

## PREVALENCE AND ASSOCIATION OF GLYCOSURIA WITH SEVERAL RISK FACTORS FOR DIABETES MELLITUS IN PRIMARY SCHOOL CHILDREN IN BALI

Ida Bagus Ramajaya Sutawan, I Wayan Bikin Suryawan, I Made Arimbawa

Department of Child Health, Udayana University Medical School/  
Sanglah Hospital Denpasar-Bali

### ABSTRACT

Nowadays, diabetes mellitus (DM) is often found in children. One of important screening for DM is urine examination to determine glycosuria. The current data on the prevalence of glycosuria in children in Indonesia, including Bali is very limited. The purpose of this study is to determine the prevalence of glycosuria in primary school children in Bali and the association of several risk factors for DM on the occurrence of glycosuria. A cross sectional study of children aged 6-12 years in several primary schools in Bali was done. Samples were taken using multistage random sampling technique. Glycosuria was determined by urine reagent strips and determination of risk factors for DM was by questionnaire and physical examination. Total of 1020 children were examined in this study. Fiftyone point five percents of samples were male, obesity was found in 36.8% of samples. Family history of DM was found in 2.6% of samples. This study found 17 cases of glycosuria with a prevalence of 1.7%. Several factors were found associated with glycosuria, including obese with OR 5.32 (95% CI 1.65 to 17.16; P=0.005), family history of DM with OR 12.98 (95% CI 3.11 to 54.27; P<0.001), and male gender with OR 6.05 (CI 95% 1.34 to 27.33; P=0.019). Based on this study, it could be concluded that the prevalence of glycosuria was quite high at primary school children in Bali. Therefore glycosuria screening in children needs to be done, especially in those with risk factors for DM to detect this disease earlier. [MEDICINA 2014;45:156-160].

**Keyword:** glycosuria, children prevalence

## PREVALENSI DAN HUBUNGAN GLIKOSURIA DENGAN BEBERAPA FAKTOR RISIKO DIABETES MELLITUS PADA ANAK SEKOLAH DASAR DI BALI

Ida Bagus Ramajaya Sutawan, I Wayan Bikin Suryawan, I Made Arimbawa

Bagian/SMF Ilmu Kesehatan Anak Fakultas Kedokteran Universitas Udayana/  
Rumah Sakit Umum Pusat Sanglah Denpasar

### ABSTRAK

Diabetes mellitus (DM) saat ini semakin sering ditemukan pada anak. Salah satu skrining penting penyakit ini adalah dengan pemeriksaan urin untuk mengetahui adanya glikosuria. Saat ini data mengenai prevalensi glikosuria pada anak di Indonesia termasuk di Bali sangat terbatas. Tujuan penelitian ini adalah untuk mengetahui prevalensi glikosuria pada anak usia sekolah dasar di Bali dan mengetahui hubungan beberapa faktor risiko DM dengan kejadian glikosuria. Penelitian ini dilakukan dengan metode *cross sectional* terhadap anak berusia 6-12 tahun di beberapa sekolah dasar di Bali. Sampel diambil dengan teknik *multistage random sampling*. Penentuan glikosuria dilakukan dengan *urine reagent strips*, penentuan faktor risiko DM dengan kuesioner dan pemeriksaan fisik. Sebanyak 1020 anak diperiksa pada penelitian ini. Lima puluh satu koma lima persen dari sampel berjenis kelamin laki-laki, obesitas ditemukan pada 36,8% sampel. Riwayat DM pada orangtua sebanyak 2,6%. Pada penelitian ini ditemukan 17 kasus glikosuria dengan prevalensi 1,7%. Beberapa faktor yang ditemukan berkaitan dengan glikosuria adalah obesitas dengan rasio odds (RO) 5,32 (IK 95% 1,65- 17,16; P=0,005), riwayat DM pada orangtua dengan RO 12,98 (IK 95%: 3,11-54,27; P<0,001), dan jenis kelamin laki-laki dengan RO 6,05 (IK 95%:1,34-27,33; P=0,019). Simpulan penelitian ini adalah prevalensi glikosuria cukup tinggi pada anak usia sekolah dasar di Bali. Skrining glikosuria perlu dilakukan terutama pada anak yang memiliki faktor risiko DM untuk mendeteksi penyakit ini lebih dini. [MEDICINA 2014;45:156-160].

**Kata kunci:** glikosuria, anak, prevalensi.

## INTRODUCTION

Nowadays, incidence of diabetes mellitus (DM) in children and adolescents are increasing. DM is part of a metabolic disease characterized by chronic hyperglycemia, which is caused by a defect in insulin secretion, in insulin action, or both.<sup>1-3</sup> High level of glucose in the blood that passes through the filtration and absorption threshold level of the kidney will result in the presence of glucose in urine which is called glycosuria.<sup>4-7</sup> DM screening program in children is important to detect asymptomatic children.<sup>8</sup> One of important screening tool is the examination of urine to determine the presence of glycosuria. This test has a sensitivity of 21-64% and a specificity of >98% for diagnosing DM.<sup>8,9</sup> Urine test for glycosuria is very useful especially in population screening because it is relatively inexpensive, simple, affordable, safe, and does not require sophisticated equipment, as well as having high specificity.<sup>7</sup>

The estimated prevalence of DM in children is 0.02%, about 440,000 children worldwide suffer from diabetes mellitus with approximately 70,000 new cases each year.<sup>10</sup> Most of DM in children is type 1,<sup>1,2</sup> but DM type 2 also start to increase, especially in those with risk factors, such as obesity, family history of DM, and signs of insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, and polycystic ovarian syndrome).<sup>2,8</sup> Riset Kesehatan Dasar (Riskesdas) Nasional in 2007 reported that the national prevalence of DM in Indonesia in the population aged of e"15 years was 1.1% and in the Bali Province was 1.0%.<sup>11,12</sup> The prevalence data of DM or glycosuria in children age less than 15 years in Indonesia including Bali is very limited. Therefore, a study to determine the prevalence of glycosuria in children in Indonesia, including in

Bali Province is required.

The purpose of this study is to determine the prevalence of glycosuria in primary school children in Bali and the association of several risk factors for DM on the occurrence of glycosuria.

## METHODS

The study was conducted with a cross-sectional design in several primary schools in Bali, were randomly selected in August 2013 to January 2014. Target population were primary school aged children in Bali and the accessible population were primary school aged children in several primary schools in Bali. Sample size was calculated using cross sectional sample size calculation for qualitative variable with  $Z_{\alpha}=1.96$ , expected proportion in population based on previous study were 0.7%, and precision 0.5%, according to the calculation sample size was 1068. Samples in this study were primary school children (aged 6-12 years) which were taken using multistage random sampling method. From 9 districts in Bali, 3 districts (Denpasar, Tabanan, Karangasem) were randomly selected based on the socio-economic stratification using stratified random sampling method, then 9 subdistricts were randomly selected using cluster sampling method. From 9 selected subdistricts, 18 primary schools were randomly selected as sampling place using cluster sampling method, and finally samples were selected from each primary school using simple random sampling. Inclusion criteria for this study were children who attended primary school in Bali and agreed to participate in the study. Exclusion criteria were children who suffered from fever, or had a period of menstruation when data retrieval was done.

Glycosuria was defined as the presence of glucose in urine which

was examined by trained staff using a urine dipstick. If in the first urine examination showed positive result, a second urine examination was done. If the second result was positive then the sample was declared positive glycosuria. If the result was negative, then the third urine examination would be done, if the third result was positive, the sample was declared positive glycosuria, and if the result was negative then the sample was declared negative glycosuria. Obesity was defined as body mass index (BMI) greater or equal to the 95<sup>th</sup> percentile based on the CDC curves which were measured by trained staff, with a portable stadiometer (microtoise) and standard digital scale that had been calibrated. Family history of DM was defined as history of one or both parents or siblings suffering from DM or taking medication regularly for DM, which were obtained through questionnaires filled by parents. Sign of acanthosis nigricans was made by clinical examination by a trained doctor.

All data obtained from questionnaires, physical examination, and urine test, were analyzed by SPSS program. The association between risk factors for DM with glycosuria was analyzed by chi-square or Fisher's exact test if the chi-square test requirements were not met, then followed by logistic regression test on the significant variables. The data analysis was presented in tables and narrative.

The study has been approved by the Ethics Committee of Medical School of Udayana University/Sanglah Hospital Denpasar. Informed consent was given to each sample/parent before the data were taken.

## RESULTS

A total of 1068 primary school children were examined in this study. Fourty eight samples were excluded because they were not in

**Table 1.** Characteristics of samples

Characteristics	N (%)
Gender	
Male	525 (51.5)
Female	495 (48.5)
Age	
6-9 years	550 (53.9)
10-12 years	470 (46.1)
Obesity	
Yes	375 (36.8)
No	645 (63.2)
Family history of DM	
Yes	27 (2.6)
No	993 (97.4)
Acanthosis nigricans	
Yes	0 (0)
No	1020 (100)

**Table 2.** Prevalence of glycosuria

Glycosuria	N (%)
+1	15 (1.5)
+2	2 (0.2)
Total of Glycosuria	17 (1.7)

school, got fever, and or had a period of menstruation at the time of examination. Out of 1020 children, 51.5% of them were male, and 53.9% were in 6-9 years old age group. The number of children who were obese reached 36.8% of the sample, and 2.6% of the samples had family history of DM. Sign of acanthosis nigricans was not found on the entire sample. Characteristics of samples were shown in **Table 1**. This study found 17 cases of glycosuria with a prevalence of 1.7% which was the main purpose of this study (**Table 2**).

Based on the results of the bivariate analysis, age was not associated with the occurrence of glycosuria (PR 1.22; 95% CI 0.47 to 3.18; P=0.683). It was found that the occurrence of glycosuria in primary school children in Bali

**Table 3.** Result of bivariate analysis of several factors related to glycosuria in primary school children in Bali

Variables	Glycosuria				P	PR	95% CI
	Yes	%	No	%			
Gender							
Male	15	88.2	510	50.8	0.002	7.07	1.63 to 30.76
Female	2	11.8	493	49.2		ref	
Age							
6-9 years	10	58.8	540	53.8	0.683	1.22	0.47 to 3.18
10-12 years	7	41.2	463	46.2		ref	
Obesity							
Yes	13	76.5	362	36.1	0.001	5.59	1.84 to 17.02
No	4	23.5	641	63.9		ref	
Family History of DM							
Yes	3	17.6	24	2.4	0.009*	7.88	2.41 to 25.83
No	14	82.4	979	97.6		ref	

\*Using Fisher's exact test due to chi-square test requirements were not met.

**Table 4.** Multivariate analysis of several factors related to glycosuria in primary school children in Bali

Variables	OR	95% CI	P
Obesity	5.32	1.65 to 17.16	0.005
Family History of DM	12.98	3.11 to 54.27	<0.001
Male Gender	6.05	1.34 to 27.33	0.019

was significantly associated with obesity (PR 5.59; 95% CI 1.84 to 17.02; P=0.001), family history of DM (PR 7.88; 95% CI 2.41 to 25.83; P=0.009), and male gender (PR 7.07; 95% CI 1.63 to 30.76; P=0.002). The results of the bivariate analysis were shown in **Table 3**.

Based on the results of multivariate analysis it was found that the occurrence of glycosuria in primary school children in Bali was significantly associated with obesity (OR 5.32; 95% CI 1.65 to 17.16; P=0.005), family history of DM (OR 12.98; 95% CI 3.11 to 54.27; P<0.001), and male gender (OR 6.05; 95% CI 1.34 to 27.33; P=0.019). The results of the multivariate analysis were shown in **Table 4**.

**DISCUSSION**

Several previous studies on

the prevalence of glycosuria in children indicated that there were a trend of increasing prevalence of glycosuria from year to year. Urakami *et al*<sup>13</sup> on screening of glycosuria in school children in Japan in 1974-2004 involving a total of 9,242,259 school children, obtained the prevalence of glycosuria of 0.05-0.1% in primary school children and 0.12-0.2% in secondary school children. A study by Bai *et al*<sup>14</sup> in 1991 in India found that the prevalence of glycosuria were 0.038% of 10,513 children aged 3-20 years, the study by Wei *et al*<sup>15</sup> in 1993-1999 in Taiwan recorded the prevalence of glycosuria were 0.28% of 2,932,000 school children from grade 1 to 12. Bassey *et al*<sup>8</sup> in 2008 in Nigeria noted the prevalence of glycosuria were 0.7% of 1,008 children aged 10-18 years, and study by Batson

*et al*<sup>16</sup> in 2009 found that the prevalence of glycosuria were 0.034% of 67,000 children aged 5-17 years. In this study, the prevalence of glycosuria was higher than the results of several previous studies, at 1.7 % of 1020 children. This relatively high prevalence likely caused by the high prevalence of obesity in the population of primary school age children in Bali, reaching 36.8% overall and 76.5% of the glycosuria samples. The differences between several prevalence study of glycosuria may be attributed to variations in methods of glycosuria determination, observer effect, age range, sample size, ethnicity, and social class.

Several factors such as obesity, family history of DM, signs of insulin resistance (acanthosis nigricans, dyslipidemia, hypertension), and ethnicity (including children with Asian ethnicity) are risk factors associated with type 2 diabetes mellitus in children.<sup>17,18</sup> Although this study could only find out the association between several risk factors with the occurrence of glycosuria in primary school children in Bali, but it supported the results of previous studies on the association of those risk factors with DM, especially type 2 DM in children.

The prevalence of glycosuria was quite high in this study. It appeared to be influenced by the high rate of obesity in cases with glycosuria in this study (13 cases of obesity out of 17 cases of glycosuria), which was also significantly associated with glycosuria. The result is quite high compared to the research by Bassey *et al*<sup>8</sup> in 2008 which only obtained 14.29% obesity in cases of glycosuria, although their research also found that the average child's weight was higher in the glycosuria group compared to non glycosuria group. A study by Wei *et al*<sup>15</sup> reported that obesity was very common in children with type 2 diabetes, this

study showed that 37.9% of boys and 39.5% of girls with DM were obese. Research by Batson *et al*<sup>16</sup> also indicated high incidence of obese in children with diabetes mellitus at 25%.

Family history of DM was found in 3 cases out of 17 cases of glycosuria and was identified to associate significantly with the occurrence of glycosuria in this study. This result was slightly lower than what was reported by Bassey *et al*<sup>8</sup> who obtained that 28.6% of children with glycosuria had a family history of DM. Although in this study the association is only in family history of DM with the glycosuria, but it supports the results of research which had found that the family history of DM associate to the incidence of DM in children. Urakami *et al*<sup>13</sup> on study in Japan even identified 56.5 % of children with type 2 diabetes in Tokyo had a family history of DM.

Gender is not specifically mentioned as a risk factor for diabetes in children, and indeed some previous studies showed different results on the association of gender with DM. In this study, the male was found to be a factor associated with glycosuria in children, the prevalence of glycosuria in male was obtained at 2.9%, while only 0.4% in female with a ratio of 7:1. These results were similar to the results obtained by Bassey *et al*<sup>8</sup> who recorded glycosuria prevalence of 1.2% in male and 0.2% in female with a ratio of 6:1. But this result contradicts with the results in school children in Japan which obtained female 1.7 times often suffered from DM than male,<sup>13</sup> and also the results by Wei *et al*<sup>15</sup> which noted that DM was higher in girls (19/100,000) than boys (14.7/100,000). Up to the present, there is no definitive explanation of the association between the gender with an incidence of DM or glycosuria in children.

Acanthosis nigricans is a sign of insulin resistance and also used

as a sign for risk factor for diabetes.<sup>17,18</sup> In this study no samples indicated to have experienced these signs, and this is similar to those obtained by Bassey *et al*<sup>8</sup> who only recorded 1 case of acanthosis nigricans in 1008 of samples.

There are several limitations of this study. First it did not measure food recall before the examination of urine which may affect the levels of glucose in the urine. Second, this was a cross sectional study so unfavorable to assess the association of risk factors of DM on the incidence glycosuria.

Based on this study, it could be concluded that prevalence of glycosuria was quite high in primary school age children in Bali. Several factors such as obesity, family history of DM, and male gender were significantly associated with glycosuria. Therefore glycosuria screening in primary school age children need to be done, especially in those with a risk factors for DM to detect and to manage this disease early. Future studies should be performed with the cohort method to determine the incidence of glycosuria and DM in children, as well as better assess the association of risk factors on the incidence of glycosuria and DM in children.

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