

**PREVALENCE OF NOCTURNAL ENURESIS AND
ASSOCIATED FACTORS AMONG 6-14 YEAR OLD CHILDREN
ATTENDING SCHOOLS IN A RURAL DISTRICT IN KENYA**

*A Dissertation Presented In Part Fulfillment For The Degree Of Master Of
Medicine In Paediatrics And Child Health At The University Of Nairobi.*

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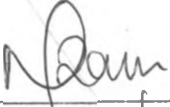
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DECLARATION

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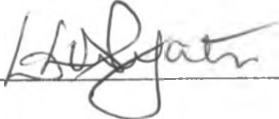
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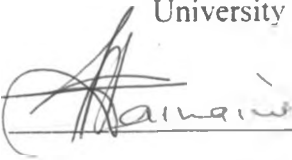
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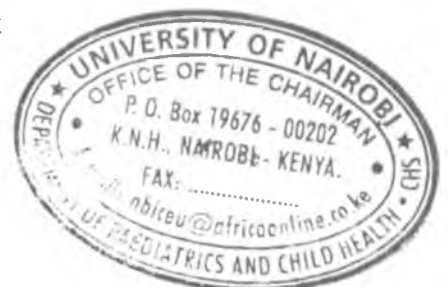
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DEDICATION

This work is dedicated to my husband Anthony and our lovely boys Adrian and Alvin, for their unwavering support throughout the programme, and to my late father Mr Samuel Nzamu Maingi, by whose inspiration I continually offer care to the sick.

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TABLE OF CONTENTS

DECLARATION	ii
DEDICATION	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF FIGURES	vii
LIST OF TABLES	viii
LIST OF ABBREVIATIONS	ix
ABSTRACT	x
1.0 INTRODUCTION AND LITERATURE REVIEW	1
2.0 STUDY JUSTIFICATION/UTILITY	21
3.0 RESEARCH QUESTION	22
4.0 OBJECTIVES	23
4.1 Primary Objective	23
4.2 Secondary Objective	23
5.0 METHODOLOGY	24
5.1 Study Design	24
5.2 Study Site	24
5.3 Study Population	24
5.4 Study Period	24
5.4.1 Inclusion Criteria	24
5.4.2 Exclusion Criteria	24
5.5 Sample Size	25
6.0 MATERIALS AND METHODS	26
6.1 RECRUITMENT OF STUDY PARTICIPANTS	26

6.2	TOOLS.....	28
6.3	DATA HANDLING.....	29
6.3.1	Data Management.....	29
6.3.2	Data Analysis.....	29
6.4	ETHICAL APPROVAL.....	30
7.0	RESULTS.....	31
8.0	DISCUSSION.....	50
9.0	CONCLUSION.....	56
10.0	LIMITATION.....	56
11.0	RECOMMENDATIONS.....	57
12.0	REFERENCES.....	58
	APPENDIX I: QUESTIONNAIRE.....	63
	APPENDIX II: ETHICAL APPROVAL.....	70

LIST OF FIGURES

Figure 4.1: Sleep behaviour among children in the study	36
Figure 4.2: Reported urinary symptoms among the children in the study.....	37
Figure 4.3: Prevalence of nocturnal enuresis among school aged children in Kibwezi District, Eastern Province, Kenya.....	38
Figure 4.4: Ages at which the children in the study attained dryness.....	39

LIST OF TABLES

Table 1: Age distribution, gender and birth order of the study participants	32
Table 2: Characteristics of parents of children recruited in the study	33
Table 3: Family history of nocturnal enuresis among children participating in the study	34
Table 4: Fluid intake and voiding habits among children in the study	35
Table 5: Reported exposure to stressful events among study participants	37
Table 6: Prevalence of nocturnal enuresis among children of different ages	40
Table 7: Prevalence of nocturnal enuresis among male and female children.....	40
Table 8: Prevalence of nocturnal enuresis according to birth order of the children in the study	41
Table 9: Association between family setup and prevalence of nocturnal enuresis.....	42
Table 10: Association between family history of enuresis and prevalence of nocturnal enuresis	43
Table 11: Prevalence of nocturnal enuresis among children with urinary symptoms	43
Table 12: Prevalence of nocturnal enuresis among children with different sleeping habits	44
Table 13: Prevalence of nocturnal enuresis among children who experienced/did not experience stressful conditions	45
Table 14: Prevalence of nocturnal enuresis among children with fluid intake restrictions	47
Table 15: Association between voiding patterns and nocturnal enuresis	47
Table 16: Logistic regression of factors associated with nocturnal enuresis among the children in the study.....	49

LIST OF ABBREVIATIONS

- PE _____ Primary Nocturnal Enuresis
- SE _____ Secondary Nocturnal Enuresis
- MNE _____ Monosymptomatic Nocturnal Enuresis
- PSE _____ Polysymptomatic Nocturnal Enuresis
- DSM _____ Diagnostic and Statistical Manual for Mental Disorders
- REM _____ Rapid Eye Movement (Sleep)
- ADH _____ Antidiuretic Hormone
- UTI _____ Urinary Tract Infection
- SPSS _____ Statistical Package for Social Sciences
- DEO _____ District Education Officer
- UON _____ University of Nairobi
- KNH _____ Kenyatta National Hospital
- MS _____ Microsoft
- PC _____ Personal Computer
- SD _____ Standard Deviation

ABSTRACT

Background: All children start life being incontinent of urine both by day and by night, and as neurological maturation occurs, voluntary urinary control is gained. Children sequentially graduate from voiding by spinal cord reflex, to voluntary cortical bladder control. This is a progressive maturation process. These skills are gained by 4 years during the day and 5-6 years by night. Primary nocturnal enuresis occurs when there is involuntary passage of urine during sleep by children aged 5 years or older, who have never achieved consistent night time dryness. Secondary nocturnal enuresis occurs when a child who has previously been dry for 6 months or more begins wetting the bed again.

Objectives: To determine the prevalence of nocturnal enuresis and associated factors among 6-14 year old children attending schools in a rural district in Kenya.

Study design: A school-based cross-sectional study.

Study population: Children aged 6-14 years attending the selected schools.

Study site: Five public primary schools in Mtito-Andei Division, Kibwezi District, Makueni County.

Study period: The study was conducted between June and August 2011.

Study procedure: Five primary schools were selected randomly among the total number of primary schools in the division. Eighty children were then selected from each of the 5 schools using simple random sampling technique, and implemented using paper picking, to make a sample size of 400 children. The sampled subjects were accompanied by the primary investigator

and research assistants to their homes. where after consent, a detailed questionnaire was administered to their parents/guardians. Collected data was cleaned, stored and analyzed.

Results: The mean age of the 400 children participating in the study was 10.3 years. Fifty eight children were reported to have nocturnal enuresis, giving a **prevalence of 14.5%**. The prevalence of secondary nocturnal enuresis was **4.25%** with 17 parents reporting that their children who were initially dry for at least 6 months had resumed bedwetting. Factors found to be significantly associated with nocturnal enuresis included younger age, family set up, family history of bedwetting, voiding habits before bedtime, waking up at night to void, deep sleep and experience of stressful life events.

Conclusion: The prevalence of nocturnal enuresis among school going children in Mtito – Andei division, Kibwezi district, Makueni county was **14.5%**. Factors identified to be significantly associated with nocturnal enuresis in this study population included younger age, family set up, family history of bedwetting, voiding habits before bedtime, waking up at night to void, deep sleep and experience of stressful events in a child's life.

1.0 INTRODUCTION AND LITERATURE REVIEW

All children start life being incontinent of urine both by day and by night, and as neurological maturation occurs voluntary control of the bladder is gained first by day and then by night. Children sequentially graduate from voiding via reflex activity to voluntary urinary control over the first few years of life¹.

MECHANISM OF VOIDING

Urinary continence is dependent upon a complex interrelationship between autonomic and somatic nerves, which are integrated at various sites in the spinal cord, brain stem, midbrain, and higher cortical centers. The normal coordination of the central and peripheral nervous systems network permits the filling of the bladder and urine storage at low pressure with high outlet resistance, and voiding with low outlet resistance and sustained detrusor (bladder wall muscle) contraction.

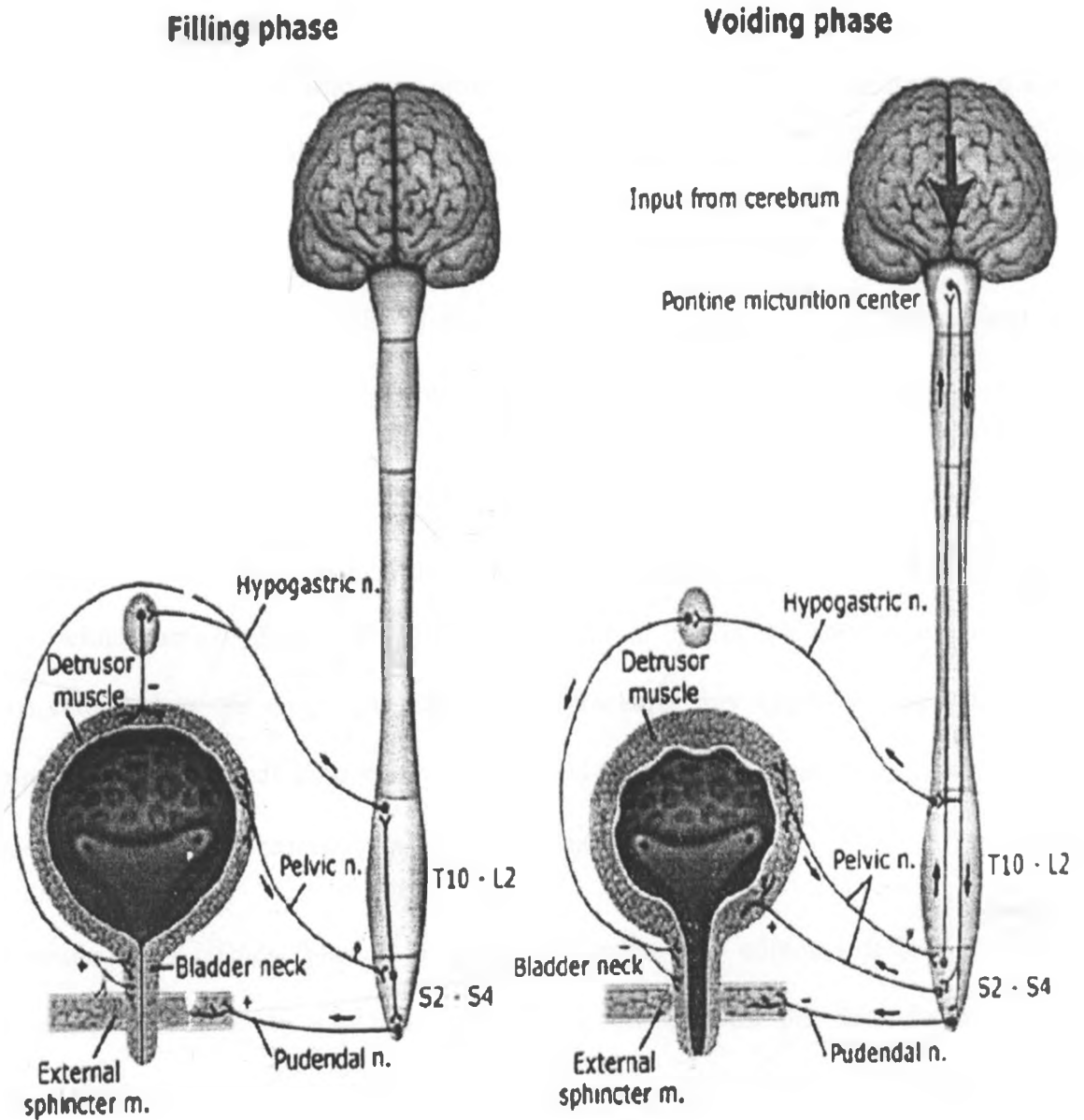
- *Filling phase* — To eliminate bladder contraction during the filling phase, activation of the sympathetic nervous system beta receptors of the bladder fundus results in detrusor muscle relaxation. Activation of sympathetic alpha receptors at the bladder neck result in bladder neck contraction and increased bladder outlet resistance. Stimulation of the pudendal motor neurons contracts the external urinary sphincter closing the bladder outlet and ensuring continence during the filling phase.
- *Voiding phase* — As the bladder fills, stretching activates mechanoreceptors, which send an ascending signal through the spinal cord to the pontine micturition center in the brainstem. A descending signal from the pontine micturition center through the spinal cord results in inhibition of the pudendal motor neurons, which relaxes the external

urinary sphincter; stimulation of the parasympathetic outflow via the pelvic splanchnic nerves resulting in detrusor muscle contraction, and inhibition of the sympathetic nervous system through the hypogastric nerves, which relaxes the bladder neck. Input from the higher cerebral centers can modify the function of the pontine micturition center.

The normal newborn infant voids approximately twenty times per day, which results in small voided volumes and incomplete bladder emptying². Infantile bladder function had been thought to be due to a primarily immature state of filling and emptying by spinal cord reflex without volitional cortical control. However, some element of cortical control in infants appears to be present as supported by the observation that infants void while awake or during arousal from sleep and never during the quiet sleep phase. Thus, it is suggested that the development of voluntary urinary control is a learned modification of the already preexisting integrated network between the peripheral and central nervous system³.

Development of bladder control is a progressive maturation process whereby the child first becomes aware of bladder filling, subsequently develops the ability to suppress detrusor contractions voluntarily, and finally learns to coordinate sphincter and detrusor function. These skills usually are achieved, at least during the day, by approximately 4 years of age. Nighttime bladder control can be achieved months to years after daytime control, but is not considered abnormal until after 5 to 6 years of age. As voluntary bladder control matures, bladder capacity also increases and voiding frequency decreases⁴.

Figure 1: Mechanism of Normal Urinary Voiding



The coordination of the central and peripheral nervous systems during bladder filling and voiding required for normal urinary continence. (adapted from UpToDate 2009)

NOCTURNAL ENURESIS

Primary Nocturnal Enuresis (PE) is the recurrent involuntary passage of urine during sleep by children aged 5 years or older, who have never achieved consistent night time dryness. It may further be subdivided into children who have enuresis only at night and those who also have daytime symptoms (urgency, frequency, daytime wetting) ⁵.

Secondary Nocturnal Enuresis (SE) is the involuntary passage of urine during sleep by children who have been previously dry for at least 6 months ⁵.

Recent urology literature describes another classification of nocturnal enuresis based on the presence or absence of other bladder symptoms. **Monosymptomatic Nocturnal Enuresis (MNE)** is defined as a normal void occurring at night in bed in the absence of any other symptoms referable to the urogenital tract, and it precludes any daytime symptomatology. **Polysymptomatic Nocturnal Enuresis (PNE)** is bed-wetting associated with other bladder symptoms such as urgency, frequency, instability, or voiding dysfunction⁵.

The Diagnostic and Statistical Manual for Mental Disorders (4TH edition) defines Nocturnal Enuresis as repeated urination into bed or clothes, occurring twice per week for at least 3 consecutive months, in a child of at least 5 years of age and not due to either a drug side effect or a medical condition ⁶.

Enuresis can be very distressing, especially in the older child, and if it persists into adulthood, there may be severe psychosocial problems affecting self esteem, careers, social life and personal relationships.

Parents of enuretic children have extra work and cost of extra laundry, in addition to the burden of caring for a child with enuresis. Up to 30% of these parents become intolerant of the enuresis and subsequently also of their child¹.

Although this condition is pathologically benign, it can have serious social and psychological repercussions for the sufferer including effects on self esteem, school success, parental disapproval and even sexual activity in later life⁷.

PATHOGENESIS

Proposed etiologic factors contributing to nocturnal enuresis include genetics, sleep arousal dysfunction, urodynamics, nocturnal polyuria, psychological components, and maturational delay⁵. Thus the condition is multi-factorial⁵.

Genetics

Nocturnal enuresis has been linked to a hereditary basis. Studies of twins show a concordance rate of 43% to 68% for monozygotic and 19% to 36% for dizygotic twins. Seventy percent of children who have enuresis have a parent who has a history of the disorder. Studies indicate that if one parent had enuresis, the probability of a child having it is approximately 40% to 45%. If both parents were affected, the probability of a child having the condition increases to 70% to 77%. If neither parent had enuresis, only 15% of offspring will have enuresis⁸. Chromosomes 12q, 13q, and 22 all have been named as possible locations of a gene(s) resulting in enuresis, but a specific mechanism for enuresis related to a gene locus is not known⁹.

Sleep Arousal Dysfunction

The association between the presence of a full bladder and the sensation in the brain of a full bladder occurs in most children by the age of 5 years. Concurrently, by this age the child's pattern of several sleep/ wake cycles daily, known as multiphasic sleep, has changed to a single period of sleep daily, known as monophasic sleep. Daytime urination control usually occurs first, followed by learning to arouse during sleep to the sensation of a full bladder. Many parents report that a child who has enuresis is more difficult to arouse from sleep than are other children in the home¹⁰.

The relationship of sleep patterns with enuresis is an area of active research. In some studies, the enuretic event seemed to occur during non-REM sleep and could occur during any part of the night¹¹. In others, enuresis reportedly was caused by a mild disturbance in arousal, based on the finding that activation of the arousal center proceeded correctly, but the transition from light sleep to complete awakening was not achieved properly. In a subset of patients, the arousal center in the brain failed to activate, despite proper full bladder sensation. There is conflicting evidence that children who have enuresis may exhibit other parasomnias, such as sleepwalking and night terrors¹¹. A recurrent theme in sleep research is the child's inability to recognize the sensation of a full bladder during sleep and failure to awaken from sleep to urinate in an appropriate place. There appears to be a maturational pattern of progressive central nervous system "recognition" of bladder fullness and control over the micturition reflex.

Urodynamics

Some children who have enuresis may have a small bladder capacity. Children who have small bladder capacities probably represent a sub-group of patients who have MNE and presumably cannot hold the normal amount of urine produced at night. They are more likely to report frequent daytime voiding, some nights with multiple episodes of enuresis per night, and no history of attaining dryness¹².

In some children who have normal bladder capacities, urgency may play a role in nocturnal enuresis. These children exhibit daytime urgency, but they can maintain bladder control during the day. They have a pattern of partial emptying of the bladder that results in frequent daytime urination to maintain continence and enuresis occurring at night when they cannot void as often. No evidence supports abnormal urodynamics in children who have MNE. Involuntary nighttime voiding in those who have MNE occurs with a urodynamically normal bladder at functional capacity. Because most patients who have abnormal urodynamics as an underlying cause for their nighttime enuresis also have daytime symptoms, asking patients about daytime voiding patterns in the initial history is important¹³.

Nocturnal Polyuria

Excessive urine production (polyuria) may be associated with chronic illnesses such as diabetes mellitus and diabetes insipidus. Caffeine, alcohol, and medications also may cause it. Factors such as irregular food and drink intake and staying up late also may contribute. It seems reasonable to limit fluid intake several hours prior to bedtime because the most common cause of polyuria is habit polydipsia¹⁴.

The theory that MNE is due to nocturnal polyuria with relative nocturnal deficiency of pituitary-produced antidiuretic hormone (ADH) has been fronted¹⁵. Early studies reported that the plasma level of ADH did not increase during sleep in those who had enuresis compared with a rise in ADH among unaffected children, resulting in relative nocturnal polyuria as a factor in enuresis. Studies documenting the percentage of children who have enuresis and lack a nocturnal surge in ADH ranges from 25% to 100%, suggesting the presence of other factors⁵.

Psychological Factors

Secondary enuresis commonly has been attributed to psychological factors. On the contrary, enuresis creates psychosocial problems for the bed-wetting child, including poor self-esteem, family stress, and social isolation¹⁶. Children who have enuresis not only have lower self-esteem than unaffected children, but they have lower self-esteem than children who have chronic, debilitating illnesses. The profound impact that enuresis may have justifies a careful evaluation of psychosocial symptoms in the family and the patient⁵.

Maturation Delay

The fact that most children who have enuresis become dry in time with or without intervention supports maturational delay as a factor in MNE. At age 5 years, 15% of children occasionally wet the bed compared with only 10% at 6 years of age. Perhaps development of central nervous system recognition of and response to the sensation of a full bladder is delayed, a concept that correlates strongly with the arousal dysfunction theory¹⁷. Proposed abnormal urodynamic factors also may normalize as the child becomes older. A similar process of maturation over time is seen in other milestones of normal development, such as the age range of 9 to 15 months at which a

child begins to walk. Maturation delay may be the most plausible and unifying concept among proposed etiologic factors in MNE⁵.

RISK FACTORS

Multiple risk factors associated with enuresis have been studied and identified. Genetic predisposition strongly impacts on enuresis in that 70% of children who have enuresis have a parent who has a history of the disorder. If one parent had enuresis, the probability of a child having it is approximately 40% to 45%. If both parents were affected, the probability of a child having the condition increases to 70% to 77%. If neither parent had enuresis, only 15% of offspring will have enuresis.⁸

Males are more predisposed than females in suffering from enuresis. In terms of the birth order, not being a first born is a risk factor for enuresis.¹⁸ Mothers tend to be very keen on the development of their firstborns, and this includes areas of toileting and achieving continence, as compared to subsequent children where the mother is more relaxed and not under pressure. Large families with many siblings have also been associated with a higher prevalence of nocturnal enuresis¹⁸.

Constipation²⁰ and encopresis are established risk factors for nocturnal enuresis. Twenty three per cent of nocturnal enuresis is associated with encopresis and daytime incontinence²¹.

Children with disturbed sleep or heavy sleepers are at an increased risk on nocturnal enuresis¹⁹. This increased risk also includes children who snore, have adenoidal hypertrophy or other forms of airways obstruction.

Recurrent UTIs and other urological abnormalities like overactive bladder syndrome and reduced bladder capacity increase both nocturnal and diurnal enuresis¹³.

Children with neurological disorders like cerebral palsy and profound mental retardation tend to be enuretic. Enuresis is to be expected as a manifestation of developmental delay in those with global developmental delay, with or without an associated syndrome like Downs syndrome²².

Low socioeconomic status, low maternal educational level, maternal smoking and maternal age below 20 years at the time of birth have also been shown to increase the risk of nocturnal enuresis¹⁸.

Drinks containing methyl xanthines (eg coffee, drinking chocolate) and pattern of fluid intake before bedtime impact on nocturnal enuresis by nocturnal polyuria⁵. Habitually voiding before bedtime reduces the risk of nocturnal enuresis⁵.

Stressful events in a child's life increase the risk of secondary nocturnal enuresis⁵. Events like divorce, bereavement, separation from a parent, bullying, sexual abuse, physical abuse, change of home or change of school have been found to contribute significantly to secondary enuresis.

MANAGEMENT

Many methods have been used in the management of nocturnal enuresis with varying success rates. Pharmacological and behavioral methods are used, either alone or in combination, but the mainstay of treatment encompasses the behavioural methods.

Basic principles

It is important to understand that the child does not wet the bed out of malevolence or deviance. It may help to explain to the parents that primary enuresis occurs because the volume of urine produced at night exceeds the capacity of the bladder to hold it and the sensation of a full bladder does not wake the child. Enuresis will thus resolve when the bladder capacity increases and/or night-time urine volume is reduced and/or the child wakes in response to a full bladder. It is therefore important not to be angry with the child, although this may be difficult at times. Stress aggravates the problem. Instead, reinforce success. Motivation and commitment of both child and parent are key to successful therapy.

Although parents may be informed that 15% of children improve each year without assistance, the others will not improve without treatment, and there is no formula to predict who will improve or when the improvement may occur, hence the need for treatment¹⁴.

All enuretic children, more so those with secondary enuresis should be referred to a child psychiatrist for therapy.

All children with daytime symptoms should be referred for specialist assessment and management to exclude congenital disorders, neurological diseases or overactive bladder syndrome⁵.

Behavioural methods

- 1) **Voiding before bedtime**: A simple measure like ensuring that the child habitually voids before going to bed significantly improves nocturnal enuresis⁵. Initially the

child needs to be reminded to pass urine before sleeping. but with time it becomes a learned habit that improves outcome.

- 2) **Fluid restriction in the evenings:** Restricting fluids for up to 3-4 hours before bedtime has been shown to improve enuresis. The child is encouraged to liberally drink fluids from morning to afternoon hours, then restricted from a particular time in the evening, depending on the time he/she goes to bed. It is important to particularly restrict drinks containing methyl xanthines⁵.
- 3) **Lifting:** Many parents choose to take the child to the toilet before they go to bed, so that the child may empty the bladder and, in effect, have a shorter night in which to need control. The child is gently lifted, taken to the toilet to pass urine and then put back to bed. A refinement of this is to ask the child to say a password to ensure that they are awake. This method is recommended by such authorities as the Royal College of Psychiatrists. One study found that lifting had better short- and long- term results (measured after 3 years) than a reward system or placebo²⁴.
- 4) **Star charts:** The aim is to reinforce success rather than to punish failure. The star chart requires a calendar and some sticky stars. Every time that the child has a dry night, a star is placed on that date. If it is not a dry night, that date is ignored. The star is a reward. There is no punishment. Perhaps a run of success, such as 7 consecutive stars, may merit a treat. For this to be viable, the child should be having a significant number of dry nights already⁵.
- 5) **Reward system:** A motivational method, which involves rewarding the child with tangible gifts or treats of the child's choice for dry nights. The child is allowed to

choose a gift of he/she would like, but obtaining that particular gift will take an agreed number of dry nights.

- 6) **Dry-bed training:** Involves waking the child on a progressive schedule at decreasing intervals over several nights, having the child change pajamas and bedding if wet or walk to the toilet when voiding is needed. As in the use of alarm therapy, the eventual goal is to have the child self-awaken to void. Although a high cure rate is reported with this technique by the authors, it is a more time- and labor-intensive process than most families are willing to undertake⁵.

- 7) **Enuresis alarm system:** Alarms are the treatment of choice in the long-term management of nocturnal enuresis. Most providers of buzzers and pads recommend that the child should be at least 7 years old and have been checked for UTI. The device should be used for 3-5 months. The buzzer and pad are common, have been in use for more than 50 years and efficacy has been demonstrated ²⁵. The aim is to wake the child as they start to urinate so that they will stop, go to the toilet and learn to recognize the nocturnal sensation of a full bladder. 65% of children become dry with treatment although, after 6 months, 50% tend to relapse. Over-learning (increasing fluid intake beyond that normally expected, to train the bladder) may help reduce this.

- 8) **Self monitoring:** The child and parent keep record of all dry or wet nights, without necessarily including any reward or gift.

Pharmacological treatment

Various pharmacological agents have been used in children for the treatment of nocturnal enuresis, and their effectiveness is variable. They include the following:-

- 1) **Desmopressin acetate**: Intermittent oral desmopressin is the treatment of choice. A synthetic analogue of the naturally occurring hormone arginine vasopressin, it acts selectively on the V1 receptors in the kidney to increase water but not electrolyte absorption within the distal collecting tubes and collecting ducts. This results in a reduction in urine volume and intra-vesicular pressure. Cochrane reviews evidence shows that desmopressin significantly reduces the number of wet nights per week experienced by children, but there was some evidence that the benefit was not sustained once treatment was finished ²⁶. Not all children respond to desmopressin; factors predicting a good response is the child being 8 or more years of age, and fewer initial wet nights (less than 3 out of 4 wet nights). Relapse rates are high (50-95%) ⁵. One study found that the incidence of recurrence was reduced if structured withdrawal was initiated rather than sudden cessation of treatment ²⁷. Usually Desmopressin is used as short-term treatment to allow a child to recover confidence or as a temporary measure to help the child for nights spent away from home. It is also a useful adjunct to alarm therapy, but alarms are more successful than desmopressin in producing a sustained response²⁸.
- 2) **Imipramine**: It is a tricyclic antidepressant that has been used for more than 3 decades to treat nocturnal enuresis. Its efficacy is similar to desmopressin, but it is cheaper and has more side effects²⁶. It appears to increase bladder capacity through a weak

anticholinergic effect and also may decrease detrusor muscle contractions via noradrenergic effects.

- 3) **Oxybutynin chloride:** It is an anticholinergic and antispasmodic drug that has a role in reducing uninhibited bladder contractions. It is used primarily to treat children who have symptoms of daytime urgency or frequency in addition to nighttime enuresis. It appears to be no better than placebo in treating children who have MNE⁵.

Treatment success

Regarding initial treatment success, the International Children's Continence Society ²⁹ defines the following criteria.

Partial response to treatment is a 50-89% decrease in wetting. *Response* is 1-3 wetting occurrences monthly. *Full response* is complete dryness or less than one wetting occurrence monthly. *Relapse* is more than one wetting occurrence monthly. *Continued success* is no relapse six months after cessation of treatment. *Complete success* is no relapse two years after cessation of treatment.

PSYCHOSOCIAL COMPLICATIONS

Nocturnal enuresis has significant psychosocial complications including *anxiety disorders*. These children may develop panic attacks or social phobias due to their condition. They also develop *mood disorders* over time, the commonest being major depressive episodes. They tend to be sad most of the day.

Low self esteem following nocturnal enuresis is a serious psychosocial complication that affects all aspects of functioning of the affected child. This worsens as the child grows into adolescence and adulthood.

Other observed psychosocial effects include *school refusal, poor school performance and poor social relationships*. Due to the poor relationship with their peers at school, most enuretic children are bullied and made fun of.

It is of great importance to ensure that the mental and emotional health of enuretic children is catered for by the various mental health workers including counsellors, psychologists and psychiatrists. This is because all these complications have been shown to be reversible with successful therapy²².

PREVALENCE OF NOCTURNAL ENURESIS

Approximately 80% to 85% of children who have nocturnal enuresis have MNE. Another 5% to 10% of cases meet the definition of PNE, with daytime wetting or other bladder symptoms. Organic causes are responsible for nocturnal enuresis in fewer than 5% of cases. Such organic causes must be searched for and ruled out if the history suggests their presence⁵.

Previous studies done elsewhere in this field have had varying prevalence results, suggesting an overall prevalence of between 3.9% - 18.9%. What is clear is that the prevalence of not being reliably dry at night decreases with age, and that mostly girls tend to be ahead of boys in achieving control. Associated factors have also been variable in different study populations.

A study on occurrence of primary nocturnal enuresis and associated factors in 5 year old outpatients in Slovenia showed a prevalence of 8.7% higher in families with many siblings. The boy:girl ratio was 4:1, and parents were more disturbed by the problem than their children³⁰. Gumus, while studying the prevalence of nocturnal enuresis and accompanying factors in Turkish children aged 7 – 11 years, found an overall prevalence of 13.7%, 10.6% females and 16.9% males. The prevalence decreased with age, and it was more common in children with a family history of bedwetting, deep sleeping and low educational level of the family³¹. A randomized study among primary school children aged 4 – 12 years living in Aydin, showed an overall prevalence of 11.6% for nocturnal enuresis and 0.8% for day time wetting. It was more prevalent in boys than girls. Age, family history, large family size, UTI and low parental socioeconomic status were statistically associated. Family history among the enuretics and non-enuretics was 40.7% and 9.5% respectively. Of the enuretics, 11% had been treated professionally, 65% treated traditionally and 25% sought no help³².

In Sweden, nocturnal enuresis prevalence among children aged 7 years was 5%³³. Bower studied the epidemiology of childhood enuresis among 5 – 12 year olds in western Sydney, Australia, and found an overall prevalence of nocturnal enuresis of 18.9% and daytime wetting of 5.5%. Among these, 34% had consulted with a health worker³⁴. A cross sectional study of childhood nocturnal enuresis in Malaysia, among children aged 7, 9, and 12 years, revealed an overall nocturnal enuresis prevalence of 8%, with primary being 6.2% and secondary being 1.8%. Positive family history was found in 53%, and 87% had not sought any form of treatment. Significant predictors were younger age and male sex³⁵.

Ozkan investigated school children aged 6 – 11 years in South East Anatolia, and found an enuresis prevalence of 12.96%. It was commoner in boys than girls with a male:female ratio of 6:1 and rates decreased by age without gender bias. Rate of positive family history was 42% for siblings only and 66% for parents. Parental concern was not high, only 15% of enuretics had visited a doctor for treatment. Low socioeconomic status was found to be an associated factor³⁶. A cross-sectional study in 8 elementary schools in Bangkok, Thailand, among 5-15 year olds, showed an overall enuresis prevalence of 4.2%, with nocturnal enuresis being at 3.9%. Prevalence declined with increasing age, 10% (5 year olds), 5.3% (7 year olds), 3% (10 year olds) and 1.2% (12 year olds). Unlike many other studies, prevalence was more in females than males. Positive family history and encopresis were found to be associated³⁷.

Mithani conducted a cross-sectional study among school children aged 3-13 years in Karachi, and revealed an overall enuresis prevalence of 9.1%. It was commoner in boys (53.9%) than girls (46%). Among these, 54% sought help, 26% consulting doctors and the rest home/traditional remedies. Family history was present in 25.6%³⁸. A study of enuresis among primary school

children in Isfahan, Iran, showed a nocturnal enuresis prevalence of 6.2%, diurnal enuresis 0.5% and 0.8% of combined day and night wetting. Positive family history in the father was 51% while in the mother it was 39%. Younger age, gender and low maternal education level were significant predictors³⁹. In Zhengzhou city, China, enuresis prevalence among 1-18 year olds was 23.03% (1-4 yr), 5.66% (5-12 yr) and 1.37% (13-18 yr). There was a positive relationship with male gender, living in rural areas and associated day time symptoms⁴⁰.

Tai found a nocturnal enuresis prevalence of 6.8% among primary school children in Taiwan. More boys were affected than girls (8% versus 5.5%). Gender, age, urine frequency or urgency, heredity, drinking habits before sleep and difficulty in waking were the recognized associated factors⁴¹. A study from south east Europe, Turkey, found an enuresis prevalence of 9.8%. Urination more than 5 times in a day, UTI history, psychological or physical trauma, large family size, lack of a private bedroom and constipation were associated with enuresis. Family history and low maternal educational level were risk factors. Parental concern was high, and 50% of the enuretic children visited a doctor for management⁴².

Desta Menelik conducted a study among 6-15 year old Ethiopian children on Epidemiology of Child Psychiatric disorders in Addis Ababa. The most prevalent condition was enuresis at 12.1%. Male sex, younger age and lower achieved educational grade of the child were all independently associated with childhood enuresis. It was significantly higher for children in families with extreme poverty and among children from single parent homes⁴³.

Figure 2: Some studies on the prevalence of nocturnal enuresis

PLACE	YEAR, AUTHOR	AGE GROUP	PREVALENCE	FACTORS
Taiwan	2007, Tai et al	Primary school children	6.8%	Males, age, heredity, urine frequency or urgency, drinks before sleep, difficulty in waking
China	2007, Wang et al	5-12 years	5.66%	Males, rural life, daytime symptoms
Iran	2006, Azhir et al	Primary school children	6.2%	Family history, younger age, males, low maternal educational level
Karachi	2005, Mithani et al	3-13 years	9.1%	Males, family history
Thailand	2005, Hansakunachai et al	5-15 years	3.9%	Females, family history, encopresis
Turkey	2004, Ozkan et al	6-11 years	12.96%	Males, family history, socioeconomic status
Malaysia	2003, Kanaheshwari et al	7-12 years	8%	Family history, younger age, male sex
Ethiopia	2002/2003, Desta	6-15 years	12.1%	Male sex, younger age, lower educational grade, poverty, single parent homes
Turkey	2001, Oge et al	4-12 years	11.6%	Male sex, age, family history, large family size, UTIs, low socioeconomic status
Australia	1996, Bower et al	5-12 years	18.9%	34% had consulted with a health worker

2.0 STUDY JUSTIFICATION/UTILITY

Nocturnal enuresis is a humiliating condition for which various simple behavioural treatment strategies have been shown to be successful. It has been reported to be a common condition in various studies done in other countries/ continents.

In our country, the burden of disease is not known. This study will provide important data on the prevalence and associated factors for nocturnal enuresis in our community, information that is lacking.

By bringing enuresis to the forefront, this study will sensitize parents, children and the community to be more vigilant in identifying and seeking help for children with nocturnal enuresis promptly.

Results of this study will form a basis for health education in our communities and schools, addressing the factors identified to be associated with nocturnal enuresis.

Enuresis has significant psychosocial implications among our children. It has been shown that self-esteem is restored by successful treatment among affected children ²². The impact of these complications worsens as they grow into adolescence and adulthood. This study will enlighten both the community and health workers on early detection and management of nocturnal enuresis.

3.0 RESEARCH QUESTION

1. What is the prevalence of nocturnal enuresis among 6-14 year old children attending schools in a rural district in Kenya?
2. What factors are associated with enuresis in the study population?

4.0 OBJECTIVES

4.1 Primary Objective

To determine the prevalence of nocturnal enuresis among 6-14 year old children attending schools in a rural district in Kenya.

4.2 Secondary Objective

To determine factors associated with nocturnal enuresis in the study population, including age, sex, birth order, family set up, family history of bedwetting, maternal education level, fluid intake before bedtime, voiding habits before bedtime, sleep habits, daytime urinary symptoms and stressful events in a child's life.

5.0 METHODOLOGY

5.1 Study Design

This was a school-based cross-sectional study.

5.2 Study Site

The study was conducted in five primary schools in Mtito-Andei division, Kibwezi district, Makueni County. This is a rural semi-arid area in Eastern Kenya. The community is majorly composed of the native Kamba tribe, who are Bantus. Mtito-Andei is situated along the Nairobi-Mombasa highway, 240km from Nairobi, Kenya's capital city. It is bordered by the Tsavo East and Tsavo West National parks, and it marks the end of Eastern province and the beginning of Coast province, which borders it to the south.

5.3 Study Population

Six to Fourteen year old children attending the above mentioned primary schools.

5.4 Study Period

The study was carried out over a period of 3 months.

5.4.1 Inclusion Criteria

- All school children selected during the sampling exercise.
- Those whose parents consented and co-operated in filling the questionnaire.

5.4.2 Exclusion Criteria

- Children with cerebral palsy.
- Children with profound mental retardation.

- Children with known diabetes.
- Children on diuretic drugs.
- Subsequent siblings to an already sampled subject.

5.5 Sample Size

Sample size was calculated using the Fischer formula as shown here. This was based on the prevalence from an Ethiopian study by Menelik Desta, which found a prevalence of 12%⁴³.

$$N = Z^2 \times P (1-P) / D^2$$

Z	1.96
D	0.032
P	0.12
1-P	0.88

Sample size= 396

Where

N = required sample size

Z = Confidence level at 95%

P = estimated prevalence of nocturnal enuresis, 12%

D = margin of error at 3.2% (0.032)

A sample size of **400 children** was used.

6.0 MATERIALS AND METHODS

6.1 RECRUITMENT OF STUDY PARTICIPANTS

The study was undertaken between June and August 2011.

The first day was spent training 7 research assistants who assisted with data collection.

Selection of study participants proceeded in two stages, initially to select the schools, then participants within each school.

First, a list of all 22 public primary schools within Mtito-Andei division was obtained from the District Education Office. Five primary schools were randomly selected for inclusion from this group using the paper picking method. These selected schools were:-

-Matulani primary school

-Mtito – Andei primary school

-Kikwasuni primary school

-Kathekani primary school

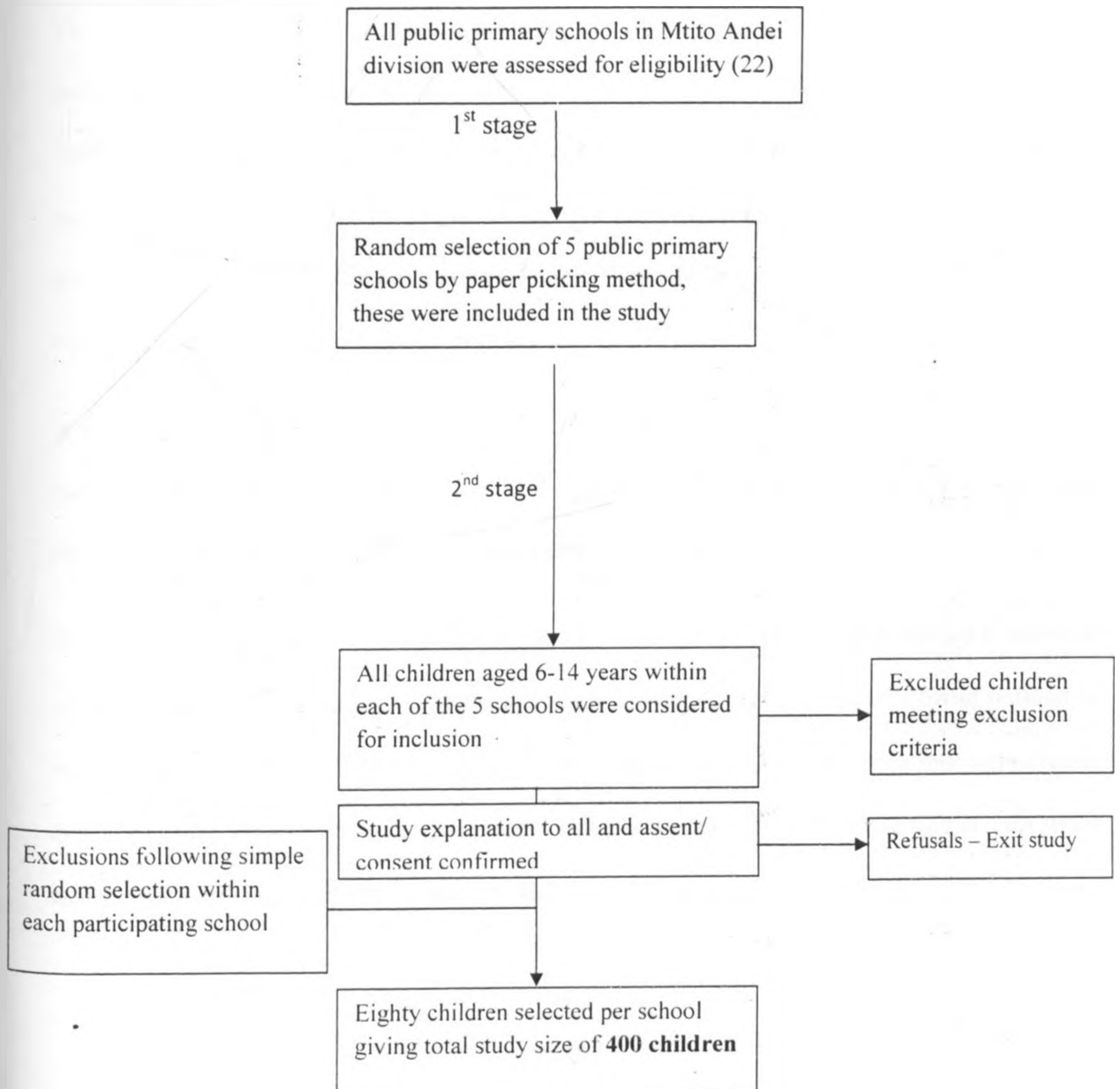
-Iviani primary school

In the second stage, a sampling frame including all the pupils meeting the inclusion criteria was assembled within each of the five randomly selected schools. The school's admission roll list was used. To ensure equal representation of each subject in the sampling frame, the study used equal probability sampling method to select participants within each school. Subjects were randomly selected within each school using simple random sampling technique, implemented using random paper picking, 400 children were selected.

Selected subjects were then accompanied by the primary investigator and research assistants to their homes, where after obtaining consent, a detailed pretested questionnaire was administered to their parents/guardians.

Parents/guardians were assisted by the primary investigator and research assistants in filling the questionnaire. Where needed, they were also assisted in the local language to gather information as accurately as possible.

Figure 3: Study profile



6.2 TOOLS

A pre tested parent questionnaire that took about 30 minutes for each parent to complete was used to collect information. Parents were assisted by the primary investigator and trained research assistants in completing the questionnaire appropriately.

The first part was on the child's details including age, sex, class, number of siblings and birth order. The parents' details (mother and father) were also filled in, including their age, level of education, marital status and occupation.

The second part of the questionnaire detailed questions relating to enuresis including presence of bedwetting or age at which night time dryness was achieved, number of wet nights in a week, voiding habits before bedtime, waking up at night to void, easy arousal from sleep, snoring, fluid intake and restrictions in the evenings, presence of daytime urinary symptoms, family history of previous or current bedwetting and relationship to the child in question, and any known stressful event that the child may have gone through.

A final section reserved only for the parents with enuretic children enquired whether these parents were bothered by the bedwetting, if they had sought any help for it, and if so, then what interventions they had obtained to assist their enuretic children.

All the urinary symptoms in the study were defined according to The Standardization Committee of the International Childrens Continence Society⁴⁴, with daytime frequency being defined as voiding more than 8 times during waking hours. Urgency and dysuria symptoms were clearly explained to the respondents. Our definition for nocturnal enuresis was bedwetting at least twice weekly, with the initial criteria for primary and secondary enuresis considered.

6.3 DATA HANDLING

6.3.1 Data Management

Data was collected using questionnaires and subsequently entered into custom developed databases using MS Access in a PC format. To reduce data entry errors, range and consistency checks were built into the initial database. All data was verified and cleaned prior to analysis.

6.3.2 Data Analysis

Data was analyzed with SPSS (version 17). The sample characteristics were described by calculating descriptive statistics using procedures available in SPSS. All continuous variables including age were expressed as means (SD) or medians (range). Binary or categorical demographic characteristics e.g. gender were summarized as percentages and the percentage distributions of these factors were presented in frequency tables and graphs. In the bivariate analysis associations between prevalence of nocturnal enuresis and categorical data was tested using the chi-square test, except when expected cell counts were less than 5 when a Fischer's exact test was used. Means of continuous variables among children with and without nocturnal enuresis were compared using t-tests for normally distributed data and Mann-whitney tests for variables showing significantly skewed distributions. Multiple logistic regression analysis was used to obtain adjusted estimates and 95% confidence intervals for the effect of independent variables on prevalence of nocturnal enuresis.

6.4 ETHICAL APPROVAL

Prior to the commencement of the study, the following ethical procedure was accomplished.

- Written consent was obtained from the Schools Administration and from the National Council for Science and Technology.
- Approval was obtained from the Ministry of Education and the local District Education Officer (DEO), Kibwezi District.
- Verbal consent was sought from the parents of the study subjects, and assent from subjects above 8 years of age.
- Approval was granted by the University of Nairobi/KNH Ethics, Research and Standards Committee.
- There was no additional cost, risks nor any direct rewards to the participants.
- Confidentiality of the information received was maintained.

7.0 RESULTS

Introduction

There were a total of 400 children aged between 6 to 14 years in the study, recruited from 5 primary schools in Kibwezi district in Kenya, during the study period of May to July 2011. The initial results present a univariate description of the characteristics of the school children. The second part presents the prevalence of nocturnal enuresis among school children forming the main study outcome. Lastly, the identified factors associated with nocturnal enuresis are described using logistic regression.

CHARACTERISTICS OF THE STUDY POPULATION

Children's age

The mean age of the children was 10.3 years (SD = 2.6). The age distribution of the children in 3-years age groups is shown in Table 1 below. The children were similarly distributed across the age groups with 32.7% aged 6 to 8 years, 35.2% aged 9 to 11 years and 32% between 12 to 14 years.

Gender

There were 202 (50.5%) males and 198 (49.5%) females in the study, with a male-to-female ratio of 1:1. As shown in Table 1 below, the distribution of male and female participants in the different age categories was similar with approximately one-third of both male and female children found in the each age group. Thirty one percent of males and 34.3% of females were aged between 6 to 8 years.

Birth order

The birth order of study participants ranged from first child through to twelve. Most of the children were either first (26.8%, n =107) or second (25.3%, n = 101) births. As shown in Table 1 below, 19.3% (n = 77) of the children were third born children while the remaining 115 (28.9%) were of a higher birth order.

Table 1: Age distribution, gender and birth order of the study participants

	Frequency (%)
Age	
6 to 8 years	131(32.8)
9 to 11 years	141(35.3)
12 to 14 years	128(32)
Gender	
Male	202 (50.5)
Female	198(49.5)
Birth order	
First	107 (26.8)
Second	101 (25.3)
Third	77 (19.3)
Fourth	115 (28.8)

Family setup

Parents' characteristics

Parental characteristics are summarized in Table 2. The average age of mothers of participating children was 35.5 years (SD = ± 6.9), compared to the fathers' average age of 41.6 years (SD = ± 7.9). Most mothers reported that they had attended formal education and achieved primary level education (62.8%, n = 251) while most fathers had secondary level education (46.5%, n = 186).

Three hundred and seventeen (79.2%) of mothers and 309 (77.2%) of fathers were married.

Table 2: Characteristics of parents of children recruited in the study

Parental characteristic	Mothers	Fathers
	n (%)	n (%)
Average age (\pm SD)	35.3 (± 6.9)	41.6 (± 7.9)
Level of education		
None	16 (4.0)	5 (1.3)
Primary	251 (62.8)	109 (27.2)
Secondary	121 (30.3)	186 (46.5)
College/ University	12 (3.0)	24 (6.0)
Marital status		
Single	33 (8.3)	1 (0.3)
Married	317 (79.2)	309 (77.2)
Divorced/ separated	16 (4.0)	2 (0.5)
Widowed	20 (5.0)	2 (0.5)

Family history of bedwetting

As shown in Table 3, 113 (28.6%) respondents reported that at least one family member of the participating child was known to have experienced bedwetting. The relationship between the relative with history of bedwetting and the participating child was commonly a sibling 45 (41.7%). In addition 154 (39.2%) of the children had a relative who was currently bedwetting and similar to those with past history, this relative was commonly a sibling 122 (81.9%).

Table 3: Family history of nocturnal enuresis among children participating in the study

	Frequency (%)
Family member known to have experienced bedwetting	
Yes	113 (28.6)
No	287 (72.3)
Relationship between child and family member	
Parent	15 (13.9)
Sibling	45 (41.7)
Cousin	11 (10.2)
Grandparent	16 (14.8)
Other	21 (19.4)
Family member currently bed wetting	
Yes	154 (39.2)
No	239 (60.8)
Relationship between child and family member	
Sibling	122 (81.9)
Cousin	24 (16.1)
Other	3 (2.0)

Fluid intake and voiding habits

Table 4 presenting fluid intake and voiding habits shows that 236 (59%) children in this study did drink fluids in the evenings. Fluid intake was restricted in 153 (38.3%) of children. Fluid intake was commonly (52.8%) restricted for approximately 2 to 3 hours before bedtime. Most (93%) children voided before going to bed and 60.3% of children woke up during the night to void.

Table 4: Fluid intake and voiding habits among children in the study

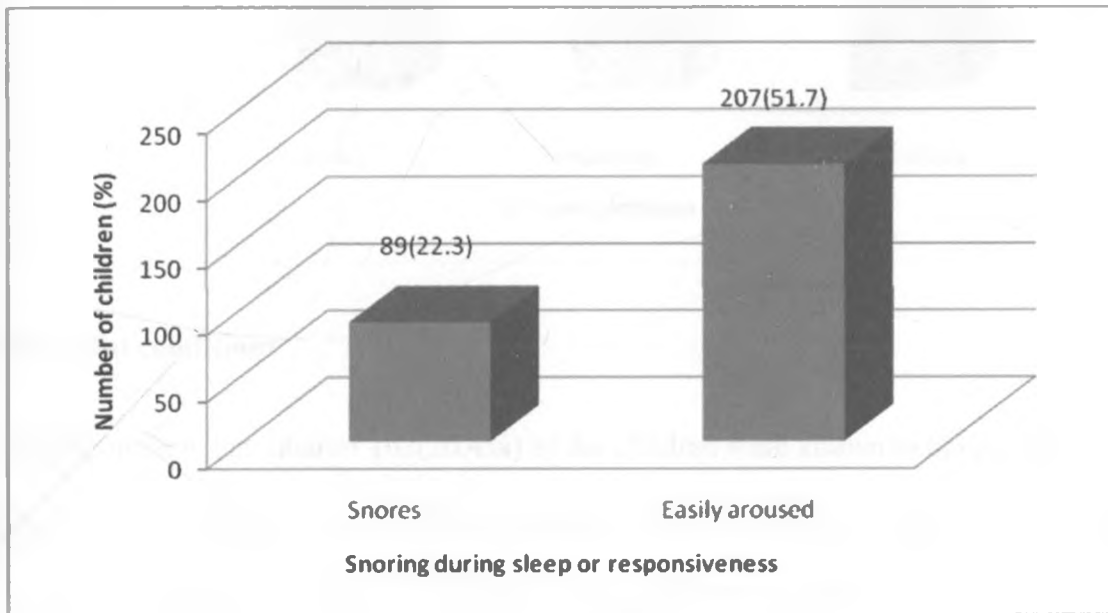
	Frequency (%)
Fluid intake restricted	
Yes	153 (38.3)
No	236 (59)
No response	11(2.7)
Duration of restriction before bedtime	
1 hour or less	20 (13.9)
2 to 3 hours	76 (52.8)
Over 3 hours	48 (33.3)
Child voids before going to bed	
Yes	372 (93.0)
No	28 (7.0)
Child wakes up to void	
Yes	241 (60.3)
No	156 (39.0)
No response	3(0.7)

Sleep behavior

The sleep behaviour of children is presented in Figure 4.1. Approximately one-half 207(51.7%) of children were reported to be easily aroused from sleep.

Eighty nine (22.3%) of the children snored while asleep.

Figure 4.1: Sleep behaviour among children in the study

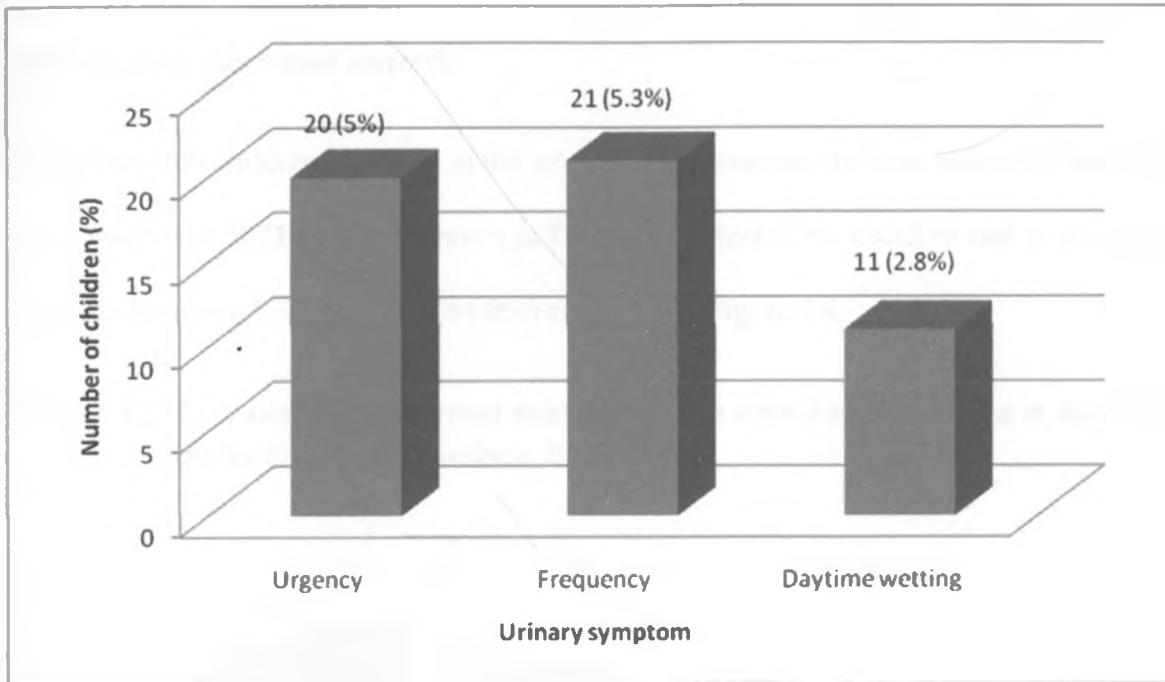


Urinary symptoms

The prevalence of different urinary symptoms is shown in Figure 4.2. The most common urinary symptom was frequency affecting 21(5.3%) of children, followed by urgency in 20(5%).

Daytime wetting was reported in 11 (2.8%) of children.

Figure 4.2: Reported urinary symptoms among the children in the study



Stressful conditions

Approximately one-quarter 102(26.4%) of the children were known to have experienced a significantly stressful event (Table 5). The commonly reported stressful events included change of school 56(14.0%), change of home 49(12.3%) and bereavement in 22(5.5%).

Table 5: Reported exposure to stressful events among study participants

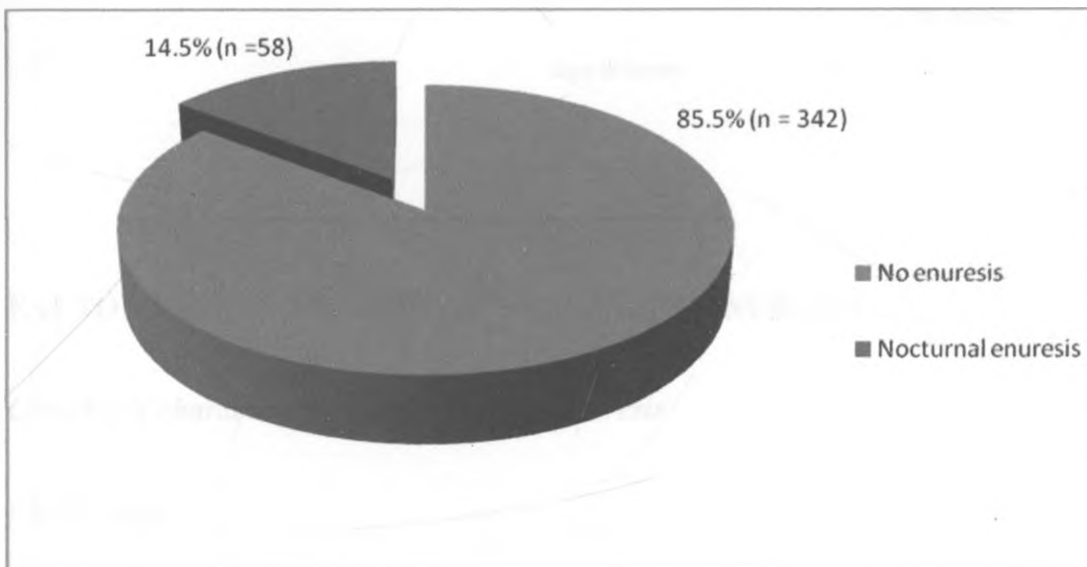
	Frequency (%)
Child known to have experienced stressful event	
Yes	102 (26.4)
No	284 (73.6)
Type of stressful event	
Change of school	56 (14.0)
Change of home	49 (12.3)
Bereavement	22 (5.5)
Physical abuse	14 (3.5)
Other	7 (1.8)

NOCTURNAL ENURESIS

Prevalence of nocturnal enuresis

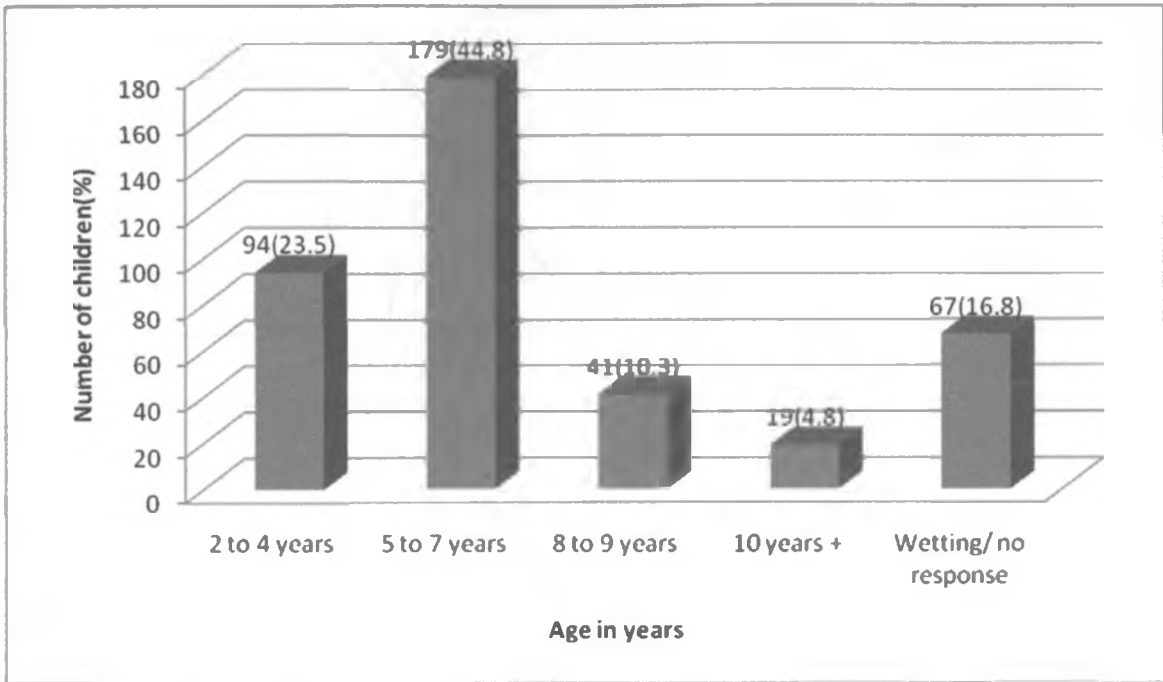
Out of the 400 children recruited in the study 58 were reported to have nocturnal enuresis giving a prevalence of 58 (14.5%), as shown in Figure 4.3. Most of the children had attained dryness at the ages between 5 – 7years 179(44.8%) as shown in Figure 4.4.

Figure 4.3: Prevalence of nocturnal enuresis among school aged children in Kibwezi District, Eastern Province, Kenya



The prevalence of secondary nocturnal enuresis was 4.25% with 17 parents reporting that their children who were initially dry for at least 6 months had resumed bedwetting.

Figure 4.4: Ages at which the children in the study attained dryness



FACTORS ASSOCIATED WITH NOCTURNAL ENURESIS

Children's characteristics and nocturnal enuresis

Child's age

As shown in Table 6, the age of children in the study was significantly associated with prevalence of enuresis. The prevalence of nocturnal enuresis declined from 18.3% among children in the youngest age group (6 to 8 years) to 7.0% among children aged between 12 to 14 years of age ($p = 0.014$).

Table 6: Prevalence of nocturnal enuresis among children of different ages

	Nocturnal enuresis		Chi square	P value
	Yes. n (%)	No. n (%)		
Age (in years)				
6 to 8	24 (18.3)	107 (1.7)	8.5	0.014
9 to 11	25 (17.7)	116 (82.3)		
12 to 14	9 (7.0)	119 (93)		

Child's sex

Table 7 shows that male and female children had nocturnal enuresis prevalence of 15.8% and 13.1%, respectively. This slightly higher prevalence of nocturnal enuresis among male children compared to females was not statistically significant ($p = 0.44$).

Table 7: Prevalence of nocturnal enuresis among male and female children

	Nocturnal enuresis		Chi square	P value
	Yes. n (%)	No. n (%)		
Sex				
Male	32 (15.8)	170 (84.2)	0.59	0.44
Female	26 (13.1)	172 (86.9)		

Birth order

The findings in Table 8 show that the prevalence of nocturnal enuresis among children of different birth orders ranged from 12.2% to 18.8%. These prevalence did not differ significantly across the different birth orders ($p = 0.53$).

Table 8: Prevalence of nocturnal enuresis according to birth order of the children in the study

	Nocturnal enuresis		Chi square	P value
	Yes, n (%)	No, n (%)		
Birth order				
First	13 (12.2)	94 (87.8)	2.19	0.53
Second	19 (18.8)	82 (81.2)		
Third	11 (14.3)	66 (85.7)		
Fourth or greater	15 (13.0)	100 (87.0)		

Family setup and history and nocturnal enuresis

Out of all 400 participating children, 305 (76.3%) children had both parent reporting that they were married. This response was used as a proxy for family set up and its association with nocturnal enuresis is presented in Table 9.

Family set up showed a significant association with nocturnal enuresis. Children of married parents had a significantly lower prevalence (12.1%) of nocturnal enuresis compares to those of parents who reported other marital status (22.1%).

Maternal level of education showed evidence of an association with enuresis. Children of mothers with no formal education had the highest prevalence of nocturnal enuresis at 31.3%. The prevalence among children of mothers with different levels of formal education ranged from 0% for tertiary level maternal education to 18.2% for secondary level education.

Table 9: Association between family setup and prevalence of nocturnal enuresis

	Nocturnal enuresis		Chi square	p value
	Yes, n (%)	No, n (%)		
Maternal education				
None	5(31.3)	11(68.7)	5.67	0.05
Primary	31(12.4)	220(87.6)		
Secondary	22(18.2)	99(81.8)		
College/ University	0	12(100)		
Parental marital status				
Married	37 (12.1)	268 (87.9)	5.81	0.016
Other	21 (22.1)	74 (77.9)		

Family history of enuresis

A positive family history of nocturnal enuresis was significantly associated with occurrence of enuresis ($p = 0.006$). Twenty two percent of children with a family history of enuresis had enuresis compared to 11.3% of those without a positive family history of enuresis (Table 10).

Table 10: Association between family history of enuresis and prevalence of nocturnal enuresis

	Nocturnal enuresis		Chi square	p value
	Yes, n (%)	No, n (%)		
Family history of enuresis				
Yes	25(22.1)	88(77.9)	7.58	0.006
No	32(11.3)	250(88.7)		

Urinary symptoms and nocturnal enuresis

The presence of urinary symptoms among the children did not show a significant association with prevalence of nocturnal enuresis. Twenty percent of children with urgency and 23.8% of those with frequency had nocturnal enuresis compared to 14.2% and 14.0% of children without urgency and enuresis, $p = 0.51$ and 0.21 , respectively (Table 11).

Table 11: Prevalence of nocturnal enuresis among children with urinary symptoms

	Nocturnal enuresis		p value
	Yes, n (%)	No, n (%)	
Urgency			
Yes	4 (20.0)	16 (80.0)	0.51*
No	54 (14.2)	326 (85.8)	
Frequency			
Yes	5 (23.8)	16 (76.2)	0.21*
No	53 (14.0)	326 (86.0)	

*Fisher's exact test

Sleep behavior and nocturnal enuresis

There was a statistically significant association between the ease of arousing a child from sleep and the prevalence of nocturnal enuresis, $p < 0.001$ (Table 12). Among the children who were easily aroused from sleep the prevalence of nocturnal enuresis was 8.2% while the children who were not easily awoken had a prevalence of 21.2%. In addition there was weak evidence of a statistical association between snoring and nocturnal enuresis ($p = 0.08$). Eighteen (20.2%) children who were reported to snore had nocturnal enuresis compared to 12.9% of those who did not snore.

Table 12: Prevalence of nocturnal enuresis among children with different sleeping habits

	Nocturnal enuresis		Chi square	p value
	Yes, n (%)	No, n (%)		
Snores				
Yes	18 (20.2)	71 (79.8)	3.02	0.08
No	40 (12.9)	271 (87.1)		
Easily woken up				
Yes	17 (8.2)	190 (91.8)	8.82	< 0.001
No	41(21.2)	152(78.8)		

Stressful conditions and nocturnal enuresis

Table 13 shows that the experience of a stressful event was associated with a higher prevalence of nocturnal enuresis, $p = 0.001$. Children who had experienced a stressful event had a prevalence of nocturnal enuresis of 24.5% compared to those who had not experienced such an

event (10.9%). In particular, bereavement ($p = 0.003$) showed a significant association with nocturnal enuresis. The prevalence of nocturnal enuresis among bereaved children was almost three-fold that of children who had not been bereaved (36.4% versus 13.2%).

Table 13: Prevalence of nocturnal enuresis among children who experienced/did not experience stressful conditions

	Nocturnal enuresis		Chi square	p value
	Yes, n (%)	No, n (%)		
Stressful event				
Yes	25 (24.5)	77 (75.5)	11.2	0.001
No	31 (10.9)	253 (89.1)		
Changed school				
Yes	6 (10.7)	50 (89.3)	0.75	0.39
No	52 (15.1)	292 (84.9)		
Changed home				
Yes	8 (16.3)	71 (83.7)	0.15	0.70
No	50 (14.3)	271 (85.7)		
Bereaved				
Yes	8 (36.4)	14 (63.6)	8.98	0.003
No	50 (13.2)	328 (86.8)		

Caregiver intervention for bedwetting

The parents of 28 (48.3%) out the 58 children with nocturnal enuresis reported that they were bothered by their children's bed wetting. There was no statistically significant association

between parents concern over bedwetting and the age of their child ($p = 0.53$). Similarly, parental response on being bothered by bedwetting was not associated with either maternal level of education ($p = 0.81$) or paternal level of education ($p = 0.87$).

Only 4 (6.9%) of the parents of children with nocturnal enuresis had sought help for their child's bed wetting problem. These parents specifically reported that they sought help either from counselors ($n = 2$) or used herbal remedies ($n = 2$) for the enuresis. A total of 153 (39.3%) parents had intervened to try and stop enuresis through fluid restriction, 372 (93%) encouraged their children to void before bedtime and 241 (60.7%) woke their child to void at night.

Fluid restriction and enuresis prevalence

Caregivers of 153 (39.3%) of children reported that they restricted fluid intake in the evenings. The results presented in Table 14 shows that the prevalence of enuresis was similar among the group of children with restricted fluid intake (13.7%) and children with no fluid restrictions (15.7%). The durations of fluid restriction before bed time ranged from one hour or less to over 3 hours. The prevalence of enuresis for these different durations of enuresis ranged from 9.2% to 18.8%. There was, however, no statistically significant association between enuresis and either fluid restriction ($p = 0.60$) or duration of fluid restriction prior to bedtime ($p = 0.30$).

Table 14: Prevalence of nocturnal enuresis among children with fluid intake restrictions

	Nocturnal enuresis		Chi square	p value
	Yes, n (%)	No, n (%)		
Fluids restricted				
Yes	21 (13.7)	132 (86.3)	0.28	0.60
No	37 (15.7)	199 (84.3)		
Duration of fluid restriction				
One hour or less	3 (15.0)	17 (85.0)	2.40	0.30
2 to 3 hours	7 (9.2)	69 (90.8)		
Over 3 hours	9 (18.8)	39 (81.2)		

Voiding patterns and enuresis prevalence

Table 15 shows that children who voided before going to bed had a lower prevalence (13.4%) of nocturnal enuresis compared to those who did not void (28.6%) prior to going to bed, $p = 0.028$. Similarly, children who woke up at night to void had a nocturnal enuresis prevalence of 10.4% and children who did not wake up to void during the night had a prevalence of 21.2%, $p = 0.003$.

Table 15: Association between voiding patterns and nocturnal enuresis

	Nocturnal enuresis		Chi square	p value
	Yes, n (%)	No, n (%)		
Voided before bedtime				
Yes	50 (13.4)	322 (86.6)	4.81	0.028
No	8 (28.6)	20 (71.4)		
Wakes up at night to void				
Yes	25 (10.4)	216 (89.6)	8.82	0.03
No	33 (21.2)	123 (78.8)		

MULTIVARIABLE ANALYSIS

Logistic regression of factors associated with nocturnal enuresis

Table 16 presents results of the logistic regression of all factors showing significant association with nocturnal enuresis. Children who had not experienced stressful events had lower odds of nocturnal enuresis compared to those who had been through such events: Odds ratio 0.47, 95% CI 0.24-0.93, p value 0.031, implying that the odds of nocturnal enuresis were 54% lower among children not exposed to stress.

The odds of nocturnal enuresis reduced with age. The older children had lower odds of nocturnal enuresis compared to those aged 6 to 8 years, Odds ratio 0.87, 95% CI 0.43-1.75 (for 9-11 years) and Odds ratio 0.32 % CI 0.13-0.72 (for 12 to 14 years), p value 0.048.

There was an increase in the odds of nocturnal enuresis among children who were difficult to arouse: Odds ratio 2.51, 95% CI 1.26-5.00, p value 0.009; and a reduction in odds among those from a family set up where both parents were married Odds ratio 0.45, 95% CI 0.23-0.87, p value 0.02.

Only two factors: passing urine before going to bed ($p = 0.057$) and family history of nocturnal enuresis ($p = 0.05$) were not significantly associated with nocturnal enuresis after adjusting for the effects of the factors shown in Table 4.10 including age, past exposure to stressful events and family set up.

Table 16: Logistic regression of factors associated with nocturnal enuresis among the children in the study

	Odds Ratio	95% Confidence interval		P value
Age group				
6 to 8 years	1.00			
9 to 11 years	0.87	0.43	1.75	0.048
12 to 14years	0.32	0.13	0.72	
Family setup				
Unmarried parents	1.00			
Parents married	0.45	0.23	0.87	0.02
Child passes urine before bedtime	1.00			
Does not pass urine before bedtime	2.61	0.97	7.04	0.057
Child wakes up at night to pass urine				
Yes	1.00			
No	2.07	1.07	4.01	0.031
Child easily aroused from sleep				
Yes	1.00			
No	2.51	1.26	5.00	0.009
Experienced stressful event				
Yes	1.00			
No	0.47	0.24	0.93	0.031
Family history of nocturnal enuresis				
Yes	1.00			
No	0.52	0.27	1.00	0.05

8.0 DISCUSSION

Our study aimed to determine the prevalence of nocturnal enuresis among 6-14 year old children attending schools in Mtito-Andei Division, Kibwezi District in rural Kenya. Out of the 400 children recruited in the study, 58 had nocturnal enuresis, giving a prevalence of **14.5%** (Figure 4.3). This prevalence is almost similar to that found by Desta among 6-15 year old Ethiopian children, where the prevalence was 12.1%⁴³. It is also similar to the prevalence in South East Anatolia where a study conducted by Ozkan found a prevalence of 13%³⁶. A randomized study among primary school children aged 4 – 12 years living in Aydin, showed an overall prevalence of 11.6% for nocturnal enuresis³². Our prevalence is however much higher than that found among Karachi school children by Mithani, where the prevalence was 9.1%³⁸. It is also lower than the prevalence among Australian children where Bower's study found a prevalence of 18.9%³⁴.

Our study found the prevalence of secondary enuresis to be **4.25%**, with 17 parents reporting that their children, who were initially dry for at least 6 months, had resumed bedwetting. This is higher than Malaysia, where the overall nocturnal enuresis prevalence was 8%, with primary being 6.2% and secondary being 1.8%.³⁵ Our higher prevalence for secondary enuresis may be due to significant stressful events the children had been exposed to, as shown in Table 13, and unstable family set ups that were clearly evident among these children.

Prevalence was found to decrease with increasing age. Age showed a statistically significant association with prevalence of enuresis. (chi square = 8.5, $p = 0.014$). Twenty four (18.3%) children aged 6 to 8 years and 25 (17.7%) children aged 9 to 11 years had enuresis compared to only 9 (7.0%) of the children between 12 and 14 years of age. Most of the children had attained

dryness at the ages between 5 – 7years 179(44.8%). This may be explained by the maturational delay in progression of neurological continence control. This finding is similar to other studies that identified younger age as a significant risk factor, including the five above mentioned studies (Desta⁴³, Ozkan³⁶, Aydin³², Mithani³⁸ and Bower³⁴.)

In our study, gender was not a statistically significant association. Among the 58 enuretic children, 32(15.8%) were male and 26(13.1%) were female. ($p = 0.44$). This finding contrasts the findings in Turkey where Gumus found male sex to be a significant association³¹, in Malaysia where male sex was found to be an important predictor³⁵, the South East Anatolia study by Ozkan that found a male: female ratio of 6:1³⁶, and the Chinese study that found a strongly positive correlation with male gender⁴⁰. Unlike the above studies, female sex was found to be a significant association in Bangkok, Thailand³⁷.

Among our local children, birth order did not show any significant association with nocturnal enuresis, unlike in England and Scotland where a study conducted by Rona in the 90's showed that not being first born was an important determinant for enuresis¹⁸. The most likely explanation to this observation was that new mothers were very keen with the development of the first child, seeking help promptly when their first child had not achieved bladder control. In our study, this was not observed.

Family set up came out as a strong predictor of nocturnal enuresis among our local school going children. Children of married parents had a significantly lower prevalence (12.1%) of nocturnal enuresis compared to those of parents who reported other marital status (22.1%), ($p = 0.016$). This finding is consistent with the Ethiopian study conducted by Desta Menelik that revealed a higher prevalence of enuresis among children from single parent homes compared to those from

families with married parents.⁴³ This emphasizes the importance of social and emotional stability in the upbringing of our children.

Maternal level of education showed evidence of an association with enuresis. Children of mothers with no formal education had the highest prevalence of nocturnal enuresis at 31.3%. The prevalence among children of mothers with different levels of formal education ranged from 0% for tertiary level maternal education to 18.2% for secondary level education. However when chi square association test was applied, the p value was 0.05, indicating a weak association. This might be because the fathers in most homes were more educated, but we did not analyze paternal education level against enuresis.

A family history of nocturnal enuresis was significantly associated with occurrence of enuresis ($p = 0.006$). Twenty two percent of children with a family history of enuresis reported to be bed wetting compared to 11.3% of those without a positive family history of enuresis (Table 4.6). This finding is similar to what was found in Ozkans study, where the rate of positive family history was 42% for siblings only and 66% for parents, and was strongly associated with bedwetting.³⁶ In most homes that we visited, the wetting family member had been a sibling. My speculation is that some parents may not have been completely truthful due to the embarrassment that goes with enuresis, particularly in a rural African cultural setting. In Karachi, Mithani found that family history of enuresis was present in 25.6%³⁸. In Isfahan, Iran, positive family history in the father was 51% while in the mother it was 39%.³⁹

Our study found that voiding habits were strong indicators for nocturnal enuresis. Children who voided before going to bed had a lower prevalence (13.4%) of nocturnal enuresis compared to those who did not void (28.6%) prior to going to bed, ($p = 0.028$). Similarly, children who woke

up at night to void had a nocturnal enuresis prevalence of 10.4% and those who did not wake up to void during the night had an enuresis prevalence of 21.2%. ($p = 0.003$). This finding is consistent with the current concepts in nocturnal enuresis⁵, that voiding before bed time has been shown to reduce the risk of nocturnal enuresis. Many mothers were comfortable with asking their children to void before bedtime, but were not so sure about waking them up at night to void. This may be because these mothers were so tired at the end of the day, having been performing chores, and at night they preferred to rest/sleep knowing that they needed to be up early the next day. The interruption of sleep may not be such a welcome idea, but waking these children at night to void significantly improves enuresis.

Among our local children, neither fluid restriction before bedtime nor the duration of fluid restriction before bedtime showed significant correlation to enuresis. There were no statistically significant association between enuresis and fluid intake ($p = 0.83$), fluid restriction ($p = 0.60$) or duration of fluid restriction prior to bedtime ($p = 0.30$). We found out that there wasn't much difference between those who drank fluids freely or those who were restricted. The type of fluid taken did not make a difference either. However in Taiwan, Tai found that drinking habits before bedtime was a significant associated factor for nocturnal enuresis⁴¹.

Deep sleep has been associated with nocturnal enuresis in several studies, including the Turkish study conducted by Gumus³¹, and the Taiwan study conducted by Tai⁴¹. In our population, our study had similar findings, revealing a statistically significant association between the ease of arousing a child from sleep and the prevalence of nocturnal enuresis, $p < 0.001$. Among the children who were easily aroused from sleep the prevalence of nocturnal enuresis was 8.2% while the children who were not easily awoken had a prevalence of 21.2%. This may be

explained by the pathogenetic role that sleep plays in the etiology of enuresis, though this is still an area of active research.

Presence of daytime urinary symptoms was found to be a significant associated factor in the study done in Zhengzhou city in China⁴⁰, the south east Europe Turkish study⁴² and the Taiwan study⁴¹. In contrast to this, the presence of day time urinary symptoms did not show a significant association with prevalence of nocturnal enuresis among our children. Twenty percent of children with urgency and 23.8% of those with frequency had nocturnal enuresis compared to 14.2% and 14.0% of children without urgency and frequency, ($p = 0.51$ and 0.21 , respectively.)

Physical, social and psychological stressors in a child's life have been shown to be associated with enuresis. Our study showed that that the experience of a stressful event was associated with a higher prevalence of nocturnal enuresis, ($p = 0.001$). Children who had experienced a stressful event had a prevalence of nocturnal enuresis of 24.5% compared to those who had not experienced such an event (10.9%). In particular, bereavement ($p = 0.003$) showed a significant association with nocturnal enuresis. The prevalence of nocturnal enuresis among bereaved children was almost three-fold that of children who had not been bereaved (36.4% versus 13.2%). The observation was that this contributed more to the secondary type of nocturnal enuresis. Similarly, the epidemiological study in south east Europe (Turkey) found that both psychological and physical trauma were associated with a higher prevalence of enuresis.⁴²

We asked parents of affected children whether they were bothered by their child's enuresis. The parents of 28 (48.3%) out the 58 children with nocturnal enuresis reported that they were bothered by their children's bed wetting. There was no statistically significant association between parents concern over bedwetting and the age of their child ($p = 0.53$). Similarly, parental

response on being bothered by bedwetting was not associated with either maternal level of education ($p = 0.81$) or paternal level of education ($p = 0.87$). Only 4 (6.9%) of the parents of children with nocturnal enuresis had sought help for their child's bed wetting problem. These parents had specifically sought help either from counselors ($n = 2$) or used herbal remedies ($n = 2$) for the enuresis. A total of 153 (39.3%) parents had intervened to try and stop enuresis through fluid restriction, 372 (93%) encouraged their children to void before bedtime and 241 (60.7%) woke their child to void at night.

Like in our local setting, where only a minority of parents had sought help for their enuretic children, Ozkan in south east Anatolia found that parental concern was not high and only 15% of enuretics had visited a doctor for treatment.³⁶ In the Aydin study, among the enuretics, 11% had been treated professionally, 65% treated traditionally and 25% sought no help³². In the Australian study, a higher number of parents had sought professional help, 34% had consulted with a health worker³⁴.

9.0 CONCLUSION

Nocturnal enuresis is a significant problem among school going children in our rural community, with the current prevalence being at 14.5%, a considerable burden of disease. The prevalence of secondary nocturnal enuresis is 4.25%.

Younger age, family set up, family history of bedwetting, bedtime voiding habits, deep sleep and experience of a stressful event in a child's life are some of the factors found to be statistically significantly associated with nocturnal enuresis.

Though half the parents of enuretic children are bothered by the child's condition, they do not have information on an appropriate help-seeking mechanism to assist their enuretic children.

10.0 LIMITATION

The sample consisted of children attending rural schools in Kibwezi district, Eastern Province, Kenya, and the prevalence may not reflect urban children who are growing under very different circumstances.

11.0 RECOMMENDATIONS

Health education should be conducted concerning nocturnal enuresis in the community and in schools.

Parents to be taught on simple behavioral and motivational interventions like ensuring that their children void before sleeping and waking them up to void at night.

Information should be made available to parents and the general public on available channels to seek medical help for nocturnal enuresis.

Further studies can be conducted in urban settings and among secondary school children to identify the burden of disease and modifiable factors that can be addressed, and to determine whether they have outgrown the enuresis.

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APPENDIX I: QUESTIONNAIRE

Study title: Prevalence of nocturnal enuresis and associated factors among 6-14 year old children attending schools in a rural district in Kenya

SECTION A

1.0 Child's details

1.1 Serial no []

[]

1.2 Name _____

D [/] M [/] Y

1.3 Date of birth [/ /]

1.4 Age Years [][] Months [][]

1.5 Sex Male [1]

Female [2]

1.6 Class []

Number of

1.7 siblings [][]

1.8 Birth order [][]

2.0 Mother's details

2.1 Age [] years

Level of

2.2 education None [1]

Primary [2]

Secondary [3]

College/university [4]

2.3 Occupation [_____]

2.4 Marital status Single [1]

Married [2]

Divorced/separated[3]

Widowed [4]

3.0 **Father's details**

3.1 Age [_____years]

Level of education

3.2 education None [1]

Primary [2]

Secondary [3]

College/university [4]

3.3 Occupation [_____]

3.4 Marital status Single [1]

Married [2]

Divorced/separated[3]

Widowed [4]

SECTION B

Please provide a response to the following questions concerning your child

4 Has your child been dry at night for the last six months or more?

Yes [1]

No [2]

(If yes, go to question 4.1, otherwise skip to question 4.2)

4.1 At what age did your child attain night time dryness?.....

4.2 Did your child initially attain night time dryness for 6 months or more, then began wetting the bed again?

Yes [1]

No [2]

4.3 How many times does your child wet the bed in a week?.....

5 Does your child pass urine before going to bed?

Yes [1]

No [2]

6 Do you wake your child up at night to pass urine?

Yes [1]

No [2]

(If yes, go to question 6.1, otherwise skip to question 7)

6.1 If yes, how many times in one night?

7 Is your child easily aroused from sleep?

Yes [1]

No [2]

8 Does your child snore at night?

Yes [1]

No [2]

9 Does your child drink fluids in the evenings?

Yes [1]

No [2]

(If yes, go to question 9.1, otherwise skip to question 10)

9.1 If yes, what kind of drinks does he/she commonly take in the evenings?

i) _____

ii) _____

10 Do you restrict your child's fluid intake beyond a particular time?

Yes [1]

No [2]

(If yes, go to question 10.1, otherwise skip to question 11)

10.1 If yes, beyond what time? [] pm

11 What time does your child usually go to bed? [] pm

Does your child experience any of the following daytime urinary symptoms?

12 Urgency?

Yes [1]

No [2]

13 Frequency?

Yes [1]

No [2]

14 Daytime wetting?

Yes [1]

No [2]

15 Has any known member of your family experienced bedwetting in the past?

Yes [1]

No [2]

(If yes, go to question 15.1, otherwise skip to question 16)

15.1 If yes, what relationship is she/he to your child? [_____]

16 Is any member of your family currently wetting the bed?

Yes [1]

No [2]

16.1 If yes, what relationship is she/he to your child? [_____]

17 Has your child undergone any stressful event in his/her life that you may be aware of?

Yes [1]

No [2]

17.1 If yes, at what age and of what nature? (respond by placing a tick, and indicate age in the appropriate box)

Bereavement

[]

Separation from a parent/divorce

[]

Physical abuse

[]

Bullying

[]

Sexual abuse

[]

Change of home

[]

Change of school

[]

Any other [_____]

SECTION C

Interventions sought for bedwetting children (This section should be completed by guardians with bedwetting children only)

18 Does the bedwetting of your child bother you?

Yes [1]

No [2]

19 Have you ever sought any kind of help for the problem?

Yes [1]

No [2]

19.1 If yes, briefly explain _____

20 Have you applied any measures to help with the bedwetting?

Yes [1]

No [2]

20.1 If yes, which ones? _____

APPENDIX II: ETHICAL APPROVAL



KENYATTA NATIONAL HOSPITAL
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13th May 2011

Ref: KNH-ERC/ A/117

Dr. Irene Mbinya Nzamu
Dept.of Paediatrics & Child Health
School of Medicine
University of Nairobi

Dear Dr. Nzamu

Research Proposal: "Prevalence of Nocturnal Enuresis and Associated factors among 6-14 year old children attending schools in a rural district in Kenya" (P108/04/2011)

This is to inform you that the KNH/UON-Ethics & Research Committee has reviewed and **approved** your above revised research proposal. The approval periods are 13th May 2011 to 12th May 2012.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimens must also be obtained from KNH/UON-Ethics & Research Committee for each batch.

On behalf of the Committee, I wish you a fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research study so as to minimize chances of study duplication

Yours sincerely,

PROF A N GUANTAI
SECRETARY, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
The Dean, School of Medicine, UON
The Chairman, Dept.of Paediatrics & Child Health, UON
The HOD, Records, KNH
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