

The Prevalence of Inappropriate Medication Dose in Overweight and Obese Children in KAMC, Jeddah

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Abstract

Overweight and obesity are quite prevalent in Saudi Arabian population. There is likelihood of erroneous medication dosage in an overweight or obese child. Previous studies showed that the most common type of medication errors reported in child population is due to incorrect dosing. Therefore, we planned this study to examine the prevalence of overweight and obesity in children and the appropriateness of medication dosing in study population in pediatrics outpatient clinic at King Abdul Aziz Medical (KAMC)-Jeddah.

Aim of the study: To determine the prevalence of inappropriate medication dosing in overweight and obese children and to estimate the prevalence of overweight and obesity in children.

Method: This is a retrospective study which included the overweight and obese children aged 2-18 years who visited outpatient general pediatrics clinic during the period from June to December 2013. All patients screened using Body Mass Index (BMI) of Centers for Disease Control and Prevention (CDC) pediatric growth chart for the age and sex for the documented weight and height at the visit time. Descriptive statistics used to summarize quantitative variables while qualitative variables were summarized with proportions and percentages. The inappropriate dosing was determined using the available approved pediatrics reference at KAMC-Jeddah (pediatric and neonatal dosage handbook from Lexi-Comp) and classified as overdose and underdose.

Results: Two thousand four hundred sixty patients aged from 2-18 years were screened using BMI to determine the prevalence of overweight and obesity. Results showed that 174 children were either overweight or obese. Only 96/174 patients (55%) who were overweight or obese have received medications.

We found that the rate of overweight and obesity among males was 42% and 58% and among female were 48% and 52%. Only 96 patients out of 174 (55%) who were either obese or overweight received medications. The overall prevalence of an inappropriate medication dose prescribed in overweight and obese children was 63 out of 96 patients (66%). Over- dosage was observed in 32/63 (51%) and under dosage was found in 31/63 medications (49%).

Conclusion: Prevalence of overweight and obesity in our children population are growing concerns. Weight base dosing should be utilized for a specific indication to ensure the correct and safe dose regimen in overweight and obese children unless the child dose exceeds the recommended adult dose. We did not assess clinical outcomes, however, overweight and obese children could be at increased risk for therapeutic failures or adverse effects.

Keywords: Pediatrics; Children; Overweight; Obese; Medication errors; BMI

Introduction

Overweight and obesity in children and adolescents are well documented worldwide [1,2]. Body mass index (BMI) is the main tool used to identify the overweight and obesity in children at two years age and older and defined by comparing the plotted body mass index (BMI) on a growth chart specific for age and sex. Overweight (defined as a body mass index [BMI] >85th percentile) and obesity (defined as a BMI >97th percentile) [3,4]. Among Saudi Arabian population, the overweight and obesity in children and adolescents are common mainly in school boys, as reported in two studies [5,6].

Al Almaei SM, found that at single center, the prevalence of overweight was more common in female adolescents (17.2%) than

male adolescents (10.2%) and obesity was common in male adolescents (19.3%) than female adolescents (1.8%) [7]. The national prevalence of overweight, obesity and severe obesity in Saudi Arabian children and adolescents, ages from 5-18 years, was 23.1%, 9.3% and 2%, respectively [8].

Appropriate medication dosing in child population requires identification of correct dose and proper dosage form from the reliable resources [9-11]. Determining the appropriate dose are commonly based on child's age or weight. There are different methods to choose and calculate the child's weight; by using the actual body weight (ABW), or ideal body weight (IBW) which is calculated by the Traub and Kichen equation for children aged 1-17 years [12]. Traub and Johnson equation is used for IBW calculation in children aged 1-18 years or for children 5 feet and taller [13].

Using height based weight tools often used to estimate the child's weight especially in emergency department when there are difficulties

in weighing the child on a scale [14,15]. Medication doses are usually given as per weight (mg/kg) or per body surface area (mg/m²) in most references [9-11]. Using this method in overweight or obese children the calculated dose may result in exceeding the maximum recommended daily dose or exceeding an adult dose and potentially cause in an overdose. However, if the prescriber consider adult dose in an overweight or obese child, this may result in underestimation of the dose if regarded on weight base dose (mg/kg) and potentially cause in an underdose. Some references indicated that, weight based dosing is appropriate for children up to 40 kg. Children over 40 kg may be referred to adult dose [14].

In obese adults, the adjusted body weight (ABW) or ideal body weight (IBW) sometimes is the most appropriate dosing method for certain medication [15]. There is limited data for the use of IBW or ABW in overweight or obese children populations [16]. If IBW, ABW or age based dosing is used, this may result in underestimating the child dose for some medication.

Previous studies showed that the most common type of medication errors reported in child population are due to incorrect dosing and involved ten times the required dose. Wright L et al. state that weight base dosing in older children is one of the common reasons of medication dosing error [17].

Miller and colleagues had examined medication errors in admitted intensive care units (ICU) pediatrics and found that in obese pediatrics the most common type of errors was medication under-dosing and mainly limited to antibiotics and analgesics [18]. Several studies have examined the medication errors in overweight and obese adults but a small number of studies have examined the medication errors in overweight or obese pediatrics [19,20].

To our knowledge, there is no information on the national prevalence of inappropriate medication dose in overweight and obese children in hospital setting. To address this issue, we conduct a retrospective chart review to assess the prevalence of inappropriate medication dosing among overweight or obese children in our community.

Objectives

Primary objectives are to compare the prevalence of an inappropriate medication dose prescribing in overweight and obese children and to determine the overall mean medication dose error rate per prescription in the study population. Our secondary objectives are to determine the type of medication dosing error as (overdose, underdose), and medication class and to determine the prevalence of overweight and obesity in our children patient population [21].

Method

Participants

Pediatric clinics visit registry showed that nearly 300 to 800 children visited ambulatory care outpatient clinics and emergency department on monthly bases. We will conduct this study over six months (June to December 2013). All pediatric patients who visited ambulatory care setting will be screened for BMI plotted on CDC growth chart for the age and sex for the provided weight and height at visit time to determine the overweight and obesity.

Inclusion criteria

All overweight and obese children aged from 2 to 18 years, visited emergency department (ED) or ambulatory care outpatient clinics (ACC) and received at least one medication

Exclusion criteria

Unverifiable child weight or height (not recorded in quadramed), Child with Normal BMI, pediatric oncology outpatient clinic

Materials and Procedure

This is a retrospective chart review of cases, descriptive statistics. Descriptive statistics (means, standard deviations, medians and ranges) will be used to summarize quantitative variables while qualitative variables will be summarized with proportions and percentages. Data collection sheet was used for every patient and analyzed by using SPSS version 16.0 was used for analysis.

Patient characteristics

Patients who meet inclusion criteria included, demographics included (Age, Gender, Weight and BMI)

Dose appropriateness stratification

The type of medication dosing (Appropriate or inappropriate) and medication class was identified.

The dose appropriateness assessed and demined using the available most trusted pediatric references available at our center (Lexi-comp and Harriet lane handbook) and classified as (overdose, underdose).

Error rate as defined from previous studies will be defined as 10% deviation from dosing ranges of the accepted resources per prescription. We defined the overdose as: (1) Total weight based daily dose (mg/kg/day) or total weight based dose per dose (mg/kg/dose) exceed the maximum recommended pediatric dose, (2) Total daily dose (mg/day) exceed the maximum recommended adult dose, or (3) Exceed the recommended number of doses frequency or interval per day. Sub therapeutic or under dose defined as: (1) Total weight based daily dose (mg/kg/day) or total weight based dose per dose (mg/kg/dose) less than the recommended pediatric dose or (2) The recommended number of doses frequency or interval per day is fewer than the recommended.

Weight stratification

BMI calculated according to the formula (weight/height²) and plotted on CDC growth chart for the age and sex for the provided weight and height at visit time to determine the overweight and obesity. Overweight defined as BMI for age and sex more than or equal 85th percentile but less than 95th percentile. Obesity defined as BMI for age and sex more than or equal 95th percentile, there is no unified global definition for extreme obesity in pediatric population. Patients who meet the inclusion criteria will be grouped based on their BMI into overweight and obese group. Ideal body weight was determined if needed by relating child actual BMI to the 50th percentile for age and gender on the CDC growth charts [22].

Results

Participant characteristics

Total of 2460 patients (OPD=1510, ED=950) patients aged from 2-18 years were screened for BMI plotted on CDC growth chart for the age and sex. Patients excluded were 2286 due to the following reasons.

Age < 2years=74 patients, No documented height or/and weight at the visit time=373 patients, underweight=166 patients and patients with normal BMI plotted on CDC growth chart for the age and sex=1499 patients).

We identified 174 out of 2460 (OPD=113, ED=61) children were either overweight or obese. Only 96 out 174 patients (55%) who were overweight or obese were received medications. Boys to girls ratio among those who received medications were 54% (52/96 patients) to 46% (44/96 patients).

Rate of overweight and obesity among boys were 42% (22/52 boys patients) and 58% (30/52 boys patients) and among girls were 48% (21/44 girls patients) and 52 % (23/44 girls patients) respectively (Figures 1-3).

Prevalence rate of inappropriate medications dosing in overweight and obese children

The prevalence rate of an inappropriate medications dose found in 63 out of 96 patients (66%) and only 33 out of 96 patients (34%) received appropriate medications dose (Figure 4).

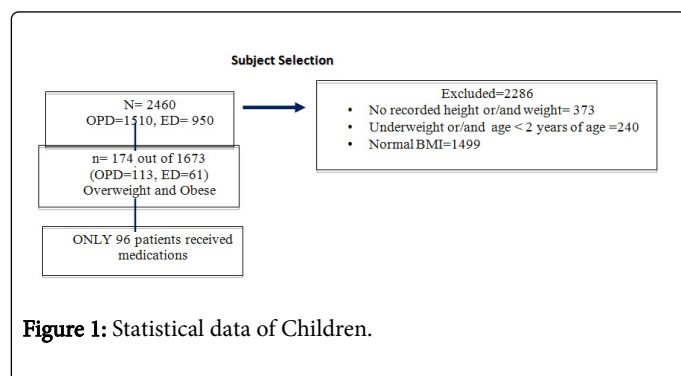


Figure 1: Statistical data of Children.

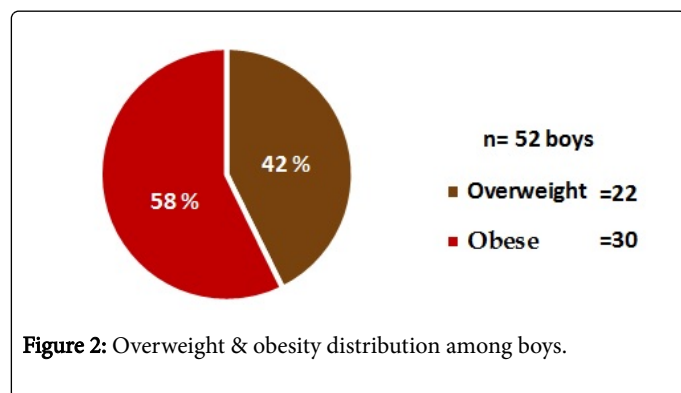


Figure 2: Overweight & obesity distribution among boys.

Among these 63 patients who received inappropriate dose, the over-dosage was found in 32 out of 63 patients (51%) and under dosage was found in 31 out of 63 patients (49%).

Medication dose errors rate

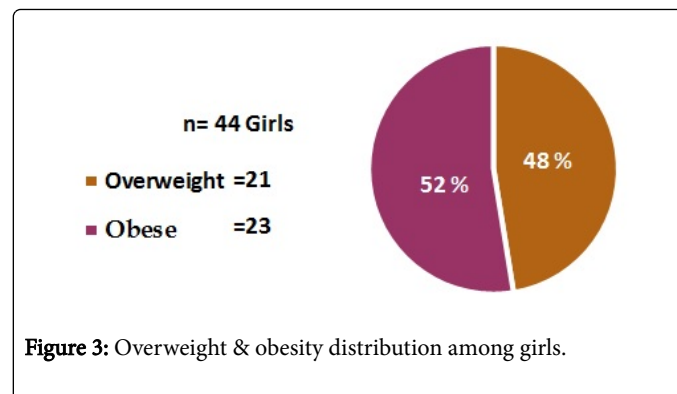


Figure 3: Overweight & obesity distribution among girls.

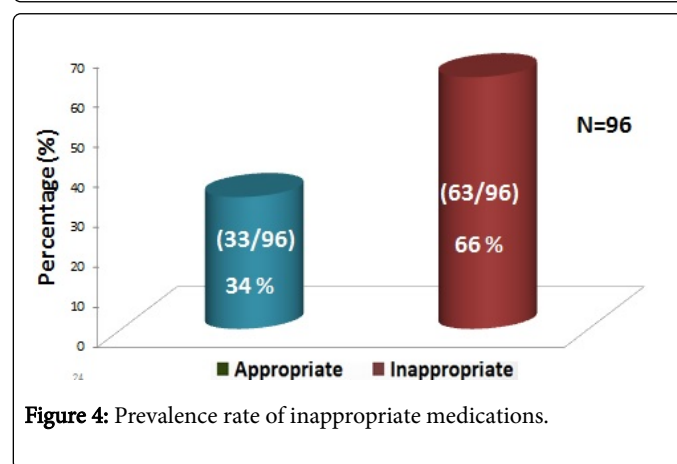


Figure 4: Prevalence rate of inappropriate medications.

Class	Number of errors identified
Antibiotics	15
Corticosteroids	13
NSAIDs	12
Acetaminophen	10
Vitamin/ Multivitamin	9
Antihistamine & decongestant	4
Thyroid drugs	3
Laxative	2
Leukoterine receptor antagonist	1
LMW heparin	1
B2-agonist inhaler	1
Antacid	1
Hormonal therapy	1

Table 1: Medication classes involved in inappropriate dosing.

Total number of medications prescribed and received by 96 patients found to be around 345 medications (1-8 medication per prescription). Only 73 out of 345 medications were wrongly prescribed with error rate of 21%. Some of medications that prescribed

inappropriately were found to be in the following class of medications: antibiotics followed by systemic corticosteroids, NSAIDs, and acetaminophen (Table 1).

Dose exceeding 100% of the correct dose	Dose between 50- 100 %	Between 25-50%
Ketoconazole topical 1	Augmentin 1	Cefuroxime 4
Fluticasone inhaler 2	Azithromycin 1	Azithromycin 2
Ibuprofen 6	Prednisolone 1	Augmentin 3
Pyridoxine 1	Fluticasone inhaler 9	Bactrim 2
Ascorbic acid 1	Seretide inhaler 1	Cephalexin 1
Letrozole 1	Ibuprofen 3	Ibuprofen 3
	Acetaminophen 7	Acetaminophen 3
	Multivitamin (sanostol) 1	Multivitamin (sanostol) 1
	Folic acid 1	VitaminD 4
	Dextromethorphan 1	Loratadine 3
	Hyoscine 1	Thyroxine 3
	Domperidone 1	Lactulose 2
		Enoxaparin 1
		Montelukast 1
		Maalox 1

Table 2: Dose error deviation from the correct dose.

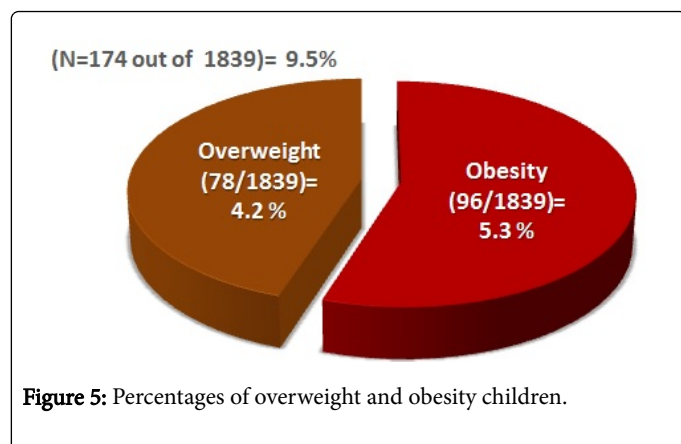


Figure 5: Percentages of overweight and obesity children.

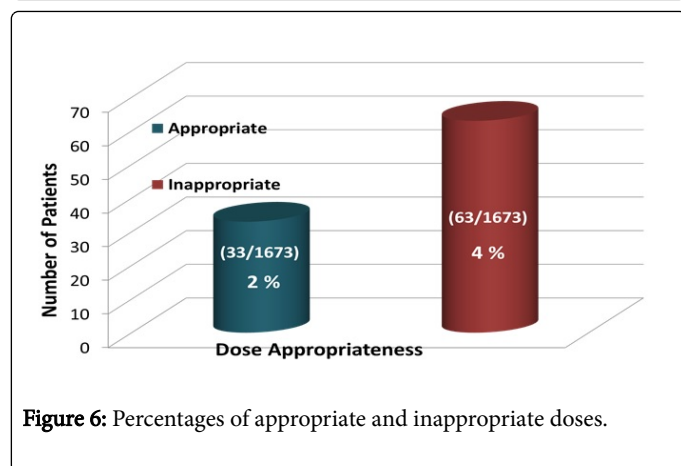


Figure 6: Percentages of appropriate and inappropriate doses.

Percentage of overweight and obesity among all children

The percentage of overweight and obesity among all children in our study found to be 9.4% 174 out of 1839 patients [1839 patients=taking into consideration patients with normal BMI (1499) + patients with normal BMI (166) + overweight and obese children (174)]. Overall overweight in study population represent 4.2 % (78/1839 patients) and obesity represent 5.2 % (96/1839 patients) (Figures 5). While the prevalence rate of inappropriate Medication Dose among All Patients (96/1673)=6% (Figure 6).

Discussion

Weight-based dosing is the most common scheme in determining medication dosing in children. Routine use of weight-based dosing of medications could potentially result in over or under dosing in these children.

Incorrect dosing is the most commonly reported error in children. Current practice suggests that weight-based dosing calculations may be used in patients up to 40 kg, while other sources indicate that weight-based dosing is more appropriate in patients less than 35 kg.

Using BMI plotted on CDC growth chart for the age and sex is the ideal method to identify overweight and obese child and hence to determine the most appropriate medication dose.

Familiarity with adult dosing regimens will be needed in order to not exceed the recommended adult dose to be given for a child for specific indication.

To date, we are aware of only one study evaluating the efficacy and safety of an adjusted body weight on medications in children. The use of dosing based on IBW or ABW cannot be routinely recommended for obese/overweight children. To our knowledge, there is no information on the national prevalence of inappropriate medication dose in overweight and obese children in Saudi children and we believe that our study is the first among fewest published studies that demonstrates the overweight and obese children are at great risk of receiving commonly prescribed medications outside the recommended doses either overdosing or underdosing which in hence, result in inappropriate dosing that may contribute in drug related problems or ineffectiveness. We decided to determine and estimate the rate of inappropriate medication dosing and the percentage of overweight and obesity in our child population.

As outlined previously our results show that dosing errors were observed in overweight and obese children at KAMC-Jeddah and it was consistence with our hypothesis. The rate of inappropriate prescribed dose associated with an error rate of 21% and we found that the overall overweight and obesity in study population were 4.2 % and 5.2 %. Obesity found to be predominant among boys and girls. The number of identified dosing errors was almost comparable in term of overdose and underdose.

Of particular concern we found that antibiotics, corticosteroids, NSAIDs, and acetaminophen were more likely to be prescribed inappropriately in the study population. Our results indicate that overdosing accounted of more than 50% of prescribed medication in overweight and obese children. This bring special concern with acetaminophen dosing because it has well established safety and efficacy profile, it is widely prescribed and used antipyretic and analgesic in children. Acetaminophen overdose can be fatal and may

lead to severe consequence such as acute liver failure [22] and under dose may lead to inadequate management of fever or pain control [23].

Although further work is required to gain a more complete understanding by studying the rate of inappropriate medication dosing in overweight and obese pediatrics compared with normal weight child, our findings indicates that hospitals should create institutional guidelines to guide the practice of dosing in overweight and obese children.

Our study has limitations as it was retrospective chart review, single institution and over short period of time. Although we did not assess clinical outcomes, however, overweight and obese children could be at increased risk for therapeutic failures or adverse effects. To further test the clinical outcome, a prospective broader study is needed.

Conclusion

The results described above suggested the rate of inappropriate medications dosing was found to be 66% with a dosing error rate of 21%. These results provided some evidence that overweight and obese children may receive inappropriate medications dosing.

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