	18.9
N.Sembilan	16.7	1.3	16.7	26.9	14.1	5.1	19.2
Pahang	18.4	0.0	17.1	22.4	15.8	5.3	21.1
P.Pinang	18.8	6.3	18.8	31.3	6.3	0.0	18.8
Perak	16.1	0.0	15.3	24.1	17.5	2.2	24.8
Perlis	14.3	0.0	14.3	19.1	14.3	14.3	23.8
Selangor	17.9	1.8	16.7	24.8	14.5	4.1	20.2
Terengganu	20.3	0.0	19.3	19.8	16.0	3.2	21.4
Sabah	17.8	0.6	12.3	30.1	14.7	2.5	22.1
Sarawak	19.4	0.0	16.9	19.5	10.2	1.0	19.4
KL	19.5	0.0	16.9	19.5	18.2	1.3	24.7
Labuan	13.6	0.0	9.1	50.0	9.1	9.1	9.1
Household income							
RM <400	21.0	0.0	15.3	24.2	16.1	1.6	21.8
RM 400 - <700	20.2	0.3	15.6	24.7	14.3	4.3	20.7
RM 700 - <1000	17.0	0.0	16.0	24.5	16.0	3.3	23.1
RM 1000 - <2000	17.6	0.8	16.3	26.5	13.5	3.9	21.5
RM 2000 - <3000	19.1	1.1	14.7	27.2	11.8	4.0	22.1
RM 3000 - 4000	17.2	1.4	20.0	23.5	15.2	1.4	21.4
RM 4000 - 5000	21.1	0.0	14.0	24.6	12.3	1.8	26.3
RM >5000	16.9	0.0	19.2	23.8	15.7	3.5	20.9
Educational level							
None	6.7	6.7	13.3	26.7	6.7	13.3	26.7
Primary	18.5	0.7	16.1	23.4	14.1	3.9	23.4
Secondary	15.6	2.2	13.4	23.7	10.8	13.4	21.0

Table 12: Various forms of asthma medications used

Treatment					
No Treatment	Short acting	Inhaled corticosteroids	Combination	Anti leukotriene	Long acting
N=586	N=117	N=54	N=41	N=31	N=46
66.7%	13.3%	6.2%	4.7%	3.5%	5.2%

Table 13: Overall asthma severity and asthma medications given

Severity	Types of asthma medications		
	None	Short Acting	Preventer
Intermittent	72.1%	10.9%	17.1%
Persistent	68.3%	9.7%	22.0%
Total	69.6%	10.1%	20.3%

Table 14: Distribution of asthmatic children by site of seeking treatment during asthmatic attack

	Source of treatment			
	Doctor	Pharmacy with old prescription	Over the counter	T/CM
	%	%	%	%
Total prevalence	**85.4**	**5.0**	**4.2**	**5.4**
Age group				
0 - 4	86.1	6.6	3.9	3.5
5 - 9	88.9	6.3	2.5	2.5
10 - 14	84.8	2.2	6.3	6.7
15 -18	77.1	3.4	5.1	14.4
Gender				
Male	85.6	4.5	3.9	6.1
Female	85.2	5.6	4.6	4.6
Race				
Malay	84.3	5.5	4.7	5.5
Chinese	89.3	3.6	3.6	3.6
Indians	85.5	2.6	1.3	10.5
Other Bumis	89.7	4.6	3.5	2.3
Others	100.0	0.0	0.0	0.0
Strata				
Urban	88.1	4.5	3.5	4.2
Rural	81.6	5.7	5.1	5.4
State				
Johor	84.2	1.4	7.9	6.5
Kedah	76.1	6.0	10.5	7.5
Kelantan	89.2	6.2	1.5	3.1
Melaka	100.0	0.0	0.0	0.0
N.Sembilan	73.2	2.4	2.4	22.0
Pahang	93.1	3.5	0.0	3.5
P.Pinang	80.0	6.7	13.3	0.0
Perak	88.9	3.7	1.9	5.6
Perlis	71.4	14.3	14.3	0.0
Selangor	87.6	4.9	1.6	6.0
Terengganu	76.3	11.9	5.1	6.8
Sabah	88.9	6.2	2.5	2.5
Sarawak	91.8	4.9	1.6	1.6
KL	90.2	4.9	2.4	2.4
Labuan	78.6	7.1	14.3	0.0
Household income				
RM <400	86.4	6.8	1.7	5.1
RM 400 - <700	84.0	7.3	1.3	7.3
RM 700 - <1000	85.6	3.3	6.5	4.4
RM 1000 - <2000	83.8	3.7	4.6	7.9
RM 2000 - <3000	87.1	3.6	5.7	3.6
RM 3000 - 4000	84.5	5.6	4.2	5.6
RM 4000 - 5000	84.9	6.1	9.1	0.0
RM >5000	89.2	6.8	2.7	1.4
Educational level				
None	50.0	16.7	16.7	16.7
Primary	85.8	4.0	4.4	5.8
Secondary	81.2	2.4	4.7	11.8

Table 15: Percentage of drug utilisation in asthmatic children

	Drug utilization		
	None	Short acting	Preventer
	%	%	%
Total prevalence	**69.0**	**10.0**	**21.0**
Age group			
0 - 4	81.3	5.2	13.5
5 - 9	72.2	6.7	21.1
10 - 14	60.7	14.6	24.8
15 -18	65.3	18.2	26.5
State			
Male	72.7	8.7	18.6
Female	65.1	11.5	23.4
Race			
Malay	70.7	9.7	19.6
Chinese	63.8	13.9	22.3
Indians	60.7	10.1	29.2
Other Bumis	70.6	8.0	21.4
Others	82.3	9.3	8.4
Strata			
Urban	62.9	10.8	26.3
Rural	81.5	8.3	10.3
State			
Johor	73.5	11.2	15.3
Kedah	76.4	3.0	20.6
Kelantan	77.6	15.8	6.6
Melaka	63.7	13.9	22.4
N.Sembilan	69.2	18.1	12.7
Pahang	84.2	0.0	15.8
P.Pinang	65.8	14.2	20.0
Perak	65.8	7.5	26.7
Perlis	68.0	22.3	9.7
Selangor	63.1	7.3	29.5
Terengganu	66.7	14.1	19.2
Sabah	66.5	12.2	21.2
Sarawak	73.0	6.2	20.9
KL	65.0	15.6	15.6
Labuan	68.9	15.6	15.6
Household income			
RM <400	78.3	7.1	14.7
RM 400 - <700	75.7	14.9	9.4
RM 700 - <1000	73.0	6.2	20.9
RM 1000 - <2000	77.1	5.0	17.9
RM 2000 - <3000	63.2	13.0	23.8
RM 3000 - 4000	56.5	13.7	29.8
RM 4000 - 5000	57.2	3.2	39.6
RM >5000	52.3	17.1	30.7
Educational level			
None	81.0	0.0	19.1
Primary	64.1	11.0	24.9
Secondary	55.5	18.1	26.5

CHAPTER II

ASTHMA ADULTS (AGED 18 YEARS AND ABOVE)

ABSTRACT

Asthma is a chronic inflammatory lung disease affecting all age groups. It has experienced a sharp increase in the global prevalence, morbidity, mortality and economic burden over the last 40 years.

The NHMS III 2006 was conducted with the main objective of determining the prevalence of asthma among children and adults in Malaysia. Data on Adult Asthma were obtained using Module G of the pre-coded questionnaire booklets by trained interviewers through interviewing all household members in the selected living quarters. Respondents are classified as having asthma if they answered positively to having asthmatic symptoms such as recurrent episodes of wheezing, breathlessness, chest tightness and coughing. They were then asked on their episodes of exacerbation, follow up treatment, visit to the emergency department, admission to the hospital, place where they sought treatment and days loss from work or school.

This study showed that the prevalence of adult asthma was 4.5% (CI: 4.3 - 4.8). The highest prevalence were among Malays (67%) followed by Indians (12.9%), other Bumis (10.0%) and Chinese (7.3%). By states, Selangor (22%), Johore (11.1%), Kedah (9.9%) and Sabah (8.7%) had the highest prevalence. Asthma was more prevalent among the lower income, lower education level and among the unemployed. There was no statistical significant difference in prevalence between gender and between those living in rural or urban area. Young adults were observed to have high prevalence of asthma than other age groups. In terms of asthma morbidity, 68.1% of asthmatics visited the doctor due to an asthma attack or acute breathlessness in the last 12 months. About 20% of asthmatics visited the emergency department for acute asthma exacerbation in the last 12 months. About 10% of adult asthmatics were admitted to the ward due to acute asthma exacerbation. With regards to seeking treatment, majority (75.4%) of the respondents reported going to doctors for treatment, while 10.3% went to traditional and complementary medicine (TCM) for treatment, 7.6% went to the pharmacy to refill old prescriptions and 6.6% obtained their medication treatment through over the counter (OTC). About 27.3% of asthmatics reported that they had school / work day's loss with a mean of 6 days (4-8 days) loss. About 21% of asthmatics claimed to have limitation in sleeping, 16.88% had limitation to normal physical exertion while 15.6% had limitation to housekeeping chores. Thus, this result could be inferred that having asthma did affect the quality of life of adult asthmatics.

1. INTRODUCTION

Asthma is a serious global health problem. People of all ages in worldwide are affected by this chronic airway disorder. If uncontrolled, it can lead to severe limitations on daily life and is sometimes fatal. The prevalence of asthma is increasing in most countries, especially among children, with an estimated 300 million people worldwide (Masoli et al. 2004). Asthma is a significant burden, not only in terms of health care costs but also lost productivity and reduced participation in family life (Vincent et al. 2006). Asthma is defined as a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. The chronic inflammation is associated with airway hyper responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning. These episodes are usually associated with widespread, but variable, airflow obstruction within the lungs that is often reversible either spontaneously or with treatment (Barnes et al. 1998; Miller & Lukacs 2004). Clinical manifestations of asthma can be controlled with appropriate treatment. When asthma is controlled, there should not be more than occasional flare-ups and severe exacerbations should be rare (GINA 2000).

A clinical diagnosis of asthma is often prompted by symptoms such as episodic breathlessness, wheezing, cough, and chest tightness. Measurements of lung function either by spirometry or peak expiratory flow provide an assessment of the severity of airflow limitation, its reversibility, and its variability, as well as confirmation of the diagnosis of asthma (Pellegrino et al. 2005; American Thoracic Society 1995). Measurements of allergic status can help to identify risk factors that cause asthma symptoms in individual patients. For patients with symptoms consistent with asthma and a normal lung function, measurement of airway responsiveness by bronchial challenge may help establish the diagnosis (Cockcroft 2003; Cockcroft et al. 1992; Boulet 2003). A number of factors that influence a person's risk of developing asthma have been identified. These can be divided into host factors primarily genetic and environmental factors such as viral upper respiratory tract infection, exposure to irritants or allergens such as tobacco smoke, house dust mites, animal proteins (pets, cockroaches, fungi/ molds) pollens, exercise, stress and temperature change (Ober 2005; Holgate 1999).

Asthma has been classified by severity into intermittent and persistent. Persistent asthma is again divided into three groups based on frequency of daytime symptoms, nocturnal symptoms limitations of daily activities need for reliever treatment and results of lung function tests (National Asthma Education and Prevention Program 1997; Clinical Practice Guideline Malaysian Thoracic Society/ Kementerian Kesihatan Malaysia 2002). However, asthma severity may change over time, and depends not only on the severity of the underlying disease but also its responsiveness to treatment.

Intermittent

- Symptoms less than once a week
- Brief exacerbations
- Nocturnal symptoms not more than twice a month
- FEV_1 or PEF ≥ 80% predicted
- PEF or FEV_1 variability < 20%

Mild Persistent

- Symptoms more than once a week but less than once a day
- Exacerbations may affect activity and sleep

- Nocturnal symptoms more than twice a month
- FEV_1 or PEF ≥ 80% predicted
- PEF or FEV_1 variability < 20 – 30%

Moderate Persistent

- Symptoms daily
- Exacerbations may affect activity and sleep
- Nocturnal symptoms more than once a week
- Daily use of inhaled short-acting β_2-agonist
- FEV_1 or PEF 60-80% predicted
- PEF or FEV_1 variability > 30%

Severe Persistent

- Symptoms daily
- Frequent exacerbations
- Frequent nocturnal asthma symptoms
- Limitation of physical activities
- FEV_1 or PEF ≤ 60% predicted
- PEF or FEV_1 variability > 30%

To aid in clinical management, a classification of asthma by level of control is recommended. With an estimated 300 million affected individuals, from the perspective of both the patient and society the cost to control asthma seems high, the cost of managing uncontrolled asthma is even higher (Bateman et al. 2004). Although asthma cannot be cured, it can be effectively treated. Research shows that with proper treatment, majority of asthma patients can achieve and maintain good asthma control, enabling them to participate in school, work, and other normal daily activities (Pauwels et al. 1997). Control of asthma is defined as no (twice or less/week) daytime symptoms, no limitations of daily activities including exercise, no nocturnal symptoms or awakening because of asthma, and no exacerbations (twice or less / week) (National Asthma Education and Prevention Program 1997; Pauwels et al. 1998).

There are four main interrelated components of therapy in the management of asthma, education, identifying risk and triggering factors, pharmacological intervention and appropriate monitoring (GINA 2000). Education plays a major role especially in identifying triggers for asthma attacks and in inhalation technique. This is best done by developing Patient / Doctor Partnership (Guevara et al. 2003; Gibson et al. 2003; Gibson et al. 2002).

Table 1.1: Level of asthma control

Characteristic	Controlled (All of the following)	Partly Controlled (Any measure present in any week)	Uncontrolled
Daytime symptons	None (twice or less/week)	More than twice/week	Three or more features of partly controlled asthma present in any week
Limitations of activities	None	Any	
Noclurnal symptons/awakening	None	Any	
Need for reliever/ rescue treatment	None (twice or less/week)	More than twice/week	
Lung funtion (PEF or FEV_1)	Normal	< 80% predicted or personal best (if known)	
Exacerbations	None	One or more/year*	One in any week

Medications to treat asthma can be classified as controllers or relievers. Controllers are medications taken daily on a long-term basis to keep asthma under clinical control chiefly through their anti-inflammatory effects. Relievers are medications used on an as-needed basis that act quickly to reverse broncho-constriction and relieve its symptoms. Asthma treatment can be administered in different ways either by inhalation, orally, or by injection. The major advantage of inhaled therapy is that drugs are delivered directly into the airways, producing higher local concentrations with significantly less risk of systemic side effects (Langley 1999; Newman 1995). Inhaled glucocorticosteroids are the most effective controller medications currently available (Juniper et al. 1990; The Childhood Asthma Management Program Research Group 2000; Jeffery et al. 1992) and rapid-acting inhaled β_2-agonists are the medications of choice for relief of broncho-constriction (Williams et al. 1981) and for the pre-treatment of exercise-induced broncho-constriction (Using beta 2-stimulants in asthma 1997; Godfrey & Bar-Yishay 1993). Increased use, especially daily use, of reliever medication is a warning of deterioration of asthma control and indicates the need to reassess treatment.

The goals for successful management of asthma are to achieve and maintain control of symptoms, to maintain normal activity levels, to maintain pulmonary function as close to normal as possible and to prevent asthma exacerbations while avoiding adverse effects from medications and prevent asthma mortality.

2. LITERATURE REVIEW

2.1 Prevalence

An estimated 300 million people worldwide now have asthma. Asthma affects people of all ethnic groups, socioeconomic levels, and ages. However, asthma often develops during childhood. Indeed, asthma is the chronic disease most commonly causing absence from school. The prevalence of asthma is increasing throughout the world, especially as communities adopt Western lifestyles and become urbanized. It is estimated that there may be an additional 100 million persons with asthma by 2025 (ISAAC committee 1998).

Overall, one in every 250 deaths is due to asthma and they are mostly preventable. It is estimated that 44 million in East Asia and Pacific region have asthma. The prevalence increased 5 fold over 20 years period in Taiwan and in Japan it is reported that there are 100 cases/day per 100,000 people (Lai et al. 2003).

Hospitalisation rate indicate treating severe asthma is a heavy burden on healthcare resource through out East Asia and Pacific. In China and nearby countries, over 1 in 3 people with asthma require urgent medical care, emergency room visits, or hospitalisation for asthma each year.

In South East Asia, it was reported that there were 17.5 millions cases, a prevalence of 3.3%. The highest rates were in Thailand, Philippines and Singapore. In Singapore, there was a marked difference in prevalence of asthma among different ethnic groups in the community and among the same ethnic group in different communities. The prevalence was higher in urban areas with one in four adults losing time from work and one in three children missing school due to asthma, mortality high within this region such as Malays in Singapore.

Asthma prevalence in Malaysia and the Asia Pacific region (average 8%) is less than half of that reported in Western Europe (16.7%). Asthma is prevalent among all age groups albeit higher in children, and the increasing incidence is a cause for concern. Prevalence in primary school children was 13.8% while children aged 13 to 14 years were 19.6%.

The Second National Health and Morbidity Survey (NHMS II) conducted in 1996 showed that asthma patients had exacerbations lasting 3.7 - 4.6 days for each attack. By severity, 47% had persistent asthma (20% mild persistent; 16% moderate and 11% severe persistent) and 53% had intermittent asthma. A total of 53.1% of asthmatic cases were female and 46.9% were male. There were twenty asthmatic episodes per adult (aged 15 years and above) per year, 2.6 days lost to school or work per episode.

Based on two million asthmatics, there were more than 76 million school or work days lost per year. In the AIRIAP study, 36.5% of children reported absence from school and 26.5% of adults reported absence from work in the last one year. In Malaysia, asthma is among the commonest conditions treated in health clinics. More than 73% of outpatient attendances in health clinics are for respiratory symptoms and asthma is one of the conditions noted to be treated in health clinics (Chong & Yen 2002). The national average for respiratory illness admitted into government hospitals is about 5.8% and asthma cases made up about 27.1% of the cases admitted. The State of Perlis has the highest percentage of admission for asthma compared to other states (Ishak 2002).

Asthma triggers found to be precipitating factors for asthma attacks in Perlis were environmental factors such as owning pets (cat and bird), household dust and the distance of house to environmental pollution sources (Mohamed et al. 2004). Among all asthmatic cases admitted, 78.6% was severe asthma and 21.4% was very severe asthma. There were two peaks of asthmatic admissions in government hospitals i.e. 0 to 4 years old and 30 to 34 years old. In the younger age groups of 0-14 years, more male's cases were admitted. However, more females were admitted from age 20 years and above.

By ethnicity, Indians were more commonly admitted compared to Malays, Chinese and other races. Admission rates for Indians, Malays and Chinese were 179.3, 131.8 and 35.7 respectively. Approximately 50 - 80 asthma cases were admitted to government hospitals everyday. Higher admission was noted in the months of January - February and October - November 1999, which might be consistent with rainy seasons in Malaysia. Hospital discharge due to asthma and asthma mortality was on the rise in the five years period of 1990 till 1995.

In Malaysia, just as other Asia Pacific region (as in the other regions of the world - Europe and the United States), use of inhaled corticosteroid (ICS) is low, contrary to asthma management guidelines (GINA and local). In AIRIAP study, use of inhaled corticosteroid (ICS) was reported by only 13.6% of asthma patients, 56.3% use quick relief short acting bronchodilators (SABA). In a local government hospital (Kuala Pilah), it was found that only 13.3% of asthma patients were on ICS and 66.7% on SABA, despite almost half of them having symptoms of persistent asthma. A local Malaysian study of 93 asthmatics from two local government health clinics and a State Hospital in Negeri Sembilan showed that fewer than 50% achieved minimum day or night symptoms and no restriction in daily activities (Ahmad et al. 2003).

In a nationwide survey of government and private doctors between June 2002 to May 2003, the most preferred medications for 'first-line', 'second-line' and 'third-line' treatment were for government doctors: inhaled short-acting beta2-agonist (SABA) (98%), inhaled corticosteroids (ICS) (75%), and leukotriene

antagonist (52%); and for private doctors: oral SABA (81%), ICS (68%), and oral corticosteroids (CS) (58%). (note: ICS/LABA combination drugs were introduced in 2002 in the private market, listed in government formulary 2003/2004) (Loh & Wong 2005).

Malaysian and other Asian patients (similar to Europeans*) have poor understanding of their condition and role of ICS; often leading to overestimation of their asthma control:

- Only 23.2% realized that inflammation is the underlying cause of asthma
- 17.5% thought the underlying condition could be treated
- 12.9% claimed to be familiar with ICS
- 29.2% had heard of a peak flow meter, 7.1% reported owning one, two thirds would not buy and use a peak flow meter because they could not afford it.

Even in those with severe persistent asthma, 34.3% regarded their disease as being well or completely controlled in contrast with more than 50% reported symptom rates far in excess of accepted criteria for symptom control (Partridge et al. 2006).

Therefore the burden of asthma is heavy and a major public health problem worldwide including Malaysia. However, asthma symptom control remains poor, there is under-diagnosis of the disease, and inappropriate treatment; physician and patient education need to be improved.

2.2 Asthma Prevention

The primary prevention of asthma implies the prevention of sensitization to factors that might subsequently induce disease. It requires environmental strategies aimed at reducing both the development of allergic sensitization, which is the most common precursor to development of asthma, and the development of asthma among those who have already become sensitized (WHO strategy for prevention and control of chronic respiratory diseases 2001). All the published national and international guidelines on asthma management highlighted the importance of identifying and avoiding precipitating causes of asthma where possible. Such environmental modifications can reduce the requirement for conventional treatment.

Although long term decline in lung function may not be reversible, effective management including smoking cessation (Kanner et al. 1999), pulmonary rehabilitation and reduction of personal exposure to noxious particles and gases can reduce symptoms (Miller et al. 2006), improve quality of life, and increase physical fitness. Asthma, although not curable is a treatable disease with preventable morbidity.

Early detection of occupational asthma is vital in preventing further progression and to ensure cost effectiveness of management. Secondary and tertiary prevention includes both pharmacologic and non-pharmacologic interventions, involving avoidance of allergens and non-specific triggers. Over the past 20 years, there has been increasing awareness that asthma is an inflammatory disease often present, even when the patient has no symptoms, and which can cause irreversible changes if left untreated. This knowledge has led to a change in emphasis of treatment away from a reliance on bronchodilator therapy to relieve symptoms when they occur, to a situation where a greater proportion of those with asthma are advised to take regular anti-inflammatory treatment. Optimal pharmacological treatment, including the use of anti-inflammatory medication, has been known to be cost-effective in controlling asthma, preventing the development of chronic symptoms, and reducing mortality.

It is of no value to have effective treatments available if there is no provision of health care and patient education. Optimal care and the desired therapy outcome can be achieved only if health professionals are well educated and work in a well organized manner delivering treatment in a way that ensures patient compliance. The use of national or international guidelines enables those who care for people with asthma to approach the patient with a common "language" and a common "message". Such guidelines need to be drawn up or adapted with care but where guidelines have been evaluated in a variety of conditions; their use has been shown to be associated with significant improvements in a number of outcome measures (Grimshaw & Russell 1993).

All published guidelines emphasized the importance of patient education. Cultural attitudes, unexpressed fears and concerns and lack of understanding and information may all act as barriers to education and lead to noncompliance. Such fears and expectations should be explored and patients need to be given the information which they require to enable them to ask appropriate questions. All parents need to know the diagnosis, the difference between relieving and preventive treatments, how to use inhalers and, if appropriate, monitoring devices, signs that the asthma is worsening and what to do under those circumstances (Robert et al. 2006).

The aims of asthmatics are to take control of their asthma to varying degrees in a manner guided by health professionals. Such self-management has been shown to be associated with increased compliance, improved asthma control and significant savings in terms of direct and indirect costs (Steurer-Stey et al. 2006; Halm et al. 2006). Much patient education is done on an individual basis by the patient and health professional working together in partnership, but in some instances the task could be shared, with advantage, with other health professionals or enhanced by group educational efforts (Jennifer Olajos-Clow et al. 2005).

2.3 Treatment

Asthma is a chronic (lifelong) disease that involves inflammation of the airways superimposed with recurrent episodes of limited airflow, mucus production, and cough. Treatment focuses on taking medications that control inflammation and preventing chronic symptoms such as coughing or breathlessness at night, in the early morning, or after exertion (long-term control medications), providing medications to treat asthma attacks when they occur (quick-relief medications), avoiding asthma triggers, monitoring daily asthma symptoms in an asthma diary and monitoring peak flows.

Pharmacological therapy or treatment for asthma is based on two classes of anti-asthmatic drugs. The first are anti-inflammatory drugs, which suppress the inflammation that triggers the airways to narrow. Long-term control medications are taken daily and used regularly as 'preventers' to maintain control of persistent asthma. They primarily serve to control airway inflammation. Anti-inflammatory drugs include corticosteroids (which are inhaled, taken orally, or given intravenously), leukotriene modifiers, and cromolyn (Kallstrom 2004). Combinations of steroids and other medications (such as long-acting beta2 agonists or leukotriene-antagonists) have been proven to be effective for both treating and preventing asthma attacks in patients with moderate to severe asthma.

The second are bronchodilators or 'relievers', the quick-relief medications which help to achieve prompt reversal of an acute asthma "attack" by relaxing bronchial smooth muscle and widen (dilate) the airways. Generally, these are bronchodilator called short-acting beta-adrenergic agonists (beta2-agonists). Others

sometimes used in special cases include theophylline, and certain anticholinergic agents. None of these agents have any effect on the disease process itself. They are only useful for treating symptoms.

Treatment with inhaled anti-inflammatory drugs and inhaled bronchodilators is the mainstay of treatment the asthma. Traditionally, inhaled corticosteroids have been considered to be the most effective treatment for the inflammatory component of asthma, and ß2-agonists have been considered as the most effective bronchodilator. The demonstration that the combination of an inhaled corticosteroid with a long-acting ß2-agonist, on average, improved measures of airflow better than higher doses of inhaled corticosteroids alone prompted national and international guidelines to recommend therapy with a combination of the two drugs when asthma is inadequately controlled with a moderate dose of inhaled corticosteroids (Krishnan Parameswaran 2006; Saltpeter et al. 2006).

2.4 Route of Administration

Asthma medications come in many forms; some are oral medications, other injectables and some are inhaled using special devices. Oral asthma medications are used for asthma control to prevent asthma flare-ups and not used to relieve immediate symptoms. They are taken daily even when a person does not have any asthma symptoms.

Systemic corticosteroids (steroids that get into the blood stream and don't just go to the lungs) are used to treat severe asthma episodes. These drugs are used with other medications to either control sudden and severe asthma attacks or to treat long-term, hard-to-control asthma.

Inhaled medicines go directly into your lungs where they are needed. There are many kinds of inhalers that require different techniques. Inhaled medications can act as either "rescue" medications when immediate relief is needed or used to control asthma symptoms from occurring. Most asthma medicines are inhaled directly into the breathing tubes using some type of inhaler device. There are different types of inhalers for asthma medicines. By inhaling the medicine into the breathing tubes, the medicine goes to the lungs and very little of it gets into the rest of the body, meaning the risks of side effects are very small. To get the medicine to the lungs, an inhaler must be used correctly. Studies have shown that approximately half of all people with asthma do not use their inhalers correctly, which means that much of the medicine never reaches the lungs. For some types of inhalers, spacer devices or "spacers" can help deliver much more of the medicine into the lungs.

2.5 Peak Expiratory Flow Meter

Peak flow meters have been prescribed to patients with asthma, chronic obstructive pulmonary disease (COPD), and other respiratory diseases for monitoring the severity of their disease and their response to therapy at home. Home monitoring of peak expiratory flow rate was identified as an important component of asthma management by the National Heart, Lung and Blood Institute (NHLBI) in its Expert Panel Report on asthma management. The NAEPP Expert Panel Report of 2002 concluded in patients who suffer moderate or severe asthma, peak flow monitoring should be considered (National Asthma Education and Prevention Program (NAEPP) Expert panel report 2003). Peak flow monitoring may enhance clinician-patient communication and increase patient and caregiver awareness of the asthma and asthma control. The peak expiratory flow meter is intended to provide the physician with another

measure of the level of asthma control and encourage patient adherence by giving the patient a sense of control and participation in self care.

Peak flow meters help to determine how open the airways are. Patients can benefit from using a peak flow meter in several ways: to recognize that asthma may be occurring at night, to improve perception of asthma, to identify factors that worsen asthma, and to predict worsening of asthma. Peak flow measurements can help show when medication is needed (Yokoyama et al. 2007) or other action needs to be taken. Peak flow values of 50-80% of an individual's personal best indicate a moderate asthma attack, while values below 50% indicate a severe attack.

One of the most important functions of the peak flow meter is to help the patient and doctor evaluate the severity of asthma (Álvaro Augusto Cruz 2006). Peak expiratory flow, or PEF for short, is a medical term for a test that checks if your asthma is well controlled or not. According to Stedman's Medical Dictionary, it means *"The maximum flow of air at the outset of forced expiration"*. A peak flow rate measures how well you can force air out of lungs, which is directly related to how "open" your airways are. So, to put it simply, PEF will tell you if your asthma is under control. The lower the peak flow reading, the more trouble you are having with your asthma. When your asthma is well controlled, your peak expiratory flow rate will be higher. In some cases, a PEF test will pick up changes in your condition even before you start to have symptoms.

3. OBJECTIVES

3.1 General Objective

To determine the prevalence of asthma among adults (18 years old and above) in Malaysia.

3.2 Specific Objectives

3.2.1 To determine the impact of disease due to asthma among adults,
3.2.2 To determine the pattern of health utilization,
3.2.3 To determine the percentage of asthmatics on preventive medications

4. METHODOLOGY

4.1 Scope of the Study

Research problems, scopes and main issues to be included in NHMS III were obtained from discussions and feedbacks from Ministry of Health state health managers, as well as experts from the local universities and individuals. The main research team members of the NHMS III reviewed and studied closely the feasibility and practicality of the suggested research topics for this community-based

household survey. Extensive literature review was initiated. Technical and research experts in relation to the identified research areas were consulted for further advise and comments. The main research group used the following criteria in considering the suggested scopes for this survey:

a) The issue/problem is of current or potential high prevalence
b) The issue/problem is focusing on disease/disorders associated with affluence, lifestyle, environment and demographic changes.
c) The issue/problem is causing physical, mental or social disability
d) The issue/problem has important economic implications
e) It is feasible to implement interventions to reduce the problem
f) The information required related to the issue/problem is not available through the routine monitoring system or other sources.
g) The information is more appropriately obtained through a nation-wide community survey, and
h) It is feasible to obtain through a nation-wide community-based survey.

The short-listed research topics then presented to the Advisory Group Members for further deliberation and decisions. These topics were later refined by the research team members based on the decisions made at the Advisory Committee meeting. It was tabled to the Steering Committee and 18 research topics were approved to be included in the NHMS III.

4.2 Sampling Design and Sample Size

In calculating the sample size, stratification and sampling design, advice was sought from the Methodology Division Department of Statistics Malaysia as well as from several other biostatistics consultants.

4.2.1 Sampling frame

The sampling frame for this survey was updated until 2004; an effort undertaken prior to the implementation of Labor Force Survey (LFS) 2004. In general, each selected Enumeration Blocks (EB) comprised of 8 sampled Living Quarters (LQ). The EBs was geographically contiguous areas of land with identifiable boundaries. Each contains about 80-120 LQs with about 600 persons. Generally, all EBs are formed within gazette boundaries.

The EBs in the sampling frame was also classified by urban and rural areas. The classification into these strata was made up in terms of population of gazette and built-up areas as follows:

Stratum	Population of gazette areas and built-up
Metropolitan	75,000 and above
Urban Large	10,000 to 74,999
Urban Small	1,000 to 9,999
Rural	The rest of the country

For sampling purposes, the above broad classification was found to be adequate for all states in Peninsular Malaysia and the Federal Territories of Kuala Lumpur and Labuan. However, for Sabah and Sarawak, due to problems of accessibility, the rural stratum had to be further sub-stratified based on the time taken to reach the area from the nearest urban centre.

For the purpose of urban and rural analysis, Metropolitan and Urban Large strata are combined together thus referred to as 'urban' stratum, while for Urban Small and the various sub-divisions of the rural areas they are combined together to form to a 'rural' stratum.

4.2.2 Sampling design

A two stage stratified sampling design with proportionate allocation was adopted in this survey. The first stage sampling unit was the EB and within each sampled EB, the LQs were selected as second stage unit. One LQ was estimated to comprise of 4.4 individuals. All households (HH) and persons within a selected LQ were studied.

4.2.3 Sample size

The sample size was determined based on 95% Confidence Interval (CI) and the following factors were taken into consideration:

a) Expected prevalence rate

The prevalence rate of the health problems for Malaysia obtained from the National Health and Morbidity Survey II (NHMS II) were used to estimate the overall sample size. Using the previous finding of 10% prevalence rate, the initial sample size at the state level was calculated in order to come up with overall sample size. The size was further apportioned for each state using the probability proportionate to size (PPS) method.

b) Response rate of the NHMS II

The response rates, which ranged from 83 to 97% for the NHMS II of each state, were taken into consideration in the course of the determination of sample size.

c) Margin of error and design effect

As the factors of precision and efficient of the survey are paramount, the decision reached for the targeted margin of error is 1.2 and the design effect valued at 2. These values were used at the initial stage of the calculation of the sample size of each state.

The survey findings addressing the specific objectives of this survey are expected to be used for state level programmed planning. Thus, the calculation for the sample size has taken into consideration that the data is to be analyzed at the state level.

In addition to the major factors mentioned earlier, the availability of resources, namely, financial and human resources, and the time taken to conduct this survey also becomes part of the process of the determination of sample size.

4.3 Preparation of Field Areas and Logistic Support

A number of state liaison officers were recruited in preparation for the survey proper. Strong networking with state liaison officers and District Health Officers (MOH and local authorities) from the areas sampled for the survey was established. Field scouts were mobilized from these areas to identify and tag the LQ's selected for the survey, as well as to inform the community and related government agencies of the importance and schedule of the planned survey. State liaison officers were also assisting Field Supervisors in the arrangement of transportation, accommodation and other logistics for the survey teams.

4.4 Method of Data Collection

4.4.1 The questionnaire

A bi-lingual (Bahasa Malaysia and English) pre-coded questionnaire was designed, pre-tested and piloted prior to the survey.

Certain terminology and items in the questionnaire were also made available in the dialects or languages of the main ethnic groups in Malaysia, such as Hokkien and Cantonese for the Chinese and Tamil for the Indians. The local dialects of Sabah and Sarawak were also considered. These pronunciations were recorded on tape with an accompanying 'romanised' version of the script. All versions were back translated into English by independent reviewers to ensure the accuracy of the translations.

The face to face interview questionnaires consisted of 2 subtypes, i.e., the household questionnaire (orange) to be answered by the head of the household of the LQ selected, and the individual questionnaire, to be answered by each member of the household. 18 years old and above (purple) individual FI questionnaires were developed, to cater respondent for 18 years and above.

All the FI questionnaires have a consent form to be read and signed by the respondent. The outside cover of all questionnaires had to be filled with a unique individual identification (ID) number by the enumerator. The enumerator also had to fill his or her ID as well as the code for the outcome of the interview as part of the quality assurance process.

4.4.2 The interview

As far as possible, all adult members who qualify from the selected LQ's were interviewed by the data collection team members. Parents or guardians were expected to provide information for their children aged 12 years and below (primary school). Interviews commenced early in the morning and lasted till late in the evening. A trained non-medical or paramedical interviewer conducted the interview. Where an interview had been unsuccessful due to the absence of the respondent at the selected LQ, repeat visits were conducted after leaving messages with neighbours or by other means for an appointment at a later date. A household member can only be classified as a non-responded after 3 unsuccessful visits.

4.5 Field Preparations

Two main survey implementation groups had been formed: the Central Coordinating Team (CCT) and the field team. The CCT's main role was to monitor and coordinate the progress of implementation and provide administrative support in terms of financial and logistic arrangement for the field survey. The Field Teams were responsible to oversee and manage the field data collection process as well as undertake quality control.

The field data collection was conducted throughout Malaysia simultaneously, spanning within a continuous period of 4 months starting from April 2006. Teams were organized to move into 5 regions in Peninsular Malaysia, 2 regions in Sabah and 4 regions in Sarawak for data collections.

4.5.1 Pilot study

A pilot study was conducted on a sample of EB's (not included in the NHMS III) about 2 months prior to the actual nationwide survey. It was conducted in three different areas in and around the Klang Valley, namely Sepang, Klang and Bangsar. The population in these locations comprised of three distinct socio-demographic strata that are rural, semi-urban and urban respectively. The pilot study focused on the following aspects of the survey such as testing of the questionnaire, testing of the field logistic preparation, testing of the scouting activities and testing of the central monitoring and logistic support.

4.5.2 Training of data collection teams

A two weeks training course was held for field supervisors, team leaders, nurses and interviewers to familiarize them with the questionnaire, develop their interpersonal communication skills and appreciate the need for good teamwork. Briefing on the questionnaire, mock interview in the classroom and individual practice under supervision was conducted during the training.

4.6 Quality Control

Quality control procedures for the data collection were done at two stages, field and central. Detail description of quality control process has been described in NHMS III protocol.

4.7 Data Management

4.7.1 Data screening

The following data screening exercises had been conducted at field and central levels prior to data entry:

a) Field data screen by each interviewers at the end of his/her interview.
b) Field data screen of each question by peer interviewers through exchanging questionnaire booklets.
c) Field data screen by team leaders and field supervisors.
d) Central data screening of the questionnaire by the quality control team.

4.7.2 Data entry

The data entry system was developed to record the information collected during the data collection phase. It is a web based system that allows multiple simultaneous accesses to the database. The NHMS III used a double manual data entry method and any discrepancy between both entries was verified by the supervisors. The data entry started simultaneously with data collection (first week of April 2006) and was completed at the end of January 2007. The data entered was stored in the database according to the module. The databases were designed using Structured Query Language (SQL) which is a standard language for relational database management system.

4.7.3 Data analysis

Data analysis was done by exporting the data into other analysis tools such as Microsoft Excel, SPSS and STATA. The data in database (text form) was exported to the Microsoft Excel form then to the SPSS and STATA. The raw data was cleaned and analysed according to the terms, working definition and dummy table prepared by the research groups. All the analysis process were monitored and advised by the NHMS III Statistics Consultant.

4.8 Definition of Terms / Variables

Data on Adult Asthma were obtained from Module G of the questionnaire booklets. All household members, 18 years old and above, in those selected households were interviewed by trained interviewers.

In this study, for the purpose of analysis, an asthmatic was defined as any eligible respondent who had any of these symptoms for the past 12 months – breathlessness, wheezing or ever been awakened from sleep due to chest tightness, breathlessness or continuous cough. Respondent currently on any type of asthma medication was also included as well as respondent with any skin, eyes or nose allergy. This definition was based on the European Community Respiratory Health Survey (ECRHS) (Holgate 1999).

Those who answered positively to having asthmatic symptoms as mentioned above, were asked on their episodes of exacerbation (severity of illness), follow up treatment, visit to the emergency department and any admission to the hospital. Information on place where treatment was sought, day's loss from work or school was also enquired.

Estimates of the prevalence from this survey were derived using a complex estimation procedure which ensured that the survey estimates conformed to an independently estimated distribution of the total population by state and strata. In the analysis, population estimates were expressed in rates, proportions and ratios.

The severity of adult asthma was classified as intermittent or persistent. Intermittent asthmatic is when the respondents had episodes of exacerbation one to three times for the past 12 months. Persistent asthmatic is when the respondents had four and more episodes of exacerbation in the last 12 months.

The quality of life amongst asthmatics were measured by asking whether respondents illness (asthma) reduced normal physical activities, choice of job/career, social activities, sleeping pattern, lifestyle habits, housekeeping chores, sports and recreational activities. The asthmatics were also asked whether in the past 12 months, they had missed work / schools due to an asthmatic attack and number of days lost.

Information on type of sought treatment among the asthmatics were divided into either going to the doctors, sought or buying medication from pharmacy according to the old prescription, or buying medication over the counter or seeking traditional and complementary medicine.

A asthmatics who sought treatment were asked on the type of medication they used. Interviewers showed coloured pictures of various types of inhalers and medication to identify whether patient were using preventer, anti leukotriene, short acting, long acting, spiriva or combination of inhalers.

5. FINDINGS

5.1 Prevalence of Adult Asthma (refer to Appendix 1: Table 1)

The overall prevalence of adult asthma in Malaysia was 4.5% (CI: 4.3 - 4.8)

5.1.1 Prevalence of adult asthma by states

Selangor [22.0% (CI: 19.2 - 25.1)] and Johor [11.1% (CI: 9.1 - 13.4)] reported higher prevalence of adult asthma. The lowest prevalence of adult asthma was in the state of Perlis, Negeri Sembilan and Terengganu (refer to Appendix 1: Table 1 and Appendix 2: Figure 1).

5.1.2 Prevalence of adult asthma by urban and rural

The prevalence of adult asthma was higher in urban area which was 61.6% (CI: 58.9 - 64.2) compared to the rural area 38.4% (CI: 35.8 - 41.1) refer Appendix 1: Table 1. However, there was no significant difference.

5.1.3 Prevalence of adult asthma by gender

The prevalence of adult asthma was higher in females 58.4% (CI: 55.9 - 60.8) compared to males 41.6% (CI: 39.2 - 44.1) although there was no significant difference.

5.1.4 Prevalence of adult asthma by age group

The highest prevalence was amongst the age group of group 20 – 24 years old, 11.6% (CI: 10.0 - 13.3) followed by the age group 45 – 49 years old, 10.3% (CI: 8.9 - 11.9) whereas the age group of ≥ 80 years old only accounted for 2.1% (CI: 1.5 - 2.9). (Refer Appendix 1: Table 1 and Appendix 2: Figure 2)

5.1.5 Prevalence of adult asthma by ethnic group

The highest prevalence of adult asthma was the Malays 67.0% (CI: 64.0 - 69.9) followed by Indian 12.9% (CI: 11.0 - 15.1) and Other bumis, 10.0% (CI: 8.3 - 12.1).

5.1.6 Prevalence of adult asthma by education

The prevalence of adult asthma was highest amongst secondary education level 47.5% (CI: 44.9 - 50.1), followed by primary education level, 30.7% (CI: 28.4 - 33.2) and no education level, 13.2% (CI: 11.5 - 15.1). Those with tertiary education level only accounted for 8.6% (CI: 7.2 - 10.2). (Refer Appendix 1: Table 1 and Appendix 2: Figure 3)

5.1.7 Prevalence of adult asthma by occupation

The highest prevalence was amongst housewives, 26.5% (CI: 24.3 - 28.8), followed by service workers, 16.1% (CI: 14.3 - 18.1) and unemployed 15.7% (CI: 13.9 - 17.7) with p value of 0.000. (Refer Appendix 1: Table 1 and Appendix 2: Figure 4)

5.1.8 Prevalence of adult asthma by marital status

The highest prevalence of asthma was amongst the married, 69.1% (CI: 66.7 - 71.4). Widow/widowers only accounted for 7.8% (CI: 6.5 - 9.2) and divorcee, 2.7% (CI: 2.0 - 3.6). (Refer Appendix 1: Table 1 and Appendix 2: Figure 5)

5.1.9 Prevalence of adult asthma by income level

There was a descending trend observed with increasing income levels. Those in the higher income level of RM 4000 – RM 4999 had the lowest prevalence of 3.1% (CI: 2.2 - 4.3). However, the highest prevalence was amongst those with an income level of RM 1000 – RM 1999 [27.1% (CI: 24.7 - 29.6)] followed by those with an income of RM 400 – RM 699 [18.1% (CI: 16.0 - 20.3)]. (Refer Appendix 1: Table 1 and Appendix 2: Figure 6)

5.2 Exacerbations (severity of illness) of Adult Asthma (refer Appendix 1: Table 2)

5.2.1 Percentage distribution of exacerbation in adult asthma (See Appendix 2: Figure 7)

Amongst those with exacerbations, 68.1% (CI: 65.5 - 70.6), 74.2% had an asthmatic attacks of 1-3 times per year; 17.8% had asthmatic attacks of 4-12 times per year; and 8.0% had asthmatic attacks of more than 12 times per year.

The severity of adult asthmatic is as below:

- 74.2% (CI: 71.4 - 76.9) with intermittent asthma
- 25.8% (CI: 23.1 - 28.7) with persistent asthma.

5.3 Follow-up (refer Appendix 1: Table 3)

5.3.1 Percentage distribution of adult asthma on follow up

Amongst those who had follow-ups, 70.1% had one follow-up, 21.3% had two follow-ups and 8.6% had 3 or more follow-ups in a year.

5.3.2 Follow-up of adult asthma by urban and rural

There was a higher trend of follow-up amongst the urban group, 62.2% (CI: 58.4 - 65.9) compared to rural 37.8% (CI: 34.1 - 41.6).

5.3.3 Follow-up of adult asthma by gender

There was no significant difference between males and females, 59.1% (CI: 54.5 -63.5) and 40.9% (CI: 36.5 - 45.5) respectively.

5.3.4 Follow-up of adult asthma by age group (refer Appendix 2: Figure 8)

The pattern of follow-up and non follow-up according to the age group differs significantly. Majority of those who had follow-up was in the age group from 35 – 59 years old. However, in non follow-up patients, the highest percentage was amongst the age group 20 – 29 years old.

5.3.5 Follow-up of adult asthma by race

The highest percentages of follow–up are amongst the Malays (64.29% vs. 67.67%) followed by Indians, 15.8% (CI: 12.4 – 20.0) and Other bumis 9.9% (CI: 7.4 - 13.2).

5.3.6 Follow-up of adult asthma by education level

The highest percentage amongst those who had follow-up was from secondary educational level 40.4% (CI: 36.1 - 44.9)

5.3.7 Follow-up of adult asthma by occupation (see Appendix 2: Figure 9)

The highest percentage for follow-up were amongst housewives [28.1% (CI: 24.1 - 32.6)], unemployed [19.5% (CI: 16.0% - 23.4%)] and service workers [14.3% (CI: 11.3 - 17.9)].

5.3.8 Follow-up of adult asthma by marital status

The highest percentage for follow-up was from married patients 71.9% (CI: 67.6 - 75.8)

5.3.9 Follow-up of adult asthma by household income (see Appendix 2: Figure 10)

The highest group for follow-up was from those with an income of RM 1000 - RM 1999 with a percentage of 26.3% (CI: 22.2 - 30.9) and the lowest group for follow-up was from those with an income of RM 4000 - RM 4999.

5.4 Visit to Emergency Department (refer Appendix 1: Table 4)

5.4.1 Percentage distribution of adult asthma visit to emergency department

About 80.3% never had an emergency visit.

Amongst those who visited the emergency department 55.8% visited the emergency department at least once a year; 22.8% visited the emergency department at least twice a year; and 22.0% visited the emergency department at least ≥ 3 times per year. **(See Appendix 2: Figure 11)**

5.4.2 Percentage of adult asthma visit to emergency department by state

There was no significant difference in the findings between different states. However, amongst those who visited emergency department, 16.0% were from Selangor, 12.8% from Sabah and 10.3% from Kedah. (P value = 0.0173)

5.4.3 Percentage of adult asthma visit to emergency department by urban and rural

The highest percentage of adult asthmatics who visited the emergency department were from the urban, 64.3% compared to the rural, 35.7% areas.

5.4.4 Percentage of adult asthma visit to emergency department by age group

The younger age group had lesser visits to the emergency departments. Those with age 50 - 54 years old visited the emergency department frequently (≥ 3 times per year). There was no significant pattern showed in visiting emergency department by age group.

5.4.5 Percentage of adult asthma visit to emergency department by ethnicity

Among the various ethnic groups, Malays (66.0%) had a higher trend to visit the emergency department.

5.4.6 Percentage of adult asthma visit to emergency department by education

Those with lesser visits to the emergency department were mainly from those with higher education level, 5.0%, and those visited frequently were from secondary education level, 45.1%.

5.4.7 Percentage of adult asthma visit to emergency department by marital status

The highest prevalence who visited the emergency department was from amongst the married, 73.9%.

5.4.8 Percentage of adult asthma visit to emergency department by income level

There was a decreasing trend of visits to emergency department observed with increasing income level. Those with lower income of RM 1000 - RM 1999 visited the emergency department most frequently (≥ 3 visits), 30.9%.

5.5 Adult Asthma and Hospital Admission (refer Appendix 1: Table 5)

5.5.1 Percentage distribution of adult asthma admitted to hospital

About 90% responded to having no admission per year.

For those who had hospital admission per year, 6.6% had once a year admission to the hospital; 2.1% had twice a year admission to the hospital; and 1.2% had ≥ 3 times a year admission to the hospital.

5.5.2 Percentage of adult asthma admitted to hospital by urban and rural

There was a higher percentage of admission to hospitals from the urban, 63.7% (CI: 56.1 - 70.6) compared to the rural, 36.3% (CI: 29.4 - 43.9).

5.5.3 Percentage of adult asthma admitted to hospital by gender

Higher admissions were amongst the females with a percentage of 61.4% (CI: 53.1 - 69.1).

5.5.4 Percentage of adult asthma admitted to hospital by age

Those with an age of 50 years old and above had a higher percentage being admitted to the hospital (2 to ≥ 3 times per year).

5.5.5 Percentage of adult asthma admitted to hospital by ethnicity

Malays had the highest admission to hospital by ethnicity, 70.7% (CI: 62.5 - 77.8).

5.5.6 Percentage of adult asthma admitted to hospital by occupation

Those who were unemployed had higher admissions of 2 to ≥ 3 times per year.

5.5.7 Percentage of adult asthma admitted to hospital by education

Those with primary education, 35.2% and secondary education, 36.0% had a higher admission of 2 to ≥ 3 times per year.

5.5.8 Percentage of adult asthma admitted to hospital by marital status

Those in the married group had more admissions of ≥ 3 times per year with a percentage of 73.6% (CI: 65.6 - 80.2).

5.6 Physical Activity Limitation in Adult Asthma (refer Appendix 1: Table 6)

In terms of physical activity limitation, a higher percentage (21.0%) had limitations in sleeping. About 16.9% had limitations to normal physical exertion and 15.6% to housekeeping chores while 8.2% had limitations in careers choice due to their asthmatic conditions. (See Appendix 2: Figure 12)

5.7 Days Loss Due to Asthma (refer Appendix 1: Table 7)

5.7.1 Percentage distribution of days' loss due to asthma

The percentage of no days' loss was 27.3% (CI: 24.6 - 30.2) while the average duration of days' loss at work was 6 days (4 – 8 days' loss).

5.7.2 Days' loss of adult asthma by gender

Females had more days' loss, 50.6% (CI: 44.9 - 56.3) than males 49.4% (CI: 43.7 - 55.1).

5.7.3 Days' loss of adult asthma by occupation

Among the various occupation groups, the Service Workers, 23.3% (CI: 18.5 - 28.7), Skilled Agriculture, 14.1% (CI: 10.5 - 18.8) and the Craft & Related, 13.2% (CI: 9.5 - 18.0) occupation groups had the higher percentage of days' loss.

5.7.4 Days' loss of adult asthma by education

Those with secondary education, 53.6% (CI: 48.0 - 59.2) had higher percentage of days' loss than the others.

5.7.5 Days' loss of adult asthma by age

Two groups recorded high percentage of days' loss namely those in the age group of 40-44 years old [14.9% (CI: 11.3 - 19.5)] followed by those in the age group 20-24 years old [14.3% (CI: 10.8 - 18.8)].

5.8 Seeking Treatment (refer Appendix 1: Table 8)

5.8.1 Percentage distribution of seeking treatment in adult asthma

About 1396 respondents answered to this question (Q13). A high percentage went to doctors for treatment (75.4%); while 10.3% went to traditional and complementary medicine (TCM); 7.6% went to the pharmacy to refill old prescriptions and 6.6% obtained treatment through the over the counter (OTC). **(See Appendix 2: Figure 13)**

5.8.2 Type of seeking treatment in adult asthma by gender

Most of the females sought treatment by going to the doctors while the males obtained their treatment through the OTC.

5.8.3 Type of seeking treatment in adult asthma by ethnicity

Amongst those who sought treatment from the doctors, the Malays had the highest percentage of 66.4% compared to the Indians (14.5%). A large percentage of Malays (70.8%) among the ethnic groups sought TCM for treatment.

5.8.4 Type of seeking treatment in adult asthma by urban and rural

The rural group recorded the highest percentage (56.9%) seeking TCM for treatment

5.8.5 Type of seeking treatment in adult asthma by education level

Amongst those who sought treatment from the doctors, the secondary level of education had the highest percentage of 45.5% compared to the other levels of education. A large percentage of secondary level of education sought TCM (47.2%) for treatment.

5.8.6 Type of seeking treatment in adult asthma by occupation

Those in the RM 1000 to less than RM 2000 group had the highest percentage (26.4%) seeking doctors for treatment while 28.5% went to TCM for treatment.

5.9 Drug Utilization (refer Appendix 1: Table 9)

For those on medication, 32.2% were on preventer medicine and 17.1% were on short acting medication.

6. DISCUSSION

6.1 Prevalence

The international patterns of asthma prevalence are not explained by the current knowledge of the causation of asthma. Asthma has become more common in both children and adults around the world in recent decades. The increase in the prevalence of asthma has been associated with an increase in atopic sensitization, and is paralleled by similar increases in other allergic disorders such as eczema and rhinitis (Asher et al. 1995; International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee 1998). The rate of asthma increases as communities adopt western lifestyles and become more urbanized. With the projected increase in the proportion of the world's population that is urban from 45% to 59% in 2025, and the increase likelihood of further increase exposure to allergens, there is likely to be a marked increase in the number of asthmatics worldwide over the next two decades.

Despite hundreds of reports on the prevalence of asthma in widely differing populations, the lack of a precise and universally accepted definition of asthma makes reliable comparison of reported prevalence from different parts of the world problematic. Nonetheless, based on the application of standardized methods to measure the prevalence of asthma and wheezing illness in children (Barnes et al. 1998) and adults (Miller & Lukacs 2004), it appears that the global prevalence of asthma ranges from 1% to 18% of the population in different countries (Vincent et al. 2006; Barnes et al. 1998). There is good evidence that asthma prevalence has been increasing in some countries (Miller & Lukacs 2004; GINA 2000; Pellegrino et al. 2005) and has recently increased but now may have stabilized in others (Burney 2002).

Southeast Asia (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam) reported the number of persons with asthma at 17.5 millions in the total population of 529.3 millions giving a mean prevalence of clinical asthma in this region at 3.3% (Goh et al. 1994). There is a wide variation of asthma prevalence within this region, with the lowest rates in Indonesia and Vietnam and the highest rates in Thailand, Philippines, and Singapore. There are marked differences in the prevalence of asthma among different ethnic groups in the same community, and among the same ethnic group in different communities (Ng et al. 1994; Lai et al. 1996).

The prevalence of asthma is generally higher in urban compared with rural populations in Southeast Asia (Chew et al. 1999), and this too was noted in Malaysia (NSMMS III). The role of outdoor air pollution in causing asthma remains controversial (Azizi 1990). Children raised in a polluted environment have diminished lung function (Goh et al. 1996), but the relationship of this loss of function to the development of asthma is not known.

The burden of asthma within the region is considerable with 1 in 4 adults with asthma losing time from work in the last year, and 1 in 3 children with asthma having missed school in the last year due to their asthma (Lai et al. 2003; Holloway et al. 1999).

The rate of hospitalisation for asthma is particularly high in Southeast Asia. Inpatient medical care represents the major proportion of asthma costs in a number of countries within Southeast Asia and notably so in Malaysia. This situation underlines the importance of implementing public health strategies based on management regimes which have been shown to be effective in reducing hospital admissions. Under-recognition of asthma severity and under treatment of the disease represents both common problems leading to high asthma morbidity and mortality within the region. Current levels of asthma control in the region fall short of those that can be achieved with modern management (Wiesch et al. 1999).

This survey, using the definition of asthma in adults was based on symptoms such as breathlessness, wheezing, awakened from sleep due to continuous cough, chest tightness or breathlessness in the last 12 month, showed the prevalence of asthma in adult Malaysian at 4.53% (4.29 - 4.78) Compared to the previous National Health Morbidity Survey II (NHMS II) done in 1996, the self-reported doctor-diagnosed asthma was found to be 4.2% (3.9 - 4.4%). It is difficult to compare the prevalence between the two surveys since the questionnaire used was different. The disease was more prevalent among Malays 67.00% followed by Indians (12.93%) and other Bumis (10.03%) with Chinese having the lowest prevalence (7.27%). The differences between ethnic groups were also noted in the last survey. The same findings were described in Singapore, where it was reported that there are marked differences in the prevalence of asthma among different ethnic groups in the same community, and among the same ethnic group in different communities (Ng et al. 1994). The apparent racial and ethnic differences in the prevalence of asthma reflect underlying genetic variances with a significant overlay of socioeconomic and environmental factors. Multiple genes may be implicated in the pathogenesis of asthma (Manfreda et al. 2001; Chan Yeung et al. 2001) and different genes may be involved in different ethnic groups. Family studies and case-control association analyses have identified a number of chromosomal regions associated with asthma susceptibility. However, the search for a specific gene or genes involved in susceptibility to atopy / asthma continues, as results to date have been inconsistent (Horwood et al. 1985; Martinez et al. 1995).

Analysing the prevalence of adult asthma by states, Selangor (22.00%), Johor (11.07%) and Kedah (9.93%) had the highest prevalence of asthma, while the states of Perlis (0.41%) and Negeri Sembilan (3.15%) reported the lowest (see Appendix 1: Table 1).There are insufficient data to determine the likely causes of the described variations in prevalence between the states. Common features shared by the states of Selangor and Johor are that they are amongst the larger states of Malaysia with large industrial areas, while Perlis and Negeri Sembilan are small and mostly agricultural. Most epidemiological studies show a significant association between industrial air pollutants–such as ozone, nitrogen oxides, acidic aerosols, and particulate matter–and symptoms or exacerbations of asthma. On occasion, certain weather and atmospheric conditions, favor the development of asthma exacerbations by a variety of mechanisms, including dust and pollution, increases in respirable allergens, and changes in temperature/humidity (Vichyanond et al. 2002).

In Malaysia, asthma was more prevalent among the lower income group (27.10%) defined as income of less than RM 1000 - RM 1999, secondary education level (47.53% and among the housewives (26.50%). This result was comparable with the previous NHMS II. The links between asthma and socioeconomic status, with a higher prevalence of asthma in developed than in developing nations, in poor compared to affluent populations in developed nations, and in affluent compared to poor populations in developing nations, likely reflect lifestyle differences such as exposure to allergens and access to health care (GINA 2000). Similar findings are seen in the United States (Jan – Mar. 2006 National Health Interview Survey). The prevalence of the disease showed descending trend as the studied population move up in the socioeconomic and educational strata.

The survey showed significant difference in prevalence between gender with higher prevalence noted in female (female 58.4% and male 41.60%).This is an expected findings as being seen in majority of asthma prevalence study (Roa et al. 1991; Addo-Yobo et al. 2001). In children, male sex is a risk factor for asthma. Prior to the age of 14, the prevalence of asthma is nearly twice as great in boys as in girls. As children get older the difference between the sex narrows and by adulthood the prevalence of asthma is greater in women than in men. The reasons for this sex-related difference are not clear. However, lung size is smaller in males than in females at birth but larger in adulthood.

The prevalence of asthma is generally higher in urban compared with rural populations in Southeast Asia and this survey showed no difference. In West Africa, the prevalence of asthma is higher in urban communities of high compared with low socioeconomic status, and lowest in rural communities (Chan-Yeung & Malo 1994). Most epidemiological studies show a significant association between air pollutants such as ozone, nitrogen oxides, acidic aerosols, and particulate matter and symptoms or exacerbations of asthma. The excellent rural health infrastructures, and their easy accessibility may be inferred as the reason for earlier diagnosis of asthma as compared to other neighboring countries, this may be supported by the presence of national CPG.

The prevalence of asthma among adults seems to be higher in the productive age groups of young adult, 20-24 yrs (11.55%) and experienced workers of 45-49 yrs of age (10.3%). Whether this higher prevalence is related to work or social allergens exposure could not be determined. The fact is known that ooccupational asthma arises predominantly in adults (Horwood et al. 1985; Martinez et al. 1995) and occupational sensitizers are estimated to cause about 1 in 10 cases of asthma among adults of working age (Vichyanond et al. 2002). Over 300 substances have been associated with occupational asthma (Lai et al. 2003; Holloway et al. 1999; Wiesch et al. 1999; Manfreda et al. 2001; Chan Yeung et al. 2001). Marital status may have some influence on the risk of asthma as seen by the significant difference

between the higher prevalence amongst the married population (69.05%) as compared to lower prevalence amongst the widows or widowers (7.77%), while the prevalence amongst the divorcees were only 2.68%. The opposite findings were seen in National Health interview survey 2004 in USA showing marked difference in prevalence of asthma in married group (6.0%) and divorced or separated (8.7%) and widowed population (9.3%). Factors such as dietary habits, stress, exposure to home allergens, smoking and health seeking behavior have been mentioned but none was really identified as risk factor.

6.2 Morbidity

6.2.1 Exacerbations

67.81% of asthmatic patients have exacerbations with 7.98% of them had more than 12 attacks per year, and 17.79% with 4 - 12 exacerbations per year while the rest suffered less than 3 attacks per year. Patients are considered partially controlled when they have one or more exacerbation per year and uncontrolled if the attacks happen one in any week. By definition, an exacerbation in any week makes that an uncontrolled asthma week. Based on that definition, almost 25% of Malaysian asthmatics are not controlled. Comparing with results of AIRIAP1 and AIRIAP2 studies, 2% of Malaysian asthmatics had sleep disruption every night, 16% more than once a week and 5% at least once a week giving a total of 23% poorly controlled group. This figure is further supported by the result of this survey that showed by the frequency of asthma symptoms that 74.23% Malaysian asthmatic can be classified as having intermittent asthma and 25.77% with persistent asthma.

While there was no significant difference in terms of exacerbations comparing between states, this survey showed that those with no exacerbations were mainly from the rural areas, while there was a higher trend with exacerbations amongst the urban group. Acute exacerbations or transient worsening of asthma may occur as a result of exposure to risk factors for asthma symptoms, or "triggers", such as exercise, house dust mites, smoke and air pollutants (Tillie-Leblond et al. 2005; Newson et al. 1998). More prolonged worsening is usually due to viral infections of the upper respiratory tract (particularly rhinovirus and respiratory syncytial virus) (Tan 2005) or allergen exposure, which increase inflammation in the lower airways (acute on chronic inflammation) that may persist for several days or weeks, and definitely these triggers are more common in urban areas.

Females' asthmatics seem to have a more severe disease with a higher percentage of exacerbations, while up to 37% of the males had no exacerbations. Age-adjusted percentage of persons who experienced an asthma episode in the last 12 months by sex in the 2006 National Health Interview Survey in US support this findings with 3.9% male and 4.7% female having asthma episode. The younger age group appears to have better asthma control with less exacerbation, while there was an increasing trend for the older age group to have more exacerbations. The presence of co-morbidity such as heart failure, diabetes, hypertension and taking concomitant medications may have a role in lowering asthma control in this age-group.

The higher education level group, senior officers and managers reported less exacerbation, whether this was due to better understanding of the disease and the required treatment or better accessibility to the health facilities cannot be ascertain. However they seem to be less compliant to the regular clinic follow up (Jennifer Olajos-Clow et al. 2005). It is of no surprise that the unemployed, housewife, divorced and low income groups were found to have frequent exacerbations of 4 to more than 12 times per year.

6.2.2 Follow-up

The fourth component of asthma management is monitoring response to treatment by appropriate follow up, unfortunately the rate of follow up by Malaysian asthmatic is low with only 32.63% of identified asthmatic had follow up; with only 8.6% of them had follow-up more than 3 times a year while the rest it was only one to twice a year. Asthma management guidelines recommended that asthmatics on treatment should have appointment with doctor at least 3-4 monthly as to asses and to suit the medications according to disease control (Reddel et al 1999; Sont et al. 1999). There is no gender or geographical difference i.e. between urban and rural in term follow up, however what was noticeable were the significant results in different age group with the highest prevalence for no follow-up amongst the adolescence and working group. Understandably the elderly age group had the highest prevalence of follow-up most probably again due to higher degree of severity and the presence of co-morbidity. The severity factor may also explain the high follow up rate by the divorced group. Indian had the highest follow–up rate amongst the different ethnic groups. The highest group for no follow-up was from those with an income of ≥ RM 3000 with a percentage of 71.53%. Those who came for follow–up was mostly from the group with an income of RM 1000 - RM 1999 with a proportion of 26.31% (22.20% - 30.87%) and this could be due to access to health care.

6.2.3 Visit to emergency department

The visits to emergency department were always due to exacerbations secondary to poor control. The same group that had higher follow up visits was the groups that frequented the emergency areas but analysis showed that there was no positive correlation between follow up frequency and asthma control. About 80.30% of Malaysian asthmatic never had an emergency visit, however, amongst those who visited the emergency department, nearly 22% visited more than 3 times a year. The result was much lower than that reported by AIRIAP 1 that reported 49% of patients had emergency visits to their doctor or clinic in the past year. As shown in other studies the urban population utilized the health facility more than the rural, which may be related to higher exposure to risk factors. More female asthmatics (59.80%) visited the emergency department as compared to male patients (40.20%). Male patients are more likely to perceive symptoms poorly, and may have a significant decline in lung function without a significant change in symptoms. While many women complain that their asthma worsens at the time of menstruation. Premenstrual exacerbations have been documented and similarly, asthma may improve, worsen, or remain unchanged during pregnancy. Malay patients (66.01%) made up the biggest group that utilized the emergency asthmatic service, followed by the Indian (14.62%) and the Other bumi's (10.75%). More emergency visits are noted amongst the lower socioeconomic (< 2,000 / month: 71%) and educational patients. Whether this is directly related to their ability to fully understand the management of the disease, cannot be evaluated. It has been estimated that the implementation of a self-management program that in every 20 patients, it can prevent one hospitalization, and successful completion of such a program by eight patients prevents one emergency department visit (Gibson et al. 2002; Ong et al. 1995; Stewart 1995; Partridge & Hill 2000). Patients in the age-group of 40-50 years made up 31 % the total number of patients with history of emergency visits for management of their asthma, and this fact may have explained the findings that more married patients were noted to attend the emergency service than unmarried asthmatics.

6.2.4 Hospital admission

An exacerbation severe enough to require hospitalization may reflect a failure of the patient's management. In Malaysia, this may mean that patient does not adhere to the prescribed treatment, wrong inhalation technique, under assessment and may be under treatment. Health care providers should take the opportunity to review patient's understanding of the disease as patients may be particularly receptive to information and advice about their illness when they are hospitalized. Referral to specialist should be considered for repeated hospitalized patients and if available should also be subjected to re-enforce asthma education program. Only 10% adult asthma patients responded to having hospital admission due to the disease. For those who had history of hospital admission, 66.4% had once a year admission, 21.23% had twice a year and 12.32% had ≥ 3 times a year. There was no significant difference noted between urban and rural population in term of asthma hospital admission. As expected, higher admissions were seen amongst the females. Patients aged 50 years old and above had a higher risk of being admitted to the ward as they were known to have more irreversible and chronic disease complicated by other concomitant diseases. There was no significant difference between ethnic groups. Similarly, findings for exacerbation, patients who were unemployed and those with no or lower education had higher admissions of 2 to ≥ 3 times per year. The most notable finding was that patients who had lost their partners through divorce or death had more admissions of ≥ 3 times per year with a percentage of 5.59% (1.4% - 19.77%).

6.2.5 Physical activity limitation

It is known that asthma can severely affects the lifestyle of the sufferers and poor asthma control is associated with lower quality of life, but a direct correlation has not yet been shown. When giving treatment, care providers focus on clinical outcome measures, whereas patients focus on quality of life. It is important that both outcomes should be targeted. The majority of asthma patients showed moderate or some impairment in baseline quality of life described as normal daily activity involving doing housekeeping chores, sports and recreation, quality sleep, and choice of careers (Juniper et al. 2005). About 49.5% and 45.5% of asthma patients in two Canadian cross sectional studies in 1997 and 2002 respectively complained of waking up at night due to asthma symptoms. Our study showed that sleep disturbance due to asthma symptoms is the main limitation reported by 21% of the respondents. About 16.88% had problem doing normal physical exertion limitations, 15.63% had housekeeping chores limitations and 8.15% have limitations in careers choice.

Earlier study in 1998 involving 404 asthmatics in Malaysia reported worse results with 43% responders had limitation with sports and recreation, 36% with normal physical activity, 30% in choice of jobs or career, 40% with sleeping and 32% with housekeeping chores (AIRIAP). Quality of life is an important aspect of asthma management and this has been increasingly recognized over the past 10 years. Studies had shown that aiming for control with appropriate treatment brings clinically significant improvements regardless of baseline treatment and results in near-maximal mean Asthma Quality of Life Questionnaires, (AQLQ) scores (Bateman et al. 2004).

6.2.6 Days loss due to asthma

Asthma is one of the commonest chronic diseases that account for high rate of day lost. Again, it is closely related to the level of the disease control. AIRIAP Malaysian study 2003 reported 32% of adult asthmatics

had taken days off work due to their condition (Lai et al. 2003). About 68.87% of respondents reported days' loss due to asthma with the average duration of days' loss at work was 6 days. Female workers had higher days' loss as compared to male but the differences were not significant. By occupation, the higher percentage of days' loss was seen among the clerical, craft and related trade workers and elementary occupation groups. This can be explained by higher environmental exposure at work especially the prolong stay in air-condition rooms and exposure to craft materials. Asthmatics patients with higher education level seemed to have more days' loss than the other educational levels. However, no causal relation can be given. One of the highest day's losses of 14.32% (10.77 - 18.79) was seen in the age group of 20 – 24 years old. This is the age group that may have just started work, and there is a need to rule out in them the work- related asthma (occupational asthma).

6.2.7 Seeking treatment

Majority of Malaysian asthmatic are still not well educated on their condition. Believing that asthma can be cured, they continue to seek treatment that may bring prolong relief without the need to continue taking long term medication. Inhalers were once believed only for those with severe disease. Being a multiracial country with three major ethnic groups, each with its own culture and traditions, Malaysia has many traditional healers. It was not a surprise to see that 70.83% of Malay patients seek traditional treatment, but Malay patients also formed the biggest group (66.38%) that went to medical doctors for treatment. Thus about a third of Malay asthmatics received both the modern and the traditional treatments. Only 14.53% of Indians asthma patients seek modern medical treatment. From 1396 respondents from all ethnic groups, the result showed that 75.4% go to doctors for their asthma treatment, while 10.3% responded going to TCM for treatment; 7.6% responded going to the pharmacy to refill old prescriptions and 6.6% responded getting over the counter treatment or self medicated. Majority of the female patients sought treatment by going to the doctors, followed by going to the pharmacy to refill old prescriptions, but a significant proportion do get treatment by going to the TCM. The opposite were seen in the male patients as majority of them got their treatment over the counter. Comparing the type of seeking treatment in Adult asthmatics by urban and rural, the rural group had the higher percentage (56.94%) going to TCM for treatment. Surprisingly, there was no significant difference in the finding amongst the various levels of education. Comparing the group by earning, it was noted that in the RM 1000 – less than RM 2000 group had the highest percentage (26.4%) going to the doctors for treatment and 28.47% going to TCM for treatment.

6.2.8 Drug utilization

About 49.33% of the respondents that were identified as having asthma were not on any medication. About 17.10% of those on asthma medication were on long term preventer medications in the form of inhaled corticosteroids, single or in combination (12.7%); with any other antiasthmatic medications and / or leukotriene receptor antagonist (4.2%). Preventer medications are only appropriate for patients with persistent asthma, and 25.77% of the asthmatic population in this study has persistent asthma. Thus it can be deduced that a significant Malaysian asthmatics are still not receiving appropriate medications. NHMS II conducted in 1996 showed only 9% of population identified as asthmatics received preventer medication, so there was definitely a significant improvement noted. Short acting inhaled bronchodilators are used as symptoms reliever and the survey showed that 23% of the respondents identified had used them while others are still depending on oral medications. Surprisingly we noted that 0.73% was on tiotropium bromide that is more commonly used for chronic obstructive pulmonary disease and 11.14% of those on medication were on long acting inhaled B agonist (LABA) bronchodilators medications.

7. CONCLUSION

Prevalence of adult asthma in Malaysia is 4.53%. Asthma was noted to be higher in Malay populations, in female and young adults, commoner in urban than rural population, lower income, lower education level and the unemployed groups. In term of severity, nearly a quarter fulfill the criteria of persistent asthma with history of regular exacerbations that necessitate visits to emergency departments and admissions to hospitals. Asthma carries heavy disease burden in view of high utilization of health facilities. About 10% of the asthmatics reported admissions to the hospitals in the last 6 months. About forty six percent (46.4%) of the asthmatics were not on inhalers. Among those who took inhaled medication, almost half were on preventer medication. This finding is very encouraging as only 9% were reported to be on preventer medication in the last NHMS II survey. One third of the asthmatics reported workdays or school days loss. The mean day's loss was 6 days. Majority had some limitations to sleeping, physical activities and housekeeping chores. These findings confirmed the result of the earlier study by Institute of Public Health Malaysia on QOL of Malaysian asthmatics that this condition has quite significant impact on the life of the sufferers.

8. RECOMMENDATION

The prevalence of asthma in adult population of Malaysia in this study was noted to be lower than neighboring countries. From a clinical standpoint, a diagnosis of asthma is made on the basis of combined information from history, physical examination, and physiological tests, often over a period of time. There is no single test or clinical feature which defines the presence or absence of asthma, particularly from epidemiological studies of large populations. As a result, the prevalence of current asthma symptoms is not equivalent to the prevalence of clinical asthma. To determine the number of persons with asthma in each country, the mean prevalence of asthma calculated for each country was multiplied by the population of the country. The under utilization of lung function tools such as spirometer and peak expiratory meters may result in under diagnosis of asthma by doctors. It is highly recommended that these tools are utilized as they provide an assessment of the severity of airflow limitation, its reversibility, and its variability, and provide confirmation of the diagnosis of asthma.

Inhaler treatment was used only by half of the asthmatics. Asthma treatment can be administered in different ways - inhaled, orally, or by injection. The major advantage of inhaled therapy is that drugs are delivered directly into the airways, producing higher local concentrations with significantly less risk of systemic side effects, thus it is highly recommended that all patients should be treated with inhalation medication as there are choices available to suit all types of patients.

Inhaled glucocorticosteroids (ICS) are currently the most effective anti-inflammatory medications for the treatment of persistent asthma. Studies have demonstrated their efficacy in reducing asthma symptoms, improving quality of life, improving lung function, decreasing airway hyper responsiveness, controlling airway inflammation1, reducing frequency and severity of exacerbations, and reducing asthma mortality. However, they do not cure asthma, and when they are discontinued, deterioration of clinical control follows within weeks to months in a proportion of patients. In this study, more than one third of patient with persistent asthma were not on preventer medication. Education of doctors managing asthma patients is recommended to be continued and to stress further on the importance of usage of local guidelines.

The guidelines stress the advantage of partnership with patients in the target to control the disease. Patients need to be educated and to play greater role in their disease management. It is recommended a structured education program which was already in place be strengthened and reinforced in all centers managing these patients. Self management plans resulted from discussion and agreement of both parties should be adhered to, using tools and medication that are available in the locality without veering away from the latest clinical practice guidelines.

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APPENDIX

APPENDIX 1

Table 1: General findings of the survey

Characteristics	N	Yes (%)	95% Confidence Interval		N	No (%)	95% Confidence Interval	
			Lower	Upper			Lower	Upper
Asthmatic	*1561*	*4.5*	*4.3*	*4.8*	*32728*	*95.5*	*95.2*	*95.7*
State								
Johor	168	11.1	9.1	13.4	3680	11.7	10.3	13.2
Kedah	162	9.9	8.0	12.3	2399	7.0	6.0	8.2
Kelantan	78	4.5	3.4	5.9	1924	5.2	4.4	6.2
Melaka	61	4.2	2.9	6.0	834	2.8	2.1	3.7
N. Sembilan	52	3.2	2.2	4.5	1244	3.7	3.0	4.6
Pahang	105	7.0	5.3	9.2	1735	5.4	4.5	6.5
Pulau Pinang	69	4.1	3.0	5.7	2090	6.1	5.1	7.3
Perak	101	7.2	5.5	9.3	2533	8.7	7.5	10.0
Perils	7	0.4	0.2	0.9	308	0.9	0.6	1.5
Selangor	315	22.0	19.2	25.1	5593	18.9	17.2	20.6
Terengganu	69	4.1	2.9	5.7	1328	3.7	3.0	4.6
Sabah	163	8.7	6.9	10.8	3803	9.5	8.3	10.9
Sarawak	129	8.5	6.8	10.6	2851	9.1	7.9	10.5
Kuala Lumpur	62	4.2	3.1	5.7	1877	6.0	5.1	7.2
Labuan	20	1.1	0.6	1.8	529	1.3	0.9	1.9
Total	1561	**100.0**			32728	**100.0**		
Strata								
Urban	872	61.6	58.9	64.2	19463	65.0	64.3	65.6
Rural	689	38.4	35.8	41.1	13265	35.1	34.4	35.7
Gender								
Male	651	41.6	39.2	44.1	14706	44.8	44.3	45.3
Female	910	58.4	55.9	60.8	18022	55.2	54.8	55.7
Age group								
18-19	76	4.8	3.9	6.0	1622	4.9	4.6	5.2
20-24	176	11.6	10.0	13.3	3674	11.2	10.8	11.7
25-29	153	9.9	8.4	11.5	3576	11.0	10.6	11.5
30-34	120	7.8	6.6	9.3	3448	10.5	10.1	10.9
35-39	141	9.3	7.9	10.9	3482	10.6	10.2	11.0
40-44	153	9.8	8.4	11.5	3712	11.4	11.0	11.8
45-49	160	10.3	8.9	11.9	3354	10.3	9.9	10.7
50-54	146	9.4	8.0	11.0	2923	9.0	8.7	9.4
55-59	123	8.0	6.7	9.4	2379	7.3	7.0	7.7
60-64	88	5.4	4.3	6.6	1575	4.8	4.5	5.1
65-69	82	5.0	4.1	6.2	1350	4.1	3.9	4.3
70-74	66	4.1	3.2	5.1	835	2.5	2.3	2.7
75-79	43	2.7	2.0	3.6	447	1.4	1.2	1.5
≥ 80	34	2.1	1.5	2.9	351	1.1	1.0	1.2
Ethnicity								
Malays	1048	67.0	64.0	69.9	17836	53.9	52.2	55.5
Chinese	105	7.3	5.9	8.9	6849	22.4	21.1	23.8
Indian	188	12.9	11.0	15.1	2624	8.5	7.8	9.3
Other bumis	174	10.0	8.3	12.1	3757	10.3	9.2	11.4
Others	46	2.8	2.0	3.8	1662	4.9	4.4	5.4
Citizenship								
Malaysian	1520	97.5	96.6	98.2	30575	93.7	93.1	94.3
Non-Malaysian	40	2.5	1.8	3.4	2132	6.3	5.7	6.9
total	1560	100.0			32707	100.0		

Table 1: General findings of the survey (continue)

Characteristics	N	Yes (%)	95% Confidence Interval		N	No (%)	95% Confidence Interval	
			Lower	Upper			Lower	Upper
Educational Level								
None	215	13.2	11.5	15.1	3433	10.0	9.6	10.5
Primary	490	30.7	28.4	33.2	9354	28.3	27.6	29.0
Secondary	722	47.5	44.9	50.1	16447	51.1	50.4	51.9
Tertiary	123	8.6	7.2	10.2	3242	10.5	10.0	11.
total	1550	100.0			100			
Occupation								
Senior Offical & Manager	27	1.9	1.3	2.9	615	2.1	1.9	2.3
Professionals	65	4.7	3.7	5.9	2209	7.4	7.0	7.8
Technical & Asst	105	7.2	6.0	8.7	2548	8.4	8.0	8.8
Clerical Worker	71	5.0	4.0	6.4	1762	5.8	5.5	6.1
Service Workers	234	16.1	14.3	18.1	5356	17.5	16.9	18.0
Skilled Agriculture	125	7.7	6.4	9.3	2547	7.4	7.0	7.9
Craft & Related	91	6.3	5.1	7.7	1910	6.3	5.8	6.7
Plant & Machinery	62	4.1	3.2	5.3	1803	5.8	5.5	6.1
Elementary Occupation	72	4.7	3.7	5.9	1510	4.6	4.3	4.9
Housewife	391	26.5	24.3	28.8	7691	24.6	24.1	25.1
Unemployed	241	15.7	13.9	17.7	3239	10.2	9.8	10.6
total	1484				31190			
Marital status								
not married	315	20.5	18.5	22.7	6897	21.3	20.6	21.9
married	1076	69.1	66.7	71.4	23263	71.3	70.6	72.0
divorcee	42	2.7	2.0	3.6	700	2.2	2.0	2.4
widow/widower	124	7.8	6.5	9.2	1744	5.3	5.0	5.6
total	1557				32604			
Household income								
less than RM400	155	10.0	8.4	11.8	2796	8.3	7.8	8.9
RM400 - RM 699	283	18.1	16.0	20.3	4734	14.1	13.4	14.9
RM 700 - RM 999	178	11.7	10.1	13.6	3695	11.5	10.9	12.1
RM 1000 - RM 1999	403	27.1	24.7	29.6	8567	27.3	26.4	28.2
RM 2000 - RM 2999	231	15.6	13.6	17.9	4976	16.4	15.6	17.2
RM 3000 - RM 3999	101	7.0	5.7	8.6	2522	8.5	7.9	9.1
RM 4000 - RM 4999	42	3.1	2.2	4.3	1277	4.3	3.9	4.7
RM 5000 & above	102	7.4	6.0	9.2	2853	9.7	8.9	10.5
total	1495	100.0			31420			

Table 2: Distribution of asthma exacerbation by socio-demography

Asthma severity	No of Obs	percentage	95% Confidence Interval	
Intermittent	735	74.3	71.4	77.0
Persistent	28	25.7	23.0	28.6
total	989	100.0		

Table 3: Distribution of adult asthma with follow-up and without follow-up

Characteristics	N	Yes (%)	95% Confidence Interval	
			Lower	Upper
Follow-Up	461	32.80	30.3	35.4
State				
Johor	40	8.9	6.5	12.1
Kedah	51	10.5	7.7	7.7
Kelantan	22	4.3	2.7	2.7
Melaka	11	2.9	1.6	1.6
N. Sembilan	17	3.4	1.9	1.9
Pahang	27	5.9	3.9	3.9
Pulau Pinang	21	4.4	2.7	7.0
Perak	39	9.3	6.7	12.6
Perlis	3	0.6	0.2	1.8
Selangor	88	21.0	17.1	25.5
Terengganu	14	2.8	1.6	4.7
Sabah	49	8.8	6.4	12.0
Sarawak	44	9.7	7.0	13.3
Kuala Lumpur	27	6.2	4.2	9.1
Labuan	8	1.5	0.7	3.2
Total	461	100.0		
Strata				
Urban	263	62.2	58.4	65.9
Rural	198	37.8	34.1	41.6
Gender				
Male	190	40.9	36.5	45.5
Female	271	59.1	54.5	63.5
Age group				
18-19	12	2.7	1.5	4.7
20-24	30	6.6	4.7	9.4
25-29	34	7.4	5.4	10.2
30-34	26	5.5	3.7	8.1
35-39	37	8.3	6.0	11.3
40-44	50	10.9	8.4	14.1
45-49	54	11.9	9.2	15.3
50-54	53	11.5	8.9	14.8
55-59	45	10.2	7.7	13.4
60-64	29	6.0	4.2	8.5
65-69	33	7.0	5.0	9.8
70-74	29	5.8	4.1	8.3
75-79	15	3.2	1.9	5.3
≥ 80	14	2.9	1.7	4.8
Ethnicity				
Malays	299	64.3	59.3	69.0
Chinese	33	7.6	5.4	10.6
Indian	67	15.8	12.4	20.0
Other bumis	50	9.9	7.4	13.2
Others	12	2.4	1.4	4.3
Religion				
Islam	336	71.4	66.6	75.8
Christian	36	7.9	5.6	11.2
Buddha	29	6.6	4.6	9.5
Hindu	57	13.4	10.2	17.3
Others	3	0.7	0.2	2.1

Table 3: Distribution of adult asthma with follow-up and without follow-up (continue)

Characteristics	N	Yes (%)	95% Confidence Interval	
			Lower	Upper
Educational Level				
None	82	16.9	13.8	20.6
Primary	166	35.4	31.1	39.8
Secondary	180	40.4	36.1	44.9
Tertiary	31	7.3	5.2	10.2
total	459	100.0		
Marital status				
not married	67	14.7	11.8	18.2
married	330	71.9	67.9	75.8
divorcee	13	3.0	1.7	5.1
widow/widower	49	10.4	8.0	13.6
total	459	100.0		
Household income				
less than RM400	52	11.2	8.4	14.8
RM400 - RM 699	83	18.0	14.7	21.8
RM 700 - RM 999	52	11.7	8.9	15.2
RM 1000 - RM 1999	115	26.3	22.2	30.9
RM 2000 - RM 2999	69	15.8	12.6	19.7
RM 3000 - RM 3999	25	6.0	4.0	8.8
RM 4000 - RM 4999	16	3.9	2.3	6.4
RM 5000 & above	29	7.2	5.0	10.3
total	441	100.0		

Table 4: Distribution of frequency of visits to emergency departments by adults with asthma

Characteristics	N	Yes (%)	95% Confidence Interval	
			Lower	Upper
Visit to ED	290	19.7	17.7	21.9
State				
Johor	20	7.5	4.8	11.6
Kedah	30	10.3	7.0	14.7
Kelantan	13	4.1	2.3	7.3
Melaka	13	4.7	2.4	9.0
N. Sembilan	14	4.6	2.7	7.9
Pahang	20	7.4	4.4	12.0
Pulau Pinang	20	6.6	4.1	10.6
Perak	23	8.7	8.7	13.2
Perlis	2	0.6	0.2	2.5
Selangor	42	16.0	11.9	21.1
Terengganu	12	3.8	2.1	6.8
Sabah	44	12.8	9.1	17.8
Sarawak	20	7.1	4.4	11.1
Kuala Lumpur	11	4.1	2.2	7.5
Labuan	6	1.8	0.7	4.4
Total	290	100.0		
Strata				
Urban	172	64.3	59.0	69.3
Rural	118	35.7	30.7	41.2
Gender				
Male	115	40.2	34.5	46.1
Female	175	59.8	53.9	65.5

Table 4: Distribution of frequency of visits to emergency departments by adults with asthma (continue)

Characteristics	N	Yes (%)	95% Confidence Interval	
			Lower	Upper
Age group				
18-19	9	3.0	1.5	5.6
20-24	29	9.9	6.9	13.9
25-29	30	10.4	7.4	14.5
30-34	19	6.7	4.3	10.3
35-39	19	6.6	4.2	10.3
40-44	32	11.3	8.2	15.4
45-49	27	9.7	6.8	13.8
50-54	33	11.5	8.3	15.8
55-59	26	9.3	6.4	13.4
60-64	17	5.5	3.4	8.7
65-69	18	5.8	3.7	9.1
70-74	19	6.1	3.9	9.3
75-79	7	2.6	1.2	5.3
≥ 80	5	1.7	0.7	4.1
Ethnicity				
Malays	191	66.0	59.9	71.7
Chinese	11	4.2	2.3	7.5
Indian	40	14.6	10.6	19.8
Other bumis	34	10.8	7.7	14.9
Others	14	4.4	2.3	7.6
Religion				
Islam	222	75.5	69.9	80.4
Christian	18	6.2	4.0	9.7
Buddha	8	3.0	1.5	5.9
Hindu	35	12.7	9.1	17.5
Others	7	2.5	1.2	5.2
Citizenship				
Malaysian	286	99.1	97.3	99.7
Non-Malaysian	3	0.9	0.3	2.7
total	289	100.0		
Educational Level				
None	50	16.1	12.2	20.8
Primary	99	33.9	28.6	39.7
Secondary	128	45.1	39.2	51.1
Tertiary	13	5.0	2.9	8.3
total	290	100.0		
Occupation				
Senior Official & Manager	5	1.8	0.8	4.4
Professionals	10	3.9	2.1	7.0
Technical & Asst	18	6.8	4.4	10.6
Clerical Worker	15	5.7	3.5	9.3
Service Workers	44	16.0	12.2	20.7
Skilled Agriculture	11	3.4	1.9	6.0
Craft & Related	16	6.0	3.7	9.6
Plant & Machinery	7	2.6	1.2	5.4
Elementary Occupation	20	6.7	4.3	10.3
Housewife	79	28.8	23.7	34.5
Unemployed	52	18.3	14.1	23.2
Total	277	100.0		
Marital status				
not married	46	15.9	12.2	20.6
married	214	73.9	68.6	78.6
divorcee	8	2.9	1.5	5.7
widow/widower	21	7.3	4.8	10.9
total	289	100.0		

Table 4: Distribution of frequency of visits to Emergency Departments by adults with Asthma (continue)

Characteristics	N	Yes (%)	95% Confidence Interval	
			Lower	Upper
Household income				
less than RM400	34	11.5	8.1	16.1
RM400 - RM 699	51	17.9	13.7	23.2
RM 700 - RM 999	36	13.3	9.7	18.1
RM 1000 - RM 1999	85	30.9	25.5	37.0
RM 2000 - RM 2999	40	14.2	10.4	19.1
RM 3000 - RM 3999	14	5.1	2.9	8.7
RM 4000 - RM 4999	5	2.0	0.8	4.7
RM 5000 & above	13	5.1	2.7	9.3
Total	278	100.0		

Table 5: Distribution of Admission to Ward by adult with Asthma

Characteristics	N	Yes (%)	95% Confidence Interval	
			Lower	Upper
Admission to ward	146	10.1	8.6	11.7
State				
Johor	12	8.6	4.9	14.6
Kedah	17	11.6	7.1	18.4
Kelantan	5	3.1	1.3	7.3
Melaka	5	3.7	1.5	8.8
N. Sembilan	8	5.0	2.5	9.7
Pahang	14	9.9	5.7	16.4
Pulau Pinang	7	4.5	2.2	9.2
Perak	12	8.9	5.1	15.1
Perlis	2	1.2	0.3	4.8
Selangor	23	17.7	11.9	25.6
Terengganu	5	2.9	1.2	6.9
Sabah	15	8.7	5.1	14.3
Sarawak	10	6.7	3.6	12.1
Kuala Lumpur	8	5.8	2.9	11.1
Labuan	3	1.7	0.4	7.2
Total	146	100.0		
Strata				
Urban	86	63.7	56.1	70.6
Rural	60	36.7	29.4	43.9
Gender				
Male	56	38.6	30.9	46.9
Female	90	61.4	53.1	69.1
Age group				
18-19	3	2.0	0.6	6.0
20-24	13	9.2	5.4	15.2
25-29	11	7.6	4.2	13.2
30-34	6	4.5	2.0	9.7
35-39	8	5.2	2.6	10.0
40-44	14	10.1	6.1	16.4
45-49	12	8.1	4.6	13.8
50-54	14	10.1	6.1	16.3
55-59	14	10.3	6.2	16.7
60-64	14	9.2	5.5	14.9
65-69	18	11.7	7.4	17.9
70-74	11	6.9	3.9	12.1
75-79	4	2.7	1.0	7.0
≥ 80	4	2.5	0.9	6.4

Table 5: Distribution of Admission to Ward by adult with Asthma (continue)

Characteristics	N	Yes (%)	95% Confidence Interval	
			Lower	Upper
Ethnicity				
Malays	103	70.7	62.5	77.8
Chinese	6	4.4	2.0	9.5
Indian	16	11.8	7.4	18.4
Other bumis	18	11.1	7.1	16.9
Others	3	2.0	0.6	6.0
Religion				
Islam	114	77.4	69.4	83.7
Christian	9	5.8	3.1	10.8
Buddha	6	4.4	2.0	9.5
Hindu	14	10.3	6.2	16.7
Others	3	2.1	0.7	6.3
Citizenship				
Malaysian	144	99.2	94.6	99.9
Non-Malaysian	1	0.8	0.1	5.4
Educational Level				
None	31	19.9	14.3	27.1
Primary	53	35.2	27.7	43.4
Secondary	50	36.0	28.5	44.3
Tertiary	12	8.9	5.	15.0
Occupation				
Senior Official & Manager	3	2.4	0.8	7.1
Professionals	6	4.7	2.1	10.1
Technical & Asst	11	8.7	4.9	14.9
Clerical Worker	7	5.5	2.7	11.1
Service Workers	13	9.5	5.6	15.6
Skilled Agriculture	3	2.1	0.7	6.3
Craft & Related	8	5.8	2.9	11.2
Plant & Machinery	3	2.2	0.7	6.7
Elementary Occupation	5	3.5	1.4	8.1
Housewife	42	29.3	22.4	37.3
Unemployed	40	26.5	19.9	34.4
total	141	100.0		
Marital status				
not married	18	13.0	8.3	19.6
married	107	73.6	65.6	80.2
divorcee	6	4.2	1.9	9.0
widow/widower	15	9.3	5.7	14.9
Household income				
less than RM400	21	14.3	9.5	21.1
RM400 - RM 699	26	18.5	12.9	25.8
RM 700 - RM 999	10	7.1	3.8	12.7
RM 1000 - RM 1999	46	34.2	26.6	42.6
RM 2000 - RM 2999	17	12.8	8.1	19.6
RM 3000 - RM 3999	2	1.5	0.4	5.8
RM 4000 - RM 4999	7	5.6	2.7	11.2
RM 5000 & above	8	6.2	3.1	11.8
total	137	100.0		

Table 6: Percentage of adult asthmatic with physical activity limitation (column %)

Characteristics	Normal physical exertion	Choice of job / career	Social Activities	sleeping	Life style	Housekeeping chores	Sport
Malaysia	607 (16.9%)	293 (8.2%)	461 (12.8%)	755 (21.0%)	436 (12.1%)	562 (15.6%)	481 (13.4%)
State							
Johor	66 (10.9)	32 (10.9)	55 (11.9)	78 (10.3)	49 (11.2)	70 (12.5)	56 (11.6)
Kedah	73 (12.0)	36 (12.3)	55 (11.9)	86 (11.4)	46 (10.6)	65 (11.6)	43 (8.9)
Kelantan	39 (6.4)	12 (4.1)	29 (6.3)	34 (4.5)	29 (6.7)	33 (5.9)	21 (4.4)
Melaka	26 (4.3)	11 (3.8)	16 (3.5)	25 (3.3)	16 (3.7)	28 (5.0)	22 (4.6)
N. Sembilan	22 (3.6)	7 (2.4)	15 (3.3)	32 (4.2)	11 (2.5)	17 (3.0)	16 (3.3)
Pahang	39 (6.4)	21 (7.2)	26 (5.6)	52 (6.9)	33 (7.6)	31 (5.5)	28(5.8)
Pulau Pinang	31 (5.1)	16 (5.5)	24 (5.2)	25 (3.3)	16 (3.7)	25 (4.5)	26 (5.4)
Perak	29 (4.8)	17 (5.8)	24 (5.2)	39 (5.2)	22 (5.1)	23 (4.1)	30 (6.2)
Perils	2 (0.3)	2 (0.7)	2 (0.4)	4 (0.5)	3 (0.7)	3 (0.5)	0 (0.0)
Selangor	122 (20.1)	74 (25.3)	95 (20.6)	156 (20.7)	88 (20.2)	117 (20.8)	100 (20.8)
Terengganu	34 (5.6)	17 (5.8)	26 (5.6)	37 (4.9)	30 (6.9)	32 (5.7)	26 (5.4)
Sabah	69 (11.4)	22 (7.5)	40 (8.7)	93 (12.3)	46 (10.6)	61 (10.9)	56 (11.6)
Sarawak	31 (5.1)	11 (3.8)	30 (6.5)	59 (7.8)	23 (5.3)	33 (5.9)	26 (5.4)
Kuala Lumpur	21 (3.5)	13 (4.4)	20 (4.3)	25 (3.3)	18 (4.1)	20 (3.6)	24 (5.0)
Labuan	3 (0.5)	2 (0.7)	4 (0.9)	10 (1.3)	6 (1.4)	4 (0.7)	7 (1.5)
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100
Strata							
Urban	351 (57.8)	172 (58.7)	264 (57.3)	418 (55.4)	256 (58.7)	328 (58.4)	294 (61.1)
Rural	256 (42.2)	121 (41.3)	197 (42.7)	337 (44.6)	180 (41.3)	234 (41.6)	187 (38.9)
Gender							
Male	216 (35.6)	144 (49.2)	158 (34.3)	281 (37.2)	150 (34.4)	162 (28.8)	209 (43.5)
Female	391 (64.4)	149 (50.9)	303 (65.7)	474 (62.8)	286 (65.6)	400 (71.2)	272 (56.6)
Age group							
18-19	32 (5.3)	14 (4.8)	22 (4.8)	37 (4.9)	22 (5.1)	22 (3.9)	36 (7.5)
20-24	52 (8.6)	29 (9.9)	41 (8.9)	80 (10.6)	36 (8.3)	45 (8.0)	55 (11.4)
25-29	52 (8.6)	31 (10.6)	40 (8.7)	71 (9.4)	40 (9.2)	50 (8.9)	53 (11.0)
30-34	47 (7.7)	28 (9.6)	33 (7.2)	58 (7.7)	33 (7.6)	40 (7.1)	47 (9.8)
35-39	50 (8.2)	34 (11.6)	36 (7.8)	73 (9.7)	37 (8.5)	48 (8.5)	37 (7.7)
40-44	71 (11.7)	38 (13.0)	48 (10.4)	70 (9.3)	40 (9.2)	62 (11.0)	49 (10.2)
45-49	54 (8.9)	29 (9.9)	43 (9.3)	69 (9.1)	45 (10.3)	56 (10.0)	49 (10.2)
50-54	52 (8.6)	31 (10.6)	46 (10.0)	68 (9.0)	40 (9.2)	50 (8.9)	36 (7.5)
55-59	53 (8.7)	22 (7.5)	40 (8.7)	62 (8.2)	36 (8.3)	50 (8.9)	34 (7.1)
60-64	44 (7.3)	12 (4.1)	35 (7.6)	45 (6.0)	30 (6.9)	40 (7.1)	24 (5.0)
65-69	36 (5.9)	11 (3.8)	29 (6.3)	46 (6.1)	32 (7.3)	38 (6.8)	24 (5.0)
70-74	29 (4.8)	9 (3.1)	25 (5.4)	35 (4.6)	23 (5.3)	29 (5.2)	22 (4.6)
75-79	19 (3.1)	3 (1.0)	13 (2.8)	23 (3.1)	10 (2.3)	18 (3.2)	8 (1.7)
>=80	16 (2.6)	2 (0.7)	10 (2.2)	18 (2.4)	12 (2.8)	14 (2.5)	7 (1.5)
Ethnicity							
Malays	421 (69.4)	209 (71.3)	317 (68.8)	510 (67.6)	303 (69.5)	385 (68.5)	322 (66.9)
Chinese	23 (3.8)	14 (4.8)	19 (4.1)	36 (4.8)	23 (5.3)	28 (5.0)	25 (5.2)
Indian	85 (14.0)	44 (15.0)	70 (15.2)	98 (13.0)	56 (12.8)	80 (14.2)	66 (13.7)
Other bumis	62 (10.20	19 (6.5)	42 (9.1)	91 (12.1)	43 (9.9)	51 (9.1)	55 (11.4)
Others	16 (2.6)	7 (2.4)	13 (2.8)	20 (2.7)	11 (2.50	18 (3.2)	13 (2.7)
Religion							
Islam	470 (77.4)	228 (77.8)	347 (75.3)	574 (76.0)	336 (77.1)	430 (76.5)	361 (75.1)
Christian	38 (6.3)	13 (4.4)	30 (6.5)	61 (8.1)	28 (6.4)	37 (6.6)	33 (6.9)
Buddha	19 (3.1)	12 (4.1)	16 (3.5)	31 (4.1)	20 (4.6)	21 (3.7)	23 (4.8)
Hindu	74 (12.2)	36 (12.3)	63 (13.7)	81 (10.7)	49 (11.2)	70 (12.5)	58 (12.1)
Others	5 (0.8)	4 (1.4)	5 (1.1)	8 (1.1)	3 (0.7)	4 (0.7)	6 (1.3)
Unclassified	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Table 6: Percentage of adult asthmatic with physical activity limitation (column %) (continue)

Characteristics	Normal physical exertion	Choice of job / career	Social activities	sleeping	Life style	Housekeeping chores	Sport
Occupation							
Senior Official	6 (1.0)	6 (2.1)	4 (0.9)	8 (1.1)	2 (0.5)	5 (0.9)	5 (1.0)
Professionals	17 (2.8)	11 (3.8)	13 (2.8)	30 (4.0)	9 (2.1)	17 (3.0)	18 (3.7)
Technical & Asst	33 (5.4)	27 (9.2)	27 (5.9)	36 (4.8)	25 (5.7)	23 (4.1)	36 (7.5)
Clerical Worker	29 (4.8)	20 (6.8)	22 (4.8)	33 (4.4)	23 (5.3)	23 (4.1)	27 (5.6)
Service Workers	88 (14.5)	64 (21.8)	68 (14.8)	115 (15.2)	58 (13.3)	75 (13.4)	71 (14.8)
Skilled Agricultural	32 (5.3)	35 (12.0)	20 (4.3)	59 (7.8)	25 (5.7)	28 (5.0)	31 (6.4)
Craft & Related	34 (5.6)	33 (11.3)	30 (6.5)	40 (5.3)	24 (5.5)	29 (5.2)	31 (6.4)
Plant & Machinery	21 (3.5)	17 (5.8)	14 (3.0)	27 (3.6)	11 (2.5)	16 (2.9)	23 (4.8)
Elementary Occup	26 (4.3)	22 (7.5)	22 (4.8)	33 (4.4)	21 (4.8)	20 (3.6)	23 (4.8)
Housewife	178 (29.3)	29 (9.9)	134 (29.1)	204 (27.0)	133 (30.5)	194 (34.5)	106 (22.0)
Unemployed	113 (18.6)	23 (7.9)	88 (19.1)	133 (17.6)	87 (20.0)	112 (19.9)	79 (16.4)
Unclassified	30 (4.9)	6 (2.1)	19 (4.1)	37 (4.9)	18 (4.1)	20 (3.6)	31 (6.4)
Marital status							
not married	98 (16.1)	58 (19.8)	78 (16.9)	141 (18.7)	72 (16.5)	79 (14.1)	111 (23.1)
married	424 (69.9)	214 (73.0)	318 (69.0)	519 (68.7)	305 (70.0)	407 (72.4)	323 (67.2)
divorcee	20 (3.3)	7 (2.4)	16 (3.5)	19 (2.5)	12 (2.8)	17 (3.0)	10 (2.1)
widow/widower	64 (10.5)	14 (4.8)	48 (10.4)	74 (9.8)	46 (10.6)	58 (10.3)	36 (7.5)
unclassified	1 (0.2)	0 (0.0)	1 (0.2)	2 (0.3)	1 (0.2)	1 (0.2)	1 (0.2)
Household income							
less than RM400	70 (11.5)	29 (9.9)	57 (12.4)	85 (11.3)	53 (12.2)	60 (10.7)	47 (9.8)
RM400 - RM 699	120 (19.8)	55 (18.8)	92 (20.0)	156 (20.7)	92 (21.1)	109 (19.4)	78 (16.2)
RM 700 - RM 999	66 (10.9)	31 (10.6)	47 (10.2)	89 (11.8)	49 (11.2)	67 (11.9)	49 (10.2)
RM 1000 - RM 1999	162 (26.7)	79 (27.0)	119 (25.8)	204 (27.0)	106 (24.3)	149 (26.5)	124 (25.8)
RM 2000 - RM 2999	87 (14.3)	46 (15.7)	56 (12.2)	93 (12.3)	56 (12.8)	71 (12.6)	75 (15.6)
RM 3000 - RM 3999	33 (5.4)	17 (5.8)	30 (6.5)	40 (5.3)	24 (5.5)	33 (5.9)	34 (7.1)
RM 4000 - RM 4999	13 (2.1)	9 (3.1)	12 (2.6)	13 (1.7)	8 (1.8)	15 (2.7)	18 (3.7)
RM 5000 & above	32 (5.3)	22 (7.5)	23 (5.0)	43 (5.7)	22 (5.1)	30 (5.3)	35 (7.3)
unclassified	24 (4.0)	5 (1.7)	25 (5.4)	32 (4.2)	26 (6.0)	28 (5.0)	21 (4.4)
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7: Percentage of day loss due to asthma according to socio-demography

Characteristics	N	Yes (%)	95% Confidence Interval	
			Lower	Upper
Day Loss Due to Asthma	303	27.3	24.6	30.2
State				
Johor	33	11.3	7.6	16.4
Kedah	42	13.5	9.6	18.5
Kelantan	16	4.6	2.7	7.6
Melaka	10	3.1	1.6	6.1
N. Sembilan	11	3.5	1.9	6.2
Pahang	18	6.2	3.7	10.0
Pulau Pinang	12	3.9	2.1	7.0
Perak	19	6.9	4.4	10.8
Perlis	1	0.3	0.04	2.1
Selangor	62	22.7	17.7	28.6
Terengganu	11	3.3	1.7	6.2
Sabah	33	8.9	6.0	13.0
Sarawak	14	4.9	2.8	8.5
Kuala Lumpur	19	6.6	4.2	10.1
Labuan	2	0.6	0.1	2.2
Total	303	100.0		
Strata				
Urban	188	67.5	62.6	72.0
Rural	115	32.5	28.0	37.4
Gender				
Male	150	49.4	43.7	55.1
Female	153	50.6	44.9	56.3
Age group				
18-19	21	7.2	4.7	10.7
20-24	44	14.3	10.8	18.8
25-29	38	12.8	9.4	17.1
30-34	31	10.4	7.4	14.6
35-39	31	10.4	7.3	14.6
40-44	45	14.9	11.3	19.5
45-49	30	10.1	7.2	14.0
50-54	32	10.2	7.3	14.2
55-59	12	4.0	2.3	6.8
60-64	8	2.4	1.2	4.8
65-69	6	1.7	0.8	3.8
70-74	3	1.0	0.3	3.1
75-79	1	0.3	0.0	2.0
≥ 80	1	0.3	0.0	2.1
Ethnicity				
Malays	217	71.9	66.1	77.0
Chinese	12	4.1	2.3	7.1
Indian	41	14.3	10.4	19.2
Other bumis	25	7.4	4.8	11.4
Others	8	2.4	1.2	4.7
Religion				
Islam	236	77.3	71.8	82.0
Christian	21	6.8	4.4	10.3
Buddha	9	3.2	1.7	6.1
Hindu	34	11.6	8.1	16.4
Others	3	1.0	0.3	3.1
Citizenship				
Malaysian	295	98.0	95.7	99.0
Non-Malaysian	7	2.0	1.0	4.3
total	302			

Table 7: Percentage of day loss due to asthma according to socio-demography (continue)

Characteristics	N	Yes (%)	95% Confidence Interval	
			Lower	Upper
Educational Level				
None	19	6.0	3.7	9.4
Primary	81	25.5	20.9	30.6
Secondary	160	53.6	48.0	59.2
Tertiary	43	15.0	11.3	19.7
Occupation				
Senior Official & Manager	5	1.9	0.8	4.4
Professionals	19	7.5	4.9	11.5
Technical & Asst	30	11.3	8.1	15.6
Clerical Worker	27	10.3	7.1	14.8
Service Workers	63	23.3	18.5	28.7
Skilled Agriculture	43	14.1	10.5	18.8
Craft & Related	36	13.2	9.5	18.0
Plant & Machinery	21	7.3	4.8	10.9
Elementary Occupation	23	7.5	5.0	11.0
Housewife	3	0.9	0.3	2.8
Unemployed	8	2.8	1.4	5.5
Total	278	100.0		
Marital status				
not married	84	27.9	23.1	33.3
married	204	67.1	61.5	72.3
divorcee	8	2.6	1.3	5.3
widow/widower	7	2.3	1.1	4.8
Household income				
less than RM400	22	7.2	4.8	10.8
RM400 - RM 699	49	15.3	11.6	20.0
RM 700 - RM 999	32	11.1	7.8	15.3
RM 1000 - RM 1999	81	27.8	22.7	33.6
RM 2000 - RM 2999	48	16.7	12.6	22.0
RM 3000 - RM 3999	24	8.4	5.6	12.4
RM 4000 - RM 4999	8	3.0	1.5	5.9
RM 5000 & above	28	10.4	7.0	15.2
Total	292			

Table 8: Percentage of adult asthmatic seeking treatment (column %)

Characteristics	Doctors	Pharmacy with Old Prescription	Over the Counter	TCM
States				
Johor	107 (10.2)	17 (16.0)	7 (7.5)	15 (10.4)
Kedah	114 (10.8)	17 (16.0)	12 (12.9)	26 (18.1)
Kelantan	55 (5.2)	6 (5.7)	2 (2.2)	3 (2.1)
Melaka	43 (4.1)	1 (0.9)	2 (2.2)	2 (1.4)
N. Sembilan	38 (3.6)	0 (0)	1 (1.1)	2 (1.4)
Pahang	68 (6.5)	9 (8.5)	7 (7.5)	14 (9.7)
PP	45 (4.3)	4 (3.8)	7 (7.5)	10 (6.9)
Perak	69 (6.6)	3 (2.8)	9 (9.7)	6 (4.2)
Perlis	5 (0.6)	0 (0)	0 (0)	0 (0)
Selangor	215 (20.4)	12 (11.3)	12 (12.9)	30 (20.8)
Terengganu	38 (3.6)	5 (4.7)	10 (10.8)	8 (5.6)
Sabah	123 (11.7)	10 (9.4)	9 (9.7)	11 (7.6)
Sarawak	69 (6.6)	13 (12.3)	8 (8.6)	13 (9.0)
KL	51 (4.8)	6 (5.7)	6 (6.5)	1 (0.7)
Labuan	13 (1.2)	2 (2.8)	1 (1.1)	3 (2.1)
Strata				
Urban	617 (58.6)	55 (51.9)	51 (54.8)	62 (43.1)
Rural	436 (41.4)	51 (48.1)	42 (45.2)	82 (56.9)
Gender				
Male	406 (38.6)	49 (46.2)	52 (55.9)	68 (47.2)
Female	647 (61.4)	57 (53.8)	41 (44.1)	76 (52.8)
Age group				
18-19	51 (4.8)	6 (5.7)	3 (3.2)	12 (8.3)
20-24	97 (9.2)	13 (12.3)	16 (17.2)	19 (13.2)
25-29	92 (8.7)	10 (9.4)	10 (10.8)	23 (16.0)
30-34	83 (7.9)	8 (7.6)	7 (7.5)	10 (6.9)
35-39	100 (9.5)	12 (11.3)	9 (9.7)	9 (6.3)
40-44	112 (10.6)	10 (9.4)	11 (11.8)	5 (3.5)
45-49	115 (10.9)	14 (13.2)	9 (9.7)	4 (2.8)
50-54	101 (9.6)	7 (6.6)	8 (8.6)	16 (11.1)
55-59	94 (8.9)	8 (7.6)	3 (3.2)	11 (7.6)
60-64	58 (5.5)	4 (3.8)	7 (7.5)	6 (4.2)
65-69	55 (5.2)	5 (4.7)	1 (1.1)	11 (7.6)
70-74	50 (4.8)	2 (1.9)	6 (6.5)	7 (4.9)
75-79	25 (2.4)	5 (4.7)	0 (0)	6 (4.2)
≥80	20 (1.9)	2 (1.9)	3 (3.2)	5 (3.5)
Ethnicity				
Malay	699 (66.4)	74 (69.8)	66 (71.0)	102 (70.8)
Chinese	66 (6.3)	7 (6.6)	10 (10.8)	10 (6.9)
Indian	153 (14.5)	7 (6.6)	4 (4.3)	7 (4.9)
Other Bumis	108 (10.3)	15 (14.2)	10 (10.8)	16 (11.1)
Others	27 (2.6)	3 (2.8)	3 (3.2)	9 (6.3)
Religion				
Islam	785 (74.6)	83 (78.3)	74 (79.6)	118 (81.9)
Christian	78 (7.4)	13 (12.3)	7 (7.5)	7 (4.9)
Buddha	53 (5.0)	5 (4.7)	9 (9.7)	8 (5.6)
Hindu	126 (12.0)	4 (3.8)	3 (3.2)	6 (4.2)
Others	10 (1.0)	1 (0.9)	0	5 (3.5)
Unclassified	1 (0.1)	0	0	0
Nationality				
Malaysian	1033 (98.1)	103 (97.2)	89 (95.7)	134 (93.1)
Non Malaysian	19 (1.8)	3 (2.8)	4 (4.3)	10 (6.9)
Unclassified	1 (0.1)	0	0	

Table 8: Percentage of adult asthmatic seeking treatment (column %) (continue)

Characteristics	Doctors	Pharmacy with Old Prescription	Over the Counter	TCM
Education Level				
None	144 (13.7)	19 (17.9)	9 (9.7)	20 (13.9)
Primary	337 (32.0)	21 (19.8)	30 (32.3)	53 (36.8)
Secondary	479 (45.5)	54 (50.9)	48 (51.6)	68 (47.2)
Tertiary	86 (8.2)	12 (11.3)	6 (6.5)	1 (0.7)
Unclassified	7 (0.7)	0	0	0
Marital Status				
Not Married	194 (18.4)	24 (22.6)	24 (25.8)	37 (25.7)
Married	738 (70.1)	72 (67.9)	62 (66.7)	91 (63.2)
Divorcee	28 (2.7)	1 (0.9)	3 (3.2)	4 (2.8)
Widow/widower	90 (8.6)	9 (8.5)	4 (4.3)	12 (8.3)
Unclassified	3 (0.3)	0	0	0
Household Income				
< RM 400	104 (9.9)	5 (4.7)	7 (7.5)	13 (9.1)
RM 400 – 699	182 (17.3)	28 (26.4)	19 (20.4)	30 (20.8)
RM 700 – 999	125 (11.9)	14 (13.2)	5 (5.4)	18 (12.5)
RM 1000 – 1999	278 (26.4)	21 (19.8)	28 (30.1)	41 (28.5)
RM 2000 – 2999	160 (15.2)	12 (11.3)	14 (15.1)	17 (11.8)
RM 3000 – 3999	62 (5.9)	10 (9.4)	8 (8.6)	9 (6.3)
RM 4000 – 4999	28 (2.7)	5 (4.7)	1 (1.1)	6 (4.2)
RM 5000 & above	70 (6.7)	8 (7.6)	1 (1.1)	5 (3.5)
Unclassified	44 (4.2)	3 (2.8)	10 (10.8)	5 (3.5)
Occupation				
senior official	15 (1.4)	1 (0.9)	6 (6.5)	1 (0.7)
professionals	45 (4.3)	5 (4.7)	3 (3.2)	3 (2.1)
technical & ass	73 (6.9)	8 (7.6)	5 (5.4)	5 (3.5)
clerical worker	54 (5.1)	5 (4.7)	1 (1.1)	5 (3.5)
service workers	154 (14.6)	19 (17.9)	14 (15.1)	25 (17.4)
skilled agriculture	70 (6.7)	11 (10.4)	13 (14.0)	18 (12.5)
craft & related	64 (6.1)	4 (3.8)	6 (6.5)	13 (9.0)
plant & machine	36 (3.4)	4 (3.8)	2 (2.2)	10 (6.9)
elementary occ.	47 (4.5)	4 (3.8)	9 (9.7)	5 (3.5)
housewife	278 (26.4)	20 (18.9)	17 (18.3)	33 (22.9)
unemployed	165 (15.7)	19 (17.9)	13 (14.0)	21 (14.6)
unclassified	52 (4.9)	6 (5.7)	4 (4.3)	5 (3.5)

Table 9: Percentage of medication use by adult asthmatics

Independent Variables	Medication Use					
	None		Short Acting		Preventer	
	(%)	95% CI	(%)	95% CI	(%)	95% CI
States						
Johor	84 (12.0)	9.3 - 15.3	30 (14.2)	9.9 - 19.9	33 (7.7)	5.4 - 10.9
Kedah	88 (11.8)	9.0 - 15.4	23 (9.4)	6.1 - 14.2	46 (10.1)	7.5 - 13.5
Kelantan	40 (5.1)	3.5 - 7.2	12 (4.6)	2.5 - 8.2	19 (3.8)	2.4 - 5.9
Melaka	3.66 (24.0)	2.2 - 6.0	6 (2.8)	1.3 - 6.3	23 (6.0)	3.9 - 9.1
N.Sembilan	21 (2.8)	1.7 - 4.4	9 (3.6)	1.9 - 6.8	10 (2.2)	1.2 - 4.0
Pahang	48 (7.3)	4.8 - 10.9	19 (8.2)	5.0 - 13.2	27 (6.2)	4.1 - 9.2
Pulau Pinang	24(3.1)	1.9 - 5.0	13 (5.2)	3.0 - 8.7	26(5.6)	3.6 - 8.7
Perak	31 (5.0)	3.3 - 7.5	13 (6.3)	3.5 - 11.0	24 (10.6)	7.7 - 14.5
Perlis	0 (0.0)	0.0	2 (0.8)	0.2 - 3.0	2 (0.4)	0.1 - 1.6
Selangor	147 (22.2)	18.3 - 26.7	44 (20.9)	15.6 - 27.3	82 (20.8)	16.9 - 25.4
Terengganu	27 (3.6)	2.3 - 5.6	16 (6.1)	3.6 - 9.9	18 (3.7)	2.2 - 6.3
Sabah	78 (9.2)	7.0 - 12.0	26 (9.4)	6.1 - 14.1	46 (8.6)	6.1 - 12.0
Sarawak	64 (9.4)	7.0 - 12.5	10 (4.8)	2.6 - 8.8	28 (6.4)	4.2 - 9.7
W.P Kuala Lumpur	26 (3.9)	2.6 - 5.9	8 (3.6)	1.8 - 7.0	26 (6.2)	4.0 - 9.4
W.P Labuan	9 (1.1)	0.5 - 2.4	1 (0.3)	0.1 - 2.3	9 (1.7)	0.8 - 3.5
	711		232		439	
Age group (Years)						
18-19	42 (5.90)	4.4 - 7.9	14 (6.2)	3.7 - 10.1	15 (3.4)	2.0 - 5.5
20-24	91 (13.10)	10.7 - 15.9	28 (12.3)	8.6 - 17.1	29 (6.8)	4.7 - 9.7
25-29	69 (9.77)	7.8 - 12.2	24 (10.4)	7.1 - 15.0	39 (9.0)	6.7 - 12.0
30-34	52 (7.59)	5.8 - 9.9	19 (8.3)	5.3 - 12.7	37 (8.5)	6.2 - 11.5
35-39	58 (8.27)	6.4 - 10.7	23 (10.3)	6.9 - 15.1	47 (10.9)	8.3 - 14.3
40-44	59 (8.40)	6.5 - 10.8	26 (10.9)	7.5 - 15.7	50 (11.4)	8.7 - 14.7
45-49	79 (11.1)	9.0 - 13.6	16 (7.0)	4.2 - 11.4	44 (10.1)	7.6 - 13.2
50-54	62 (8.8)	6.8 - 11.2	25 (11.2)	7.7 - 16.0	45 (10.1)	7.6 - 13.3
55-59	57 (7.9)	6.1 - 10.1	18 (7.9)	4.9 - 12.4	40 (9.5)	7.1 - 12.7
60-64	34 (4.5)	3.3 - 6.2	14 (5.6)	3.3 - 9.3	27 (6.0)	4.2 - 8.6
65-69	41 (5.5)	4.1 - 7.4	11 (4.5)	2.5 - 8.0	20 (4.4)	2.8 - 6.7
70-74	28 (3.9)	2.7 - 5.7	9 (3.3)	1.7 - 6.2	24 (5.2)	3.5 - 7.7
75-79	23 (3.2)	2.1 - 4.8	3 (1.3)	0.4 - 3.9	9 (2.0)	1.0 - 3.7
80+	16 (2.1)	1.3 - 3.4	2 (0.9)	0.2 - 3.7	13 (2.9)	1.7 - 5.0
Sex						
Male	301 (42.5)	38.9 - 46.1	107 (45.7)	39.1 - 52.5	178 (40.2)	35.6 - 44.9
Female	410 (57.6)	53.9 - 61.1	125 (54.3)	47.5 - 60.9	260 (59.8)	55.1 - 64.4
Race						
Malay	479 (67.4)	63.2 - 71.4	172 (73.4)	67.1 - 78.9	280 (63.9)	58.9 - 68.7
Chinese	38 (5.9)	4.2 - 8.0	18 (8.3)	5.3 - 12.8	36 (8.8)	6.3 - 12.2
Indian	78 (11.7)	9.2 - 14.8	24 (11.4)	7.8 - 16.5	64 (15.3)	12.0 - 19.4
Other Bumis	92 (11.8)	9.2 - 15.0	11 (4.3)	2.4 - 7.6	48 (9.7)	9.6 - 13.3
Others	24 (3.2)	2.1 - 4.8	7 (2.6)	1.1 - 5.9	11 (2.3)	1.3 - 4.2

Table 9: Percentage of medication use by adult asthmatics (continue)

Independent Variables	Medication Use					
	None		Short Acting		Preventer	
	%	95% CI	%	95% CI	%	95% CI
Religion						
Islam	542 (75.5)	71.5 - 79.1	189 (79.8)	73.9 - 84.7	318 (71.6)	66.7 - 76.0
Kristian	58 (7.9)	5.9 - 10.5	11 (5.0)	2.8 - 8.9	36 ((8.0)	5.6 - 11.3
Buddha	34 (5.3)	3.7 - 7.4	13 (6.0)	3.5 - 10.1	29 (7.0)	7.0 - 4.9
Hindu	67 (10.0)	7.7 - 13.0	19 (9.1)	5.9 - 13.8	51 (12.2)	9.2 - 16.0
Others	9 (1.3)	0.7 - 2.5	0 (0.0)	0.0	5 (1.2)	0.5 - 2.8
Strata						
Urban	360 (56.8)	53.3 - 60.2	154 (71.2)	65.5 - 76.4	270 (66.5)	62.6 - 70.3
Rural	351 (43.2)	39.8 - 46.7	78 (28.8)	23.6 - 34.5	169 (33.5)	29.7 - 37.4
Socioeconomic Status						
< RM 400	72 (10.0)	7.9 - 12.7	22 (9.3)	6.2 - 13.9	38 (9.0)	6.5 - 12.3
RM 400 - < 700	151 (21.0)	17.8 - 24.6	34 (15.0)	10.6 - 20.6	76 (17.1)	13.7 - 21.1
RM 700 - < 1000	81 (11.6)	9.3 - 14.3	26 (11.6)	7.8 - 17.0	50 (12.1)	9.2 - 15.8
RM 1000 - < 2000	185 (27.3)	24.0 - 30.8	75 (34.6)	28.3 - 41.5	101(24.0)	20.0 - 28.4
RM 2000 - < 3000	97 (14.3)	11.7 - 17.4	31 (14.5)	10.2 - 20.3	72 (17.1)	13.6 - 21.3
RM 3000 - < 4000	44 (6.6)	4.9 - 8.8	13 (6.1)	3.4 - 10.8	31 (7.7)	5.3 - 11.1
RM 4000 - < 5000	19 (3.1)	1.8 - 5.3	6 (2.9)	1.3 - 6.3	12 (3.0)	1.7 - 5.2
RM ≥ 5000	37 (6.1)	4.4 - 8.3	12 (6.0)	3.4 - 10.2	39 (10.0)	7.3 - 13.6
Occupation						
Senior offical & manager	10 (1.6)	0.8 - 2.9	6 (3.0)	1.3 - 6.4	7 (1.7)	0.8 - 3.5
Profesionals	26 (4.0)	2.7 - 5.8	6 (2.9)	1.3 - 6.4	25 (6.5)	4.4 - 9.4
Technical & associate	40 (6.0)	4.5 - 8.1	18 (8.2)	5.1 - 12.9	35 (8.6)	6.2 - 11.7
Clerical workers	30 (4.6)	3.2 - 6.8	9 (4.3)	2.2 - 8.0	21 (5.4)	3.5 - 8.1
Service workers & shop	113 (16.9)	14.3 - 20.0	41 (19.5)	14.7 - 25.4	60 (14.5)	11.3 - 18.5
Skilled agricultural & fishery	76 (10.2)	8.1 - 12.7	13 (5.2)	2.9 - 9.0	25 (5.7)	3.9 - 8.3
Craft & related trade workers	40 (6.1)	4.5 - 8.2	14 (6.7)	4.0 - 11.0	28 (6.8)	4.7 - 9.7
Plant & machine operator & assembler	29 (4.3)	3.0 - 6.1	8 (3.6)	1.8 - 7.0	16 (3.7)	2.3 - 6.0
Elementary occupation	37 (5.4)	4.0 - 7.4	13 (5.6)	3.3 - 9.4	15 (3.3)	2.0 - 5.5
Housewife	170 (24.8)	21.7 - 28.2	55 (25.6)	20.1 - 32.1	118 (28.8)	24.6 - 33.3
Unemployed	113 (16.1)	13.5 - 19.1	35 (15.5)	11.2 - 20.9	66 (15.1)	12.0 - 18.8
Marital Status						
Not Married	155 (22.1)	19.1 - 25.5	54 (23.8)	18.5 - 30.1	69 (16.0)	12.8 - 19.7
Married	482 (67.7)	64.1 - 71.1	157 (67.4)	60.7 - 73.4	316 (72.3)	67.8 - 76.4
Divorce	22 (3.2)	2.1 - 4.8	1 (0.5)	0.1 - 3.1	15 (3.2)	1.9 - 5.2
Widow / Widower	51 (7.0)	5.4 - 9.1	20 (8.4)	5.5 - 12.7	39 (8.5)	6.3 - 11.5
Educational level						
None	107 (14.5)	12.0 - 17.5	21 (8.4)	5.5 - 12.7	60 (13.0)	10.3 - 16.5
Primary	247 (34.1)	30.6 - 37.7	72 (30.2)	24.5 - 36.6	129 (29.0)	24.9 - 33.4
Secondary	313 (45.4)	41.5 - 49.3	113 (49.4)	43.07 - 55.8	205 (47.8)	43.2 - 52.5
Tertiary	39 (6.0)	4.4 - 8.1	26 (11.9)	8.3 - 16.9	42 (10.2)	7.6 - 13.5
Citizenship						
Malaysian	688 (96.9)	95.3 - 97.9	229 (98.8)	96.2 - 99.6	429 (98.0)	96.2 - 99.0
Non-Malaysian	23 (3.2)	2.1 - 4.7	3 (1.3)	0.4 - 3.8	9 (2.0)	1.0 - 3.8
TOTAL	100.0		100.0		100.0	

APPENDIX 2

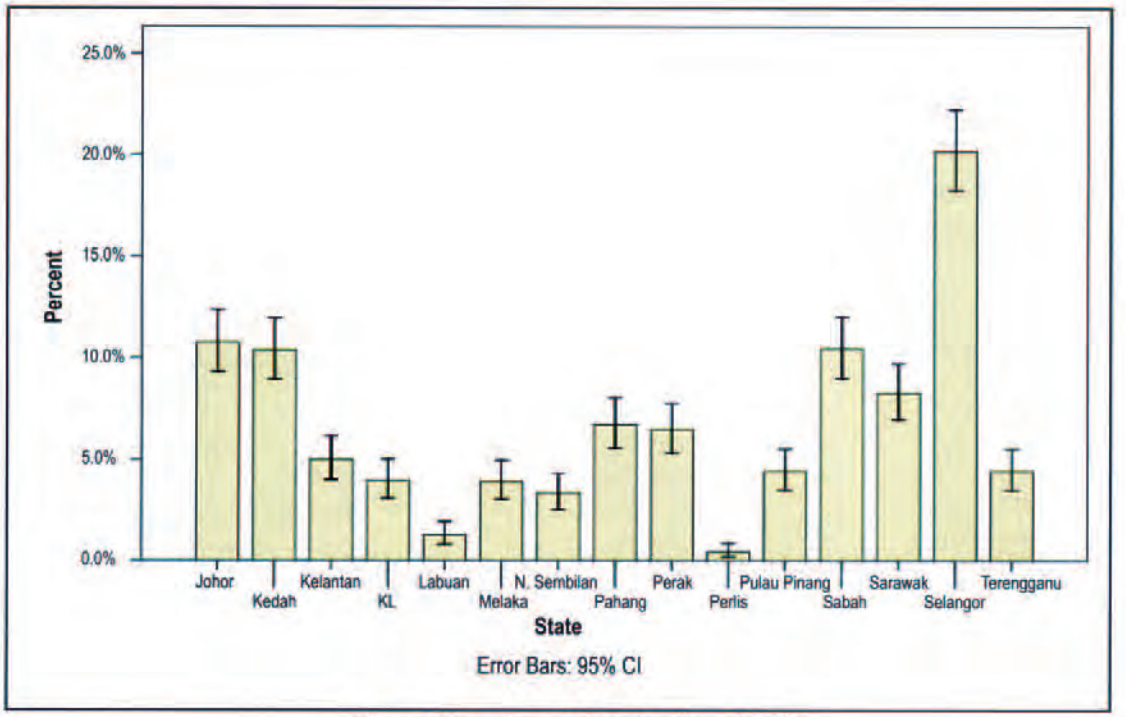

Figure 1: Prevalence of adult asthma by state

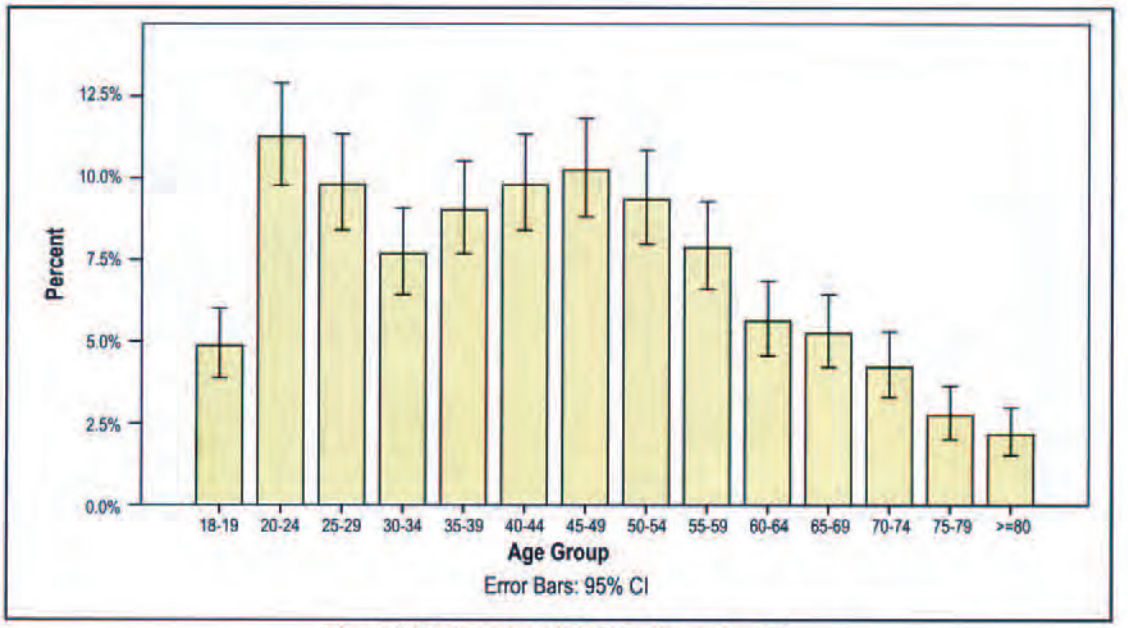

Figure 2: Prevalence of asthma by age group

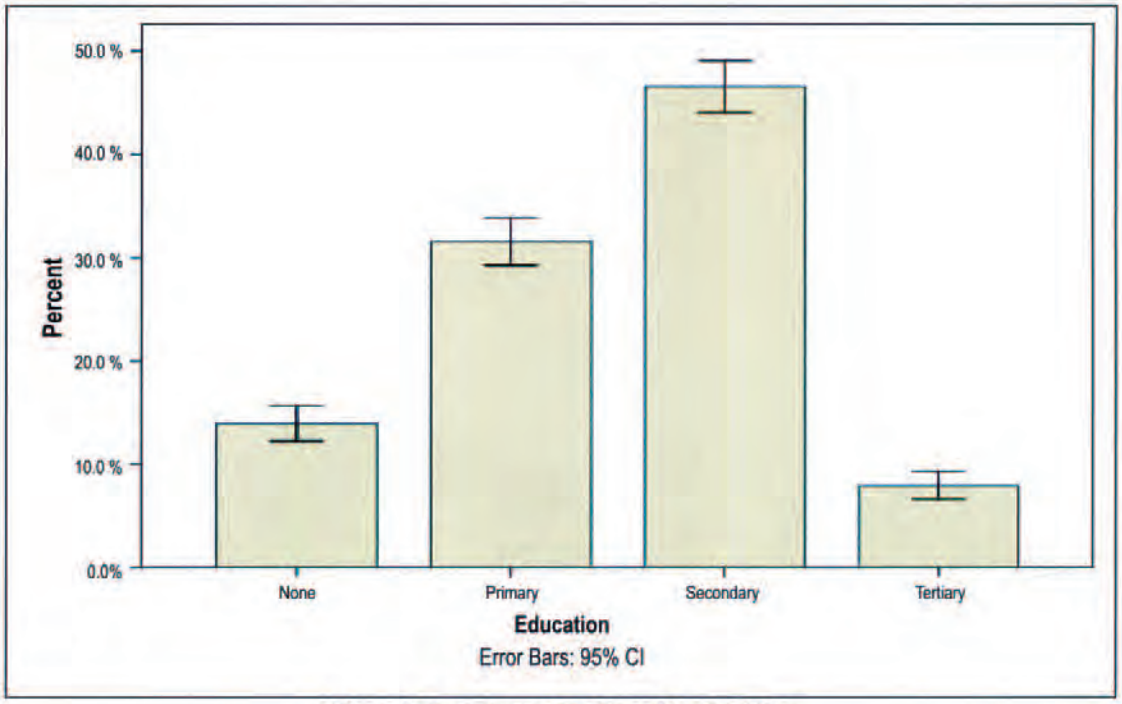

Figure 3: Prevalence of asthma by education

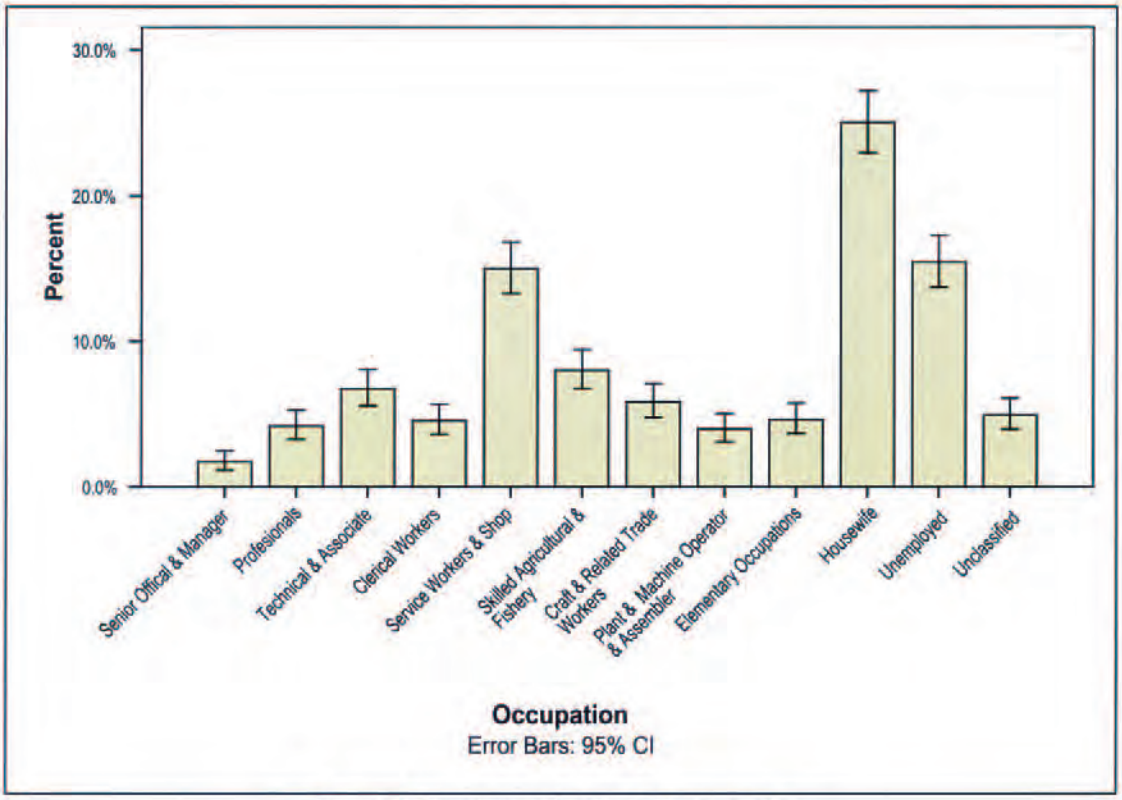

Figure 4: Prevalence of asthma by occupation

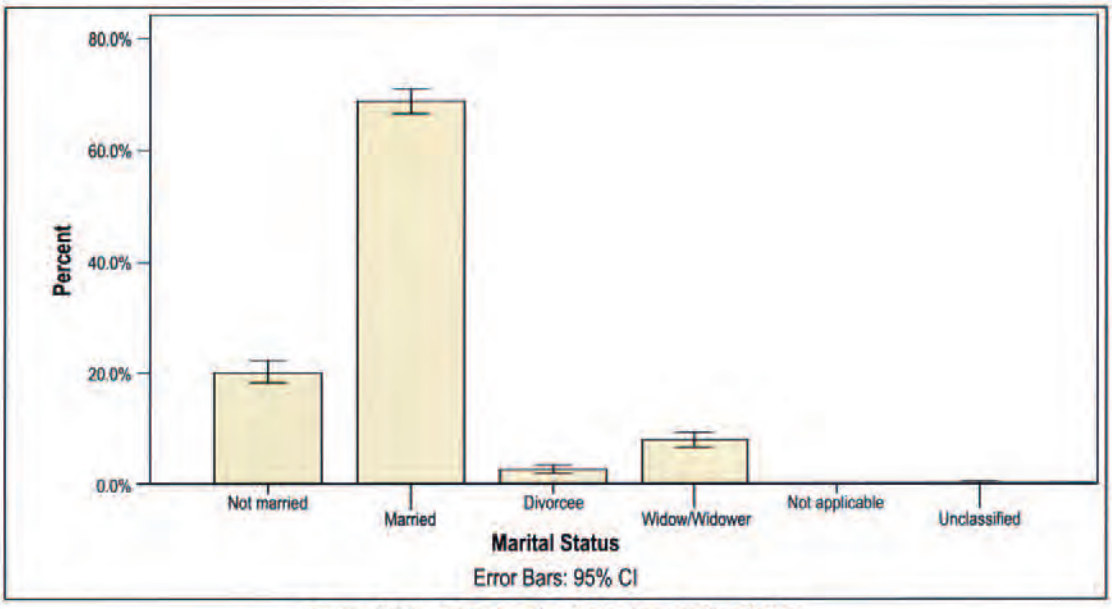

Figure 5: Prevalence of asthma by marital Status

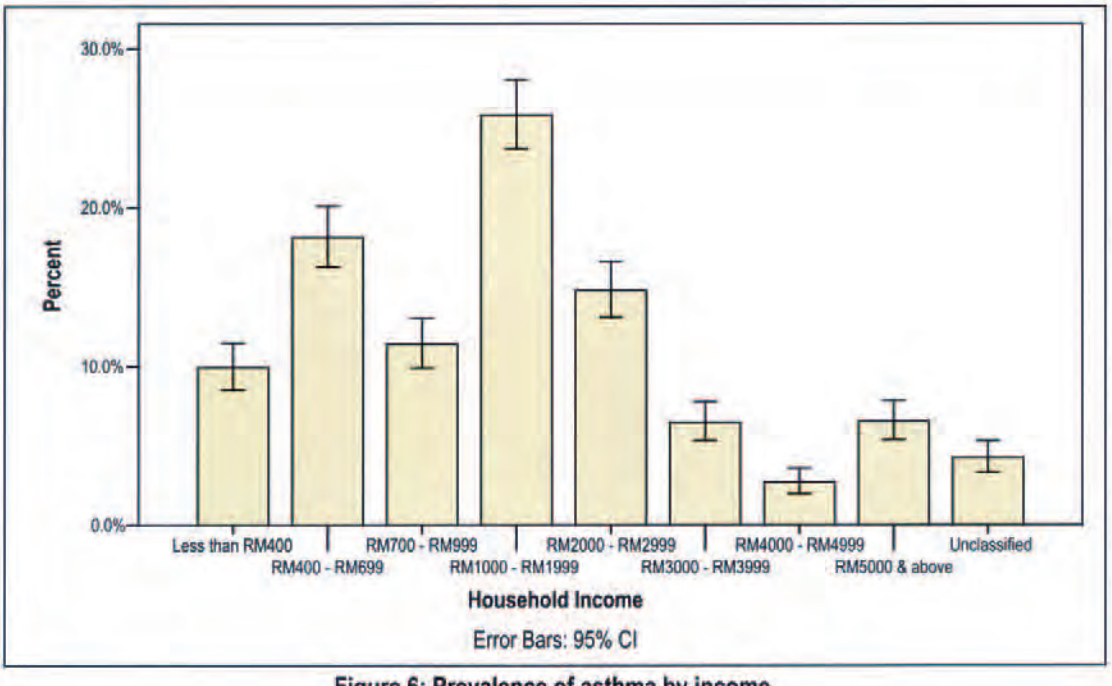

Figure 6: Prevalence of asthma by income

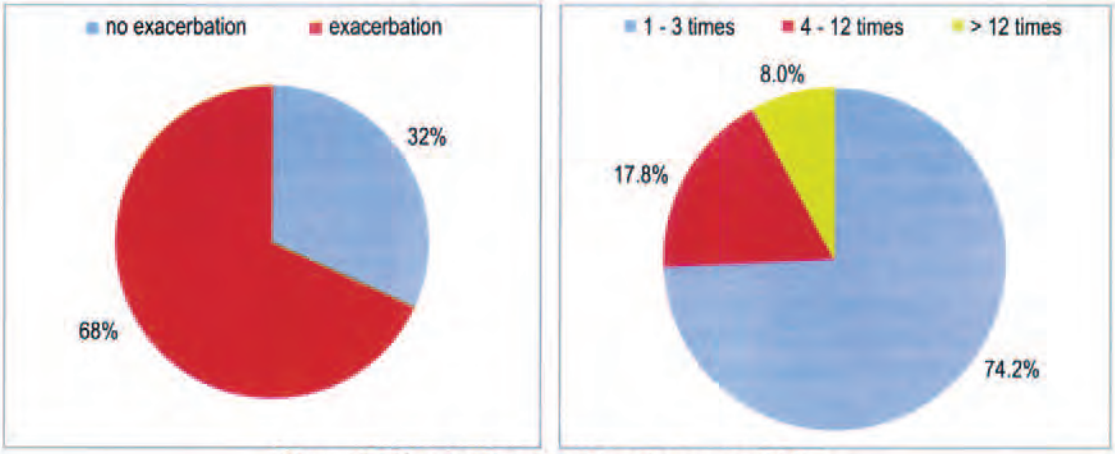

Figure 7: Distribution of asthma by exacerbation

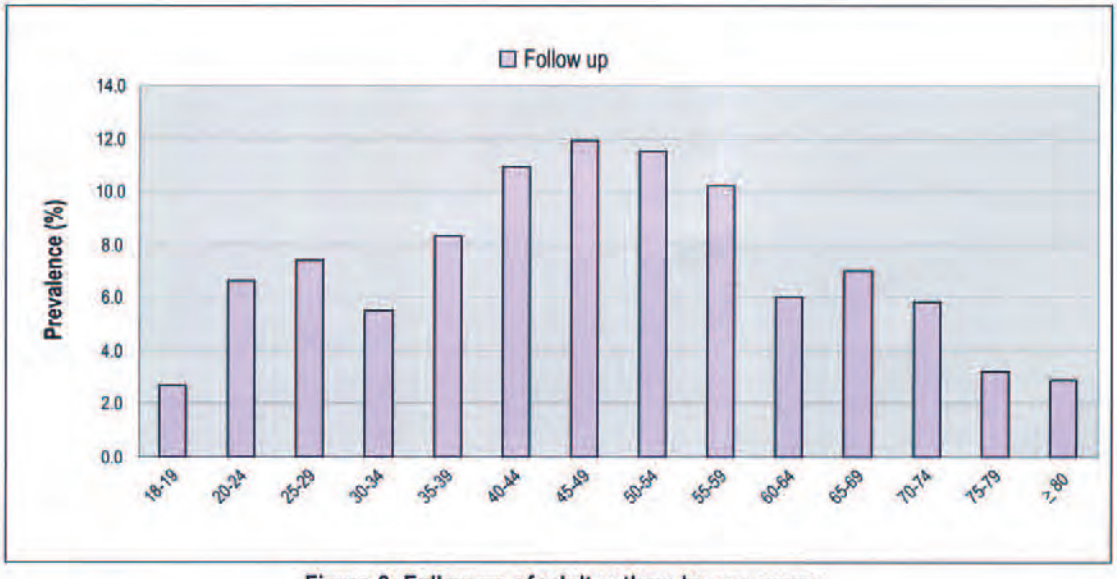

Figure 8: Follow-up of adult asthma by age group

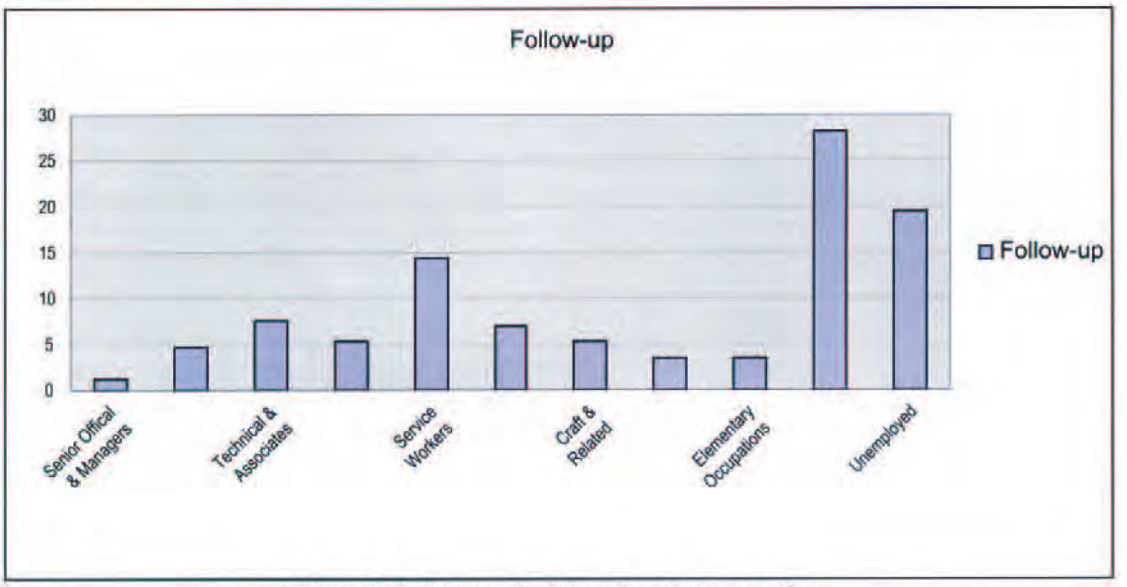

Figure 9: Follow-up of adult asthma by occupation

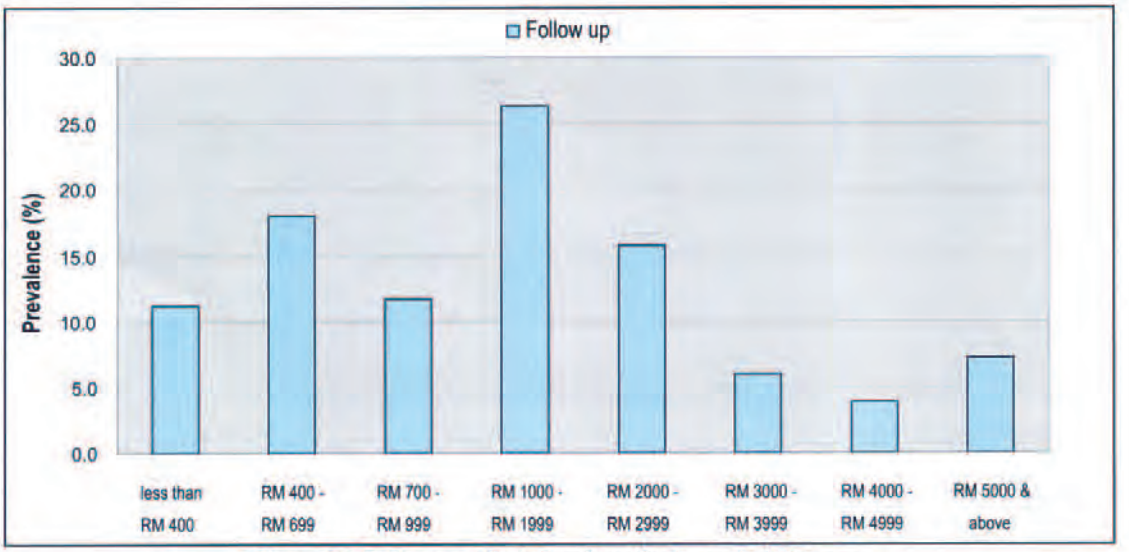

Figure 10: Follow-up of adult asthma by household income

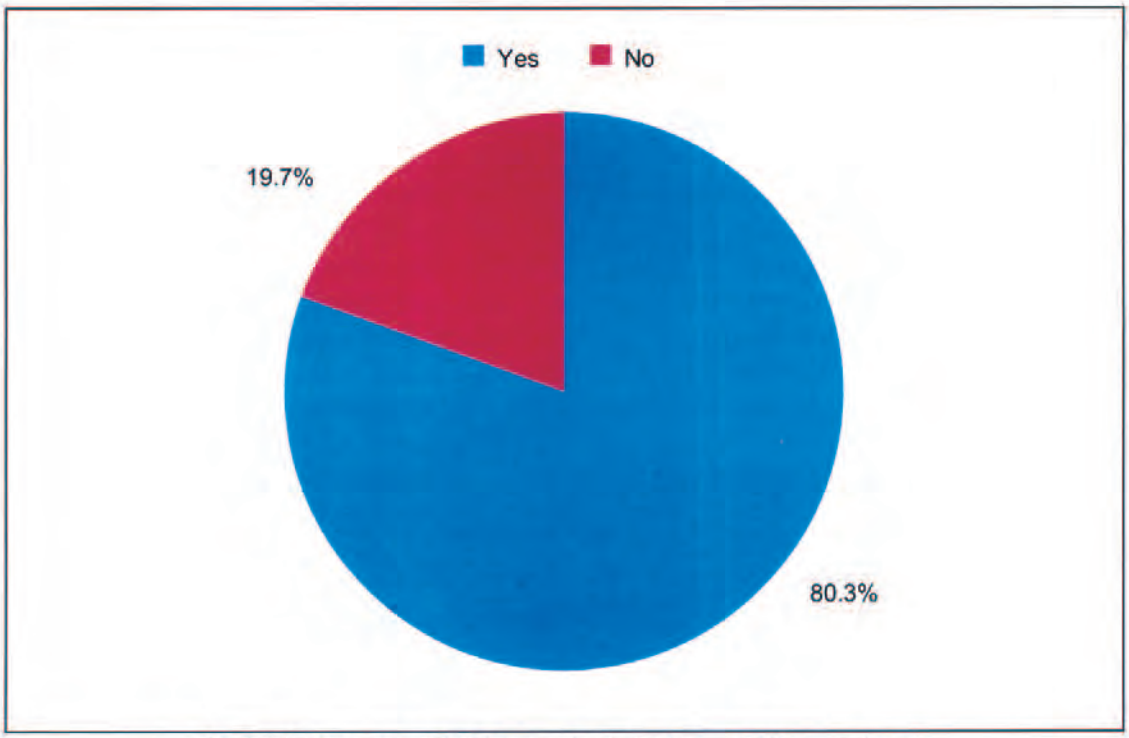

Figure 11: Percentage distribution of adult asthma visit to emergency department

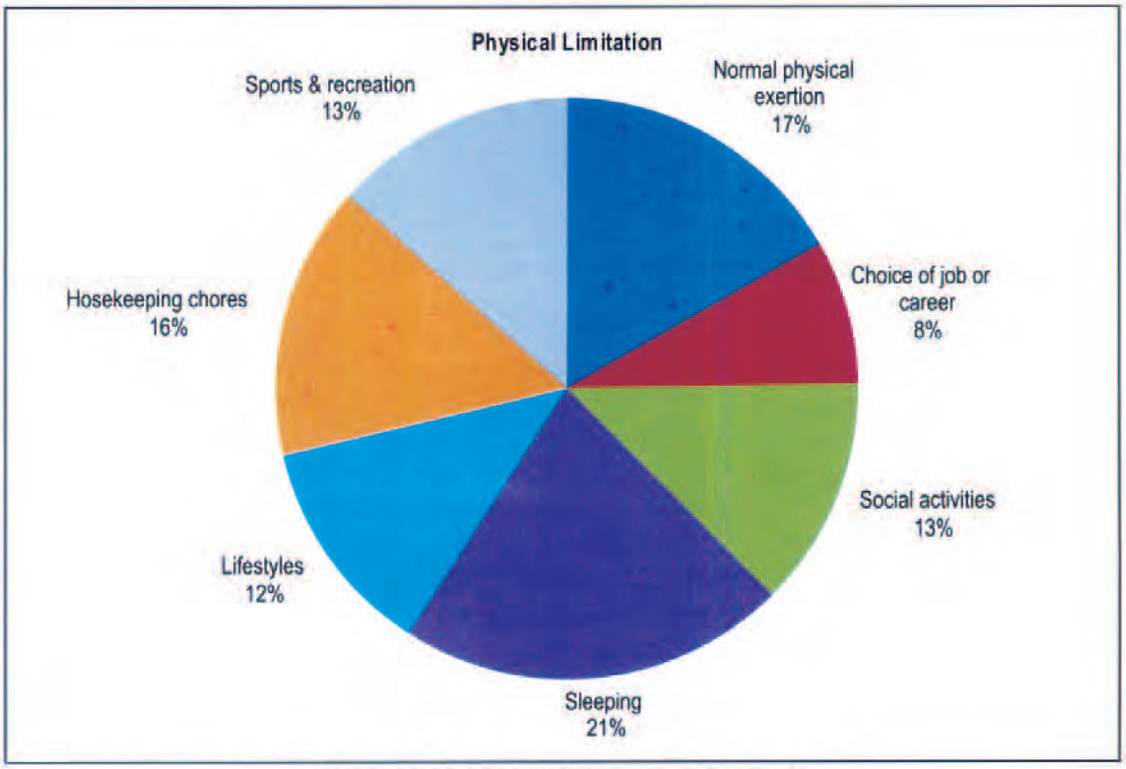

Figure 12: Physical limitations of adult asthma

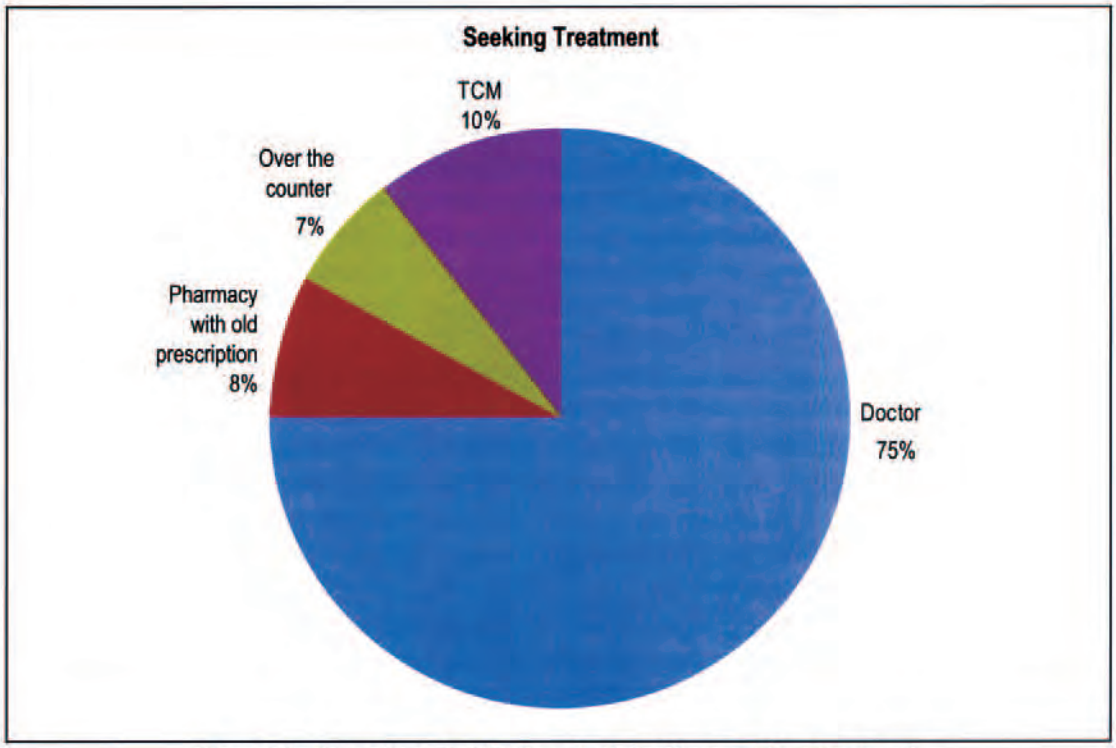

Figure 13: Percentage distribution of adult asthma seeking treatment