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Qatar Obesity Reduction Study (QORS): Report on a Pilot School-based Nutrition Education Campaign in Qatar

Choudhury S[1], Omar O[1], Arora T[2,3], Rifai NA[4], Chagoury O[1] and Taheri S[1,2*]

[1]Clinical Research Core, Department of Medicine, Weill Cornell Medicine, Doha, Qatar

[2]Department of Medicine, Weill Cornell Medicine, Doha, Qatar

[3]Weill Cornell Medicine in New York, New York, USA

[4]Communications Department, Weill Cornell Medicine, Doha, Qatar

[*]**Corresponding author:** Taheri S, Department of Medicine, Weill Cornell Medicine – Qatar, Qatar Foundation-Education City, Doha, Qatar, Tel: +974 4492-8998; Fax: +974 4492-8970 E-mail: staheri@me.com

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Abstract

Objective: As schools have continuous and intensive contact during the first two decades of a child's life, school-based interventions can instil healthy lifestyle behaviors. This study evaluated the pilot of Qatar's first school-based nutrition education campaign.

Methods: Qatar Obesity Reduction Study (QORS) was an observational study examining a pilot campaign's impact on children's eating habits (self-reported questionnaire), physical activity levels (accelerometry), and body composition (bioimpedance) across two time periods (beginning of school term 2 and end of term 3 of the school year).

Results: Baseline data were provided by 335 elementary school students, and 83.3% were followed up (n=278). The self-reported frequency of rice consumption decreased from baseline to follow-up (P<0.001). Although not statistically significant, fruit intake (a lot) increased by almost 6% post-intervention compared to baseline and vegetable intake (a lot) increased by 3.5%. Similarly, the frequency of eating 'a lot' of unhealthy food items, such as biscuits and cakes/muffins, reduced, but not significantly. Only the percentage of time spent performing light activity increased post-intervention (P<0.001). The prevalence of obesity and overweight, and BMI z scores did not change significantly.

Conclusion: We observed some positive changes in eating habits after a short nutrition education campaign in an elementary school in Qatar, a country with a high prevalence of childhood obesity. The findings are supportive for the extension of the campaign to other schools with further evaluation. A school-based nutrition education campaign could have a positive impact on choices of food consumed.

Keywords: Nutrition; Education; School; Obesity; Health habits; Physical activity

Introduction

Obesity is a significant global health problem with serious medical, psychological, social, and economic consequences [1]. Whilst the impact of obesity was initially noted in western countries, the incidence and prevalence of obesity in the Middle East and North Africa (MENA) countries, and in particular amongst populations in the Gulf Cooperation Countries (GCC), have been increasing rapidly [2]. Qatar, a GCC country, ranks amongst one of the countries with the highest prevalence of childhood obesity.

The prevalence for overweight and obesity in children aged 5-9 years in Qatar was recently reported as 18.3% and 18.2%, respectively [3]. The increasing prevalence of obesity in rapidly developing countries such as Qatar has been attributed to nutrition transition characterized by changes in food consumption with increasing intake of energy-dense western-style foods in combination with insufficient physical activity [4].

Because schools have more continuous and intensive contact during the first two decades of a child's life, school-based interventions provide a promising avenue to instill knowledge and education surrounding healthy lifestyle behaviors, intended for practice across the life-course [5]. In elementary school-aged children, 25-33% of daily energy intake is provided by food consumed in school [6].

School-based interventions have been implemented, which have focused on changing dietary intake and physical activity levels to prevent and reduce childhood obesity. These have focused on educating children about the importance of a healthy diet and adequate physical activity [7]. A recent systematic review noted that this strategy can be effective and that the key elements of successful interventions include reducing consumption of sugar-sweetened beverages, increasing fruit intake, and increasing physical activity [8].

In Qatar, a nutrition education campaign called "Sahtak Awalan – Your Health First", supported by multiple key stakeholders was piloted in an elementary school. A key element of this campaign was to promote healthy eating behaviors amongst elementary schoolchildren, aiming to diminish the future impact of obesity and type 2 diabetes mellitus in Qatar [9-11].

The intervention altered the school's canteen design, and educated schoolchildren on healthy eating habits and portion sizes. No previous school interventions have been conducted in Qatar to address the problem of childhood obesity. We report on the Qatar Obesity Reduction Study (QORS) [12], an evaluation of the Sahtak Awalan – Your Health First school campaign pilot.

QORS was a pre-post study, designed as a pragmatic evaluation of the impact of the school campaign through assessment of potential alterations in children's eating habits, physical activity, and body composition across two time periods (beginning of term 2, in January, and end of term 3, in May) during the academic year.

Methods

Study design

The study was an evaluation of a pilot school-based nutrition campaign called Sahtak Awalan - Your Health First. The campaign was supported by multiple key stakeholders in Qatar including the Ministry of Public Health, the Ministry of Education and Qatar Foundation. The stakeholders advised on the implementation of the campaign and identification of a school to pilot the intervention.

School-based nutrition campaign

As part of the Sahtak Awalan campaign, a pilot intervention was conducted to examine the impact of an elementary school nutrition education campaign on lifestyle behaviors of schoolchildren. The intervention aimed to educate children about healthy food selection through the support of the school nurse, teaching and catering staff as well as posters, which provided factual nutritional information/advice.

The school cafeteria was redesigned with colorful posters providing information regarding the benefits of macronutrients and greater intake of individual fruit and vegetables. Information cards were also provided regarding the benefits of individual fruits and vegetables. Recipe cards were available for students to take home to try healthy foods.

The school nurse and catering staff provided regular direct face-to-face consultation and feedback to students as they made food selections in the school cafeteria. The intervention also had a reward system with children receiving stamps in a book when they chose a healthy option, and a badge was awarded after obtaining a pre-specified number of stamps. The campaign was an initial pilot introduced at a single school with the aim to extend to other schools if the evaluation demonstrated potential benefits with changes in eating habits and body composition.

Study participants

The study was ethically approved by the joint institutional review board of Hamad Medical Corporation and Weill Cornell Medicine - Qatar (14-00144) and was also approved by Qatar's Ministry of Education. One large elementary school, located in Qatar's capital city, Doha, participated in the campaign.

All parents of students registered in grades 2-5 inclusive (n=445), were sent a letter/email regarding the study. An opt-out procedure was employed and non-consent, as indicated by parents, was documented (n=81). At the same time as the parental consent letter was issued, students watched an informational DVD regarding study requirements during class time.

Only children with parental consent were subsequently approached for the study (n=364) and all children provided assent prior to participation. Students who were not able to comprehend study instructions, fully comply with the protocol, or were not willing to provide assent were not included (n=29).

Study procedures

Demographics: A trained researcher conducted a one-to-one interview with students to ascertain subjective information on gender (male/female), age (7-12 years), and grade (2-5), which were also verified by the school. Participants provided subjective reports concerning their perceived ethnicity (White, Black, Asian, Arab and others).

Dietary assessment instruments: A simplified, culturally appropriate version of the Health Behavior in School-Aged Children (HBSC) food frequency questionnaire (FFQ) was used to capture frequency of consumption of 18-food/drink items [13]. Response options (None/A little/A lot) were reported for each of the 18 food items. Frequency of breakfast consumption during weekdays (0-5) and weekends (0-2) was also recorded.

Anthropometric measurements: Height (cm) was measured using a portable stadiometer (SECA 213) and recorded to the nearest 0.5 cm. A bioelectrical impedance scale machine (TANITA BC420) was used to obtain students' weight (kg) [14,15]. This was obtained when students were wearing light indoor clothing, without shoes and socks, and with empty pockets. A half a kilogram was deducted from the total weight to account for the weight of clothes. The following information was generated from bioelectrical impedance: weight (kg); fat percent (%); fat mass (kg); BMI (body mass index; kg/m2). The World Health Organization (WHO) [16] and the International Obesity Task Force (IOTF) [17] definitions were used to derive BMI cut points for overweight and obesity.

Anthropometric measurements for waist, hip and neck circumference were obtained in centimeters and reported to the nearest 0.1cm with a non-stretchable measuring tape (SECA 201) by trained researchers using a standardized procedure.

Physical activity: Levels of physical activity were assessed using wrist-worn tri-axial accelerometry (GT3X+, Actigraph, Pensacola, FL, USA) [18]. Students were instructed to wear the actigraph on their non-dominant wrist for seven consecutive days/nights, at baseline and follow-up visit. Data were downloaded according to the manufacturer's software (ActiLife, version 6).

The software, based on accepted algorithms for physical activity of Freedson cut points of sedentariness in children was used to determine level of physical activity at baseline and follow-up [19].

Accelerometry data were available for 266 (79.4%) students at baseline and 134 (48.2%) at follow-up.

Outcomes: To assess the impact of the pilot intervention, we compared dietary habits of several foods including fruits, vegetables cakes, potatoes and fast food before and after the campaign.

Body composition measures (weight, BMI, fat mass, fat free mass) before and after the intervention were assessed. Finally, physical activity levels were compared pre and post intervention.

Statistical analysis: Continuous variables were summarized using means and standard deviations. Categorical variables were summarized using frequencies and percentages. Comparison of body composition outcomes between baseline and follow up were made using the paired t-test for continuous variables and McNemar test for categorical variables. Dietary habits between baseline and follow up were compared using the Wilcoxon ranked sum test and paired t-tests were used to compare physical activity levels.

A P value of <0.05 was considered to be statistically significant. All statistical analyses were performed using Stata, version 13.0 (StataCorp LP, College Station, TX).

Results

Baseline data were provided by 335 students, and 83.3% of the sample were followed up (n=278). Of the 17% who were not followed up (either due to absenteeism at the time of data collection or study withdrawal), 66.7% were males, with an average age of 9.7 years, and 24% classified themselves as Arab, and had a mean weight of 40.4 kg.

The characteristics of the schoolchildren are presented in **Table 1**. The average age was 9.1 ± 1.2 years at baseline and 9.3 ± 1.2 years follow up.

Table 1: Sample characteristics for student participants across the two time points.

	Baseline (n=335)	Follow up (n=278)	Loss to follow up (n=57)
Gender, n (%)			
Boys	186 (55.5)	148 (53.2)	38 (66.7)
Girls	149 (45.5)	130 (46.8)	19 (33.3)
Age, yrs (SD)	9.1 (1.2)	9.3 (1.2)	9.7 (1.1)
Grade, n (%)			
2	79 (23.6)	74 (26.6)	5 (8.8)
3	88 (26.3)	77 (27.7)	11 (19.3)
4	85 (25.4)	68 (24.5)	17 (29.8)
5	83 (24.8)	59 (21.2)	24 (42.1)
Height, cm (SD)	137.6 (8.8)	139.3 (8.8)	140.6 (8.5)
Weight, kg (SD)	36.3 (11.9)	37.1 (12.1)	40.4 (14.3)
Ethnic group, n (%)			
White	41 (12.2)	39 (14.0)	2 (3.5)
Black	8 (2.4)	7 (2.5)	1 (1.7)
Asian	8 (2.4)	6 (2.2)	2 (3.5)
Arab	265 (79.1)	217 (78.1)	48 (84.0)
Other	13 (3.9)	9 (3.2)	4 (6.9)

There were no gender differences in any of the outcomes. The prevalence of obesity increased from 12.9% at baseline to 14.0% at follow up, but was not statistically significant.

Overweight status reduced non-significantly from 33.8% at baseline to 31.7% at follow up **(Table 2)**.

Table 2: Descriptive statistics for body composition of the sample studied.

Body composition measure	Baseline (n=278)	Follow up (n=278)	Difference (95% CI)	P-value*	Loss to follow up (n=57)
BMI, kg/m2	18.55 (4.1)	18.82 (4.6)	0.26 (0.09, 0.23)	0.003	20.03 (5.3)
BMI z-score	0.67 (1.5)	0.63 (1.6)	-0.04 (-0.12, 0.03)	0.221	0.96 (1.6)
Obesity, n(%)	36 (12.9)	39 (14.0)	1.08 (-4.60, 6.76)	0.508a	21.1
Overweight, n(%)	94 (33.8)	88 (31.7)	-2.16 (-9.96, 5.64)	0.146a	33.3
Waist Circumference, cm	65.3 (11.7)	65.9 (11.4)	0.55 (-0.13, 1.23)	0.114	69.2 (12.6)
Hip Circumference, cm	75.8 (11.0)	77.3 (11.7)	1.34 (0.64, 2.03)	<0.001	80.2 (13.5)
Waist to Hip ratio	0.86 (0.06)	0.86 (0.15)	0 (-0.02, 0.02)	0.926	0.86 (0.06)
Neck Circumference, cm	26.2 (3.7)	27.4 (3.9)	1.15 (0.60, 1.70)	<0.001	26.6 (3.9)
Fat percent (%)	22.5 (9.2)	22.7 (9.7)	0.15 (-0.56, 0.86)	0.68	24.1 (10.1)
Fat mass (kg)	8.8 (6.6)	9.4 (7.2)	0.58 (0.20, 0.97)	0.003	11.0 (8.7)
FFM (kg)	26.6 (5.7)	27.8 (6.1)	1.19 (0.91, 1.48)	<0.001	29.4 (6.4)
Muscle Mass (kg)	25.2 (5.4)	26.3 (5.8)	1.11 (0.85, 1.36)	<0.001	27.8 (6.1)
TBW (kg)	19.5 (4.2)	20.3 (4.4)	0.74 (0.57, 0.91)	<0.001	21.5 (4.7)
TBW percent (%)	56.8 (6.4)	56.7 (4.4)	-0.03 (-0.43, 0.37)	0.876	55.5 (7.4)

Data are presented as mean (standard deviation), unless otherwise stated.
*P value determined from paired t-test or McNemar testa, as appropriate.
CI: Confidence Interval; BMI: Body Mass Index; FFM: Fat Free Mass; TBW: Total Body Water.

Fat mass increased from 8.8 kg to 9.4 kg (P=0.003). However, there was no statistically significant change in BMI z-score measures post-intervention (z=0.73 pre and z=0.63 post, P=0.221). We observed statistically significant increases in hip (75.8 cm pre and 77.3 cm post, P<0.001) and neck circumferences (26.2 cm pre and 27.4 cm post, P<0.001) [20]. There was no change in waist circumference or waist-hip ratio. A significant increase in muscle mass (25.2 kg pre and 26.3 kg post, P<0.001) and fat free mass (26.6 kg pre and 27.8 kg post, P<0.001) was also present between pre- and post-intervention.

Table 3 shows differences in the frequency of food and drinks assessed across the two time points. The frequency of energy drink consumption altered (P=0.05) and significant changes to rice consumption were also noted (P=0.011). Fruit intake (a lot) increased by almost 6% post-intervention compared to baseline and vegetable intake (a lot) increased by 3.5%, although these subjective alterations were not statistically significant. Similarly, the frequency of eating ‘a lot’ of unhealthy food items, such as biscuits and cakes/muffins, reduced post-intervention, but these findings were not statistically significant **(Table 3)**.

Table 3: Self-reported dietary habits of the sample studied.

Type of food	Baseline (n=335)			Follow up (n=278)			P value
	None	A little	A lot	None	A little	A lot	
Fruits, %	2.1	45.1	52.8	1.8	39.6	58.6	0.16
Vegetables, %	8.1	60.9	31	10.1	55.4	34.5	0.58
Potatoes, %	16.4	53.4	30.2	14.8	59.7	25.5	0.28
Sweets, %	6.3	61.8	31.9	7.6	67.3	25.2	0.20
Fizzy Drinks, %	30.8	52.2	17	29.5	52.9	17.6	0.26
Energy drinks, %	90.8	5.4	3.6	87.4	7.9	4.7	0.05
Fruit juice, %	5.1	34.3	60.6	6.8	39.2	54	0.18
Milkshake, %	6.9	39.4	53.7	8.3	41.7	50	0.30
Rice, %	3.3	29.6	67.2	2.9	40.8	56.3	0.01

Pasta, %	8.4	60	31.6	10.4	61.2	28.4	0.21
Noodles, %	34.9	48.7	16.4	31.7	52.9	15.5	0.83
Pastries, %	23.9	57.9	18.2	20.9	65.1	14	0.66
Cakes/muffins, %	14.6	70.8	14.6	15.1	72.3	12.6	0.49
Biscuits, %	9.9	63.8	26.4	12.3	64.9	22.8	0.24
Ice-cream, %	12.2	62.4	25.4	8.7	63.2	28.2	0.17
Take away food, %	13.7	64.5	21.8	15.6	65.2	19.2	0.35
Fast-food, %	22.2	59	18.9	21.6	59	19.4	0.87
Weekday breakfast, %	8.1	60.9	31	10.1	55.4	34.5	0.58
Weekend breakfast, %	16.4	53.4	30.2	14.8	59.7	25.5	0.28

No significant changes were observed in moderate (42% at baseline vs. 41.4% follow-up) or vigorous/very vigorous (0%) physical activity levels between the two time points. However, the percentage of time spent performing light activity increased post-intervention (9.8% at baseline and 10.4% at follow-up, P<0.001) **(Table 4)**.

Table 4: Physical activity levels of the sample studied.

Type of Activity	Baseline (n=266)	Follow up (n=134)	P value
Sedentary (%)	47.9	48.2	0.98
Light activity (%)	9.8	10.4	<0.001
Moderate activity (%)	42	41.4	0.31
Vigorous/very vigorous activity (%)	0	0	-
P values obtained from paired t-test			

Discussion

The purpose of this evaluation was to assess the effectiveness of a pilot school-based nutrition education intervention conducted as part of the Sahtak Awalan - Your Health First campaign. The study evaluated the children's eating habits, body composition and physical activity levels. The campaign mainly focused on improving the food consumption choices children made, by having a canteen environment that promotes healthy eating through advertising.

The main impact of the campaign was on altering self-reported food selection towards the consumption of healthier foods. If these self-reported dietary changes are reflective of actual behaviors and are sustained, they could translate to a future reduction in obesity. This needs to be demonstrated through a randomized controlled trial.

Cecchini et al. examined the cost-effectiveness of school-based interventions for improving diet quality and physical activity to tackle obesity and its comorbidities, using a chronic disease prevention model [21]. Fiber consumption increased by 37.6 grams per day, and the percentage of total energy intake from fat reduced by 1.64%, which in turn, likely contributed to a 0.2 reduction in body mass index (BMI). Whilst these outcomes were modest, the long-term benefits of school-based interventions could produce meaningful long-term results. Early educational intervention is crucial given the well-documented challenges with limited long-term success of addressing obesity through lifestyle modifications in adulthood [22].

Dietary intake assessment has many challenges and limitations, due to its subjective nature, especially in the younger populations [23]. Our study did not quantify the amount of fruit and vegetables eaten. However, subjective intake indicated that the campaign had a positive impact on self-reported diet and most of the unhealthy foods were reported to be eaten less at follow up compared to baseline. There were also some increases in self-reported fruit and vegetable consumption. This is similar to results shown in a meta-analysis by Evans and colleagues on school-based interventions aiming to improve fruit and vegetable consumption [24]. Their meta-analysis found that fruit consumption increased by 0.24 portions (95% CI -0.05-0.43) and vegetable consumption by 0.07 portions (95% CI -0.03-0.16). Although children were eating healthier foods, the benefits of the diet change may take some time to appear [21], as the campaign evaluation was relatively short term. Future studies would also benefit from collecting surveys of food intake from parents in order to better quantify the amount consumed and provide a better indication for full days.

We observed statistically significant increases in hip and neck circumferences and significant increases in muscle mass and fat free mass between pre- and post-intervention. There was no significant change in BMI z-score measures at follow-up from baseline. The body composition of individuals changes according to age, body size and shape [25]. The results we observed on weight may be reflective of the children's growth and transition into puberty [20]. This is also highlighted in our observation that not only fat mass but also fat free mass, both components of total body mass, increased significantly post intervention.

Evans et al. found that school-based interventions fell into two general categories - a single component program and a multi-component program working with children and families [24]. They reported that multi-component programs had a trend of resulting in greater improvements in fruit and vegetable intake than single component programs. This has also been mirrored by Franks et al. who examined three school-based programs and provided useful lessons that could be learnt from these [26]. They mentioned involvement of stakeholders (which include teachers, parents, other school personnel, students) as vital during all stages of planning and dissemination in order to attain to the success of a program. The Sahtak Awalan – Your Health First campaign included these factors and engaged in a school health program that incorporated input from the school nurse, as well as involvement of catering staff, in order to help empower children to choose healthier food options. Even with a multi-component program, our study did not find any statistically significant change in BMI z-score measures. This may be because physical activity was very low in this population and the campaign did not focus on increasing activity levels. Also, as part of the campaign, there was not a focus on involving parents, who ultimately have the main responsibility for a child's nutrition.

It is well known that achieving weight loss entails more than just acquiring healthy habits and would require not only longer duration but also a consideration of shifting macro components of diet (less carbohydrates, more healthy fats etc.) but also a more discriminating attitude toward the kinds of fruits and vegetables that should be consumed (e.g., coconut and avocados vs. mangoes and bananas). The consumption of fruit and vegetables could also be improved by having variety in the diet and options available. Izumi and colleagues found that liking for foods not tried before increased if children tried different fruits and vegetables [27]. For example, they showed that rutabaga was liked by more children post-intervention than pre-intervention (78.1% *vs.* 44.2%, P=0.004). Incorporating fruit and vegetable tasting sessions into future campaigns may enhance healthy eating outcomes and could be a technique to incorporate in future intervention studies [26].

Although the campaign did not focus on improving physical activity, the prevalence of sedentariness in this population was high, with no vigorous or very vigorous activity undertaken. Physical activity has been identified as important for the health of children and is recommended as a normal part of growth and development. Zimmo et al. recently conducted a study on physical activity in elementary school students in Qatar, and found that students spent on average 58.1 ± 8.4% of school time on sedentary activities, and only 39% reached the recommended school-based moderate to vigorous physical activity of 30 min or more per day [28]. An epidemiological study of adults in Qatar found that physical activity, measured through monthly average steps taken, decreased as temperature increased during hotter months, and steps increased in the winter months as the temperatures cooled [29]. The environment itself in Qatar enforces an inactive lifestyle due to extreme weather conditions where humidity is high and temperatures can reach up to 50°C, which is likely to contribute to a positive energy balance. Future interventions should consider how the hot climate in Qatar affects physical activity behavior, and will need to provide ideas and opportunities for more indoor activities.

The environment, which includes family, friends, school, community and policy, supports or hinders behavior according to the social ecological theory [30]. Various family and social factors, such as eating together, and parental behaviors and attitudes, can influence children's eating behaviors. In order to have a significant impact on the dietary habits of schoolchildren and prevent childhood obesity persisting into adulthood, it is important to engage more with parents/guardians and people in charge of cooking at home from an early stage. Also, more than 20% of children aged between 2-5 years old, before starting the schooling system, are at risk of being overweight or obese [31]. Therefore, it would be beneficial to have campaigns with more emphasis on the community so that families are educated on the benefits of a healthy lifestyle early on and are more involved in reinforcing this out of the school environment.

Lachat et al. [32], in a systematic review on eating out of home, observed that eating out of home was associated with a higher total energy intake, energy contribution from fat in the daily diet and higher socioeconomic status. Our study found that the children regularly ate take-away foods (a little was reported by 64.5% and a lot by 15.6%) and fast food (a little was reported by 59% and a lot by 18.9%), indicating unhealthy dietary practices.

Our study benefits from a large sample of elementary school-aged children in Qatar, provides a comprehensive overview of body composition, self-reported dietary habits and objective measures of physical activity. However, we acknowledge a number of limitations. First, the campaign was evaluated over a relatively short period of time due to the academic school calendar. Future studies should focus on a longer time period. Second, our study relied on subjective information pertaining to dietary intake from relatively young children, which may be subject to biases such as recall and/or social desirability bias. Third, there was a large reduction of available accelerometry data post-intervention and reasons for this were either non-return of the device, non-usable data, or refusal to wear the device. This loss to follow-up may have biased the physical activity data. However, it should also be noted that less emphasis was placed on the physical activity aspect of the campaign. Finally, the campaign was not randomized. Future studies should look at applying the campaign in different schools in a cluster randomized controlled trial, in order to evaluate the effectiveness of the campaign.

Conclusion

We observed several changes that support the further development and testing of the school campaign in Qatar. The findings are supportive for the extension of the campaign, with additional components such as community involvement and greater emphasis on physical activity and to other schools with further evaluation.

Author Contributions

ST designed the study and the evaluation plan. SMC, TA, OO, OC, and ST contributed to study conduct and analysis. NAR designed and managed the lifestyle campaign. All authors critically appraised and approved the final manuscript.

Human Subjects Approval Statement

The study was ethically approved by the joint institutional review board of Hamad Medical Corporation and Weill Cornell Medicine - Qatar (14-00144) and was also approved by Qatar's Ministry of Education.

Disclosure of Interests

The authors declare that they have no conflicts of interest concerning this article.

Data are available from corresponding author.

The authors will provide anonymized data on reasonable written request to the corresponding author.

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