

OBSERVATIONS

Twizzlers as a Cost-Effective and Equivalent Alternative to the Glucola Beverage in Diabetes Screening

Screening for gestational diabetes mellitus requires an oral glucose challenge test with a 50-g glucola beverage and venous blood sample after 1 h. A “positive screen” is defined as a venous blood glucose of either >130 mg/dL or 140 mg/dL (1,2), and the patient then undergoes a diagnostic fasting 3-h glucose tolerance test (GTT) with a 100-g glucola (1). However, up to 30% of pregnant women cannot tolerate the traditional 50-g glucola beverage (3,4). There are few reports demonstrating viable and cost-effective alternatives, such as commercially available candy. For example, jelly beans have been shown to be better tolerated but with demonstrated lower sensitivity, potentially related to their variability in size and resultant difficulty in calculating glucose load (3,4). We therefore sought to identify whether other forms of candy (such as Twizzlers licorice ropes and Jolly Ranchers hard candies) might be suitable alternatives using a triple crossover design whereby each subject serves as their own control.

We estimated that a sample size of 20 pairs would achieve 87% power to detect equivalence when the margin of equivalence is ± 8 and the actual difference is 0 at a correlation of 0.4 ($P < 0.05$; 2000 Monte Carlo simulations). To calculate the oral intake necessary, we consulted per-piece Twizzlers and Jolly Ranchers product information regarding calories, total and saturated fat, carbohydrates, sugars/sugar alcohols, and protein. This estimated a 50-g equivalent of ten strawberry-flavored Twizzlers or eight total sour apple, grape, cherry, or watermelon Jolly Ranchers. Given subjects’ concern during our run-in pilot about tooth damage with consumption of eight Jolly Ranchers over 5 min, we limited the study to comparing 10 Twizzlers (week 1) and 50-g glucola (Azer Scientific,

Table 1—Serum glucose values and screening positive rate with Twizzlers or 50-g glucola

Maternal BMI	Glucola		Twizzlers		P
Serum glucose (g/dL)					
Overall (n = 20)	106 ± 43		109 ± 37		0.78
<25 kg/m ² (n = 16)	100 ± 36		103 ± 30		0.88
≥25 kg/m ² (n = 4)	130 ± 66		133 ± 53		0.82
Serum insulin (μU/dL)					
Overall (n = 20)	42 ± 26		34 ± 27		0.10
<25 kg/m ² (n = 16)	40 ± 21		27 ± 12		0.035
≥25 kg/m ² (n = 4)	53 ± 46		60 ± 52		0.61
	≥140 mg/dL		≥130 mg/dL		
	Twizzlers	Glucola	Twizzlers	Glucola	
Sensitivity	100%	100%	100%	100%	
Specificity	89.5%	89.5%	78.95%	84.2%	
PPV	33.3%	33.3%	20%	25%	
NPV	100%	100%	100%	100%	
ROC values	0.947	0.947	0.895	0.921	

Data are means ± SD unless otherwise indicated. No significant differences were observed when comparing subjects by BMI strata of normal-weight (<25 kg/m²) versus overweight or obese (≥25 kg/m²) subjects. In the <25 kg/m² BMI cohort, a statistically lower serum insulin was observed with the Twizzlers challenge ($P = 0.035$). A P value was calculated via a paired t test. At ≥140 mg/dL, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were similar. At ≥130 mg/dL, sensitivity and negative predictive value were the same, but specificity and positive predictive value minimally varied. Likewise, ROC values were identical at ≥140 mg/dL for both Twizzlers and glucola and minimally varied at ≥130 mg/dL.

Morgantown, PA) (week 2) with diagnostic 100-g GTT (week 3; criterion per Coustan or NDDG). Serum glucose, lactate, and insulin concentrations were determined by high-performance clinical chemistry and immunoassay.

At either ≥129 or 139 mg/dL, a comparable ratio of subjects screened positive with Twizzlers or glucola (McNemar $r = 0.45$, $P = 0.04$) (Table 1); this did not vary by BMI ($P = 0.78$ overall, $P = 0.88$ BMI <25 kg/m², $P = 0.82$ BMI ≥25 kg/m²). One patient (5% of the study population) tested positive in the diagnostic GTT (Coustan criteria); she screened positive by both the Twizzlers and glucola with demonstration of equipoise (receiver operating characteristic [ROC] at ≥140 mg/dL, 0.947, and at ≥130 mg/dL, 0.895, vs. 0.921). There was no significant difference noted in the increase of insulin ($P = 0.31$), lactate ($P = 0.78$), and dextrose (glucose monohydrate) ($P = 0.96$). However, in the <25 kg/m² BMI cohort, a statistically lower serum insulin was observed with Twizzlers challenge ($P = 0.035$). This is noteworthy, as it suggests that significant variation in insulin levels may be observed by virtue of the means of glucose load itself (5).

This study set out to demonstrate equipoise between the standard 50-g

glucola beverage and a viable candy alternative using a triple-crossover design and observed that 10 Twizzlers strawberry twists are an equivalent choice for diabetic screening. The implications to our study are both practical and immediately applicable given standard approximate cost estimates (ten individually wrapped Twizzlers: 0.97 USD). Future efforts will be to study this alternative in pregnant subjects now that we have demonstrated equipoise in a nonpregnant cohort.

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wrote the manuscript and researched data. K.M.A. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.



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