



Pattern of Energy Drink Consumption and Associated Adverse Symptoms among University Students

Adeyinka Orimoloye¹, Lisa Hurlock¹, Trevor S. Ferguson²
and Michael G. Lee^{1*}

¹Department of Medicine, The University of the West Indies, Jamaica.

²Tropical Metabolic Research Institute, The University of the West Indies, Jamaica.

Authors' contributions

This work was carried out in collaboration between all authors. Author AO designed the study, wrote the protocol, collected the data and did the initial write up author LH designed the study and reviewed the protocol. Author TSF reviewed the protocol, managed the analyses and reviewed the manuscript author MGL reviewed the protocol, wrote and submitted the manuscript. All authors reviewed and approved the final manuscript.

Research Article

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ABSTRACT

Aims: This study estimated the prevalence of energy drink consumption among students at the University of the West Indies (UWI), and describes the frequency of consumption and associated adverse symptoms.

Study Design: A cross-sectional survey was conducted using a sex-stratified random sample of students residing in the halls of residence at the UWI, in Jamaica.

Place and Duration of Study: The study was conducted at the Mona campus of UWI, between October 2011 and January 2012.

Methodology: A self-administered questionnaire was used to obtain demographic data, use of energy drinks, frequency of use, symptoms associated with use and perception of benefits.

Results: There were 607 participants, consisting of 336 (55.4%) females and 271 (44.6%) males. The mean age was 20.7 years. Jamaicans constituted 80% of responders. Energy drinks were used by 450 participants (74.1%), with 288 (64%) being once weekly users, consisting of 160 males (74.8%) and 128 females (54.2%). There were 20 students

*Corresponding author: Email: michael.lee@uwimona.edu.jm;

(4.4%) who used energy drinks 2-3 times/week, 11 (2.4%) 4-6 times weekly, 3 (0.7%) were daily users. Adverse symptoms experienced were: palpitation in 133 (29.6%), headache in 64 (14.2%), and nervousness in 58 (12.9%). Insomnia occurred in 236 (52.4%) with 129 (54.7%) females and 107 (50%) males. Chest pain was reported by 27 (6.0%) and fainting occurred in 2 respondents. Perceptions reported about the use of energy drinks included, enhanced sport performance, 38.9%, improved academic performance, 60%, and improved sexual performance, 21.8% and improvement in daily activities (both mental and physical), 22.3%.

Conclusion: Energy drink use is common among students on the halls of residence at UWI in Jamaica. Insomnia, palpitation and headache were the most common adverse symptoms, but students perceived benefits in their academic and daily activities.

Keywords: Energy drink; University students; adverse symptoms; Jamaica.

1. INTRODUCTION

The use of energy drinks has significantly increased in Jamaica as has been seen in other countries over the past decade [1]. Red Bull is the leading energy drink in the world with significant annual growth rate for the past several years [2]. In the USA, energy drinks sale topped US\$9 billion in 2011 [3]. Surveys have revealed that energy drinks are consumed by 24% to 56% of adolescents and young adults [3,4]. In a study in college students, 51% of participants reported consuming greater than one energy drink each month [2].

Most energy drinks contain caffeine and a combination of other components, including taurine, sucrose, guarana, ginseng, niacin, pyridoxine, and cyanocobalamin [3,5]. Recently, a number of concerns have been raised with regards to the safety of energy drinks. These concerns have led to a clinical report highlighting the danger of energy drinks and sports drinks among adolescents [6]. In one study, several adverse effects were reported to occur with energy drinks consumption including, nausea and vomiting, tachycardia and elevated blood pressure in patients evaluated in a health care facility. Other symptoms were: jitteriness/agitation/tremors, dizziness, chest pain and bilateral numbness [7]. Cases of caffeine-associated deaths have been reported, as well as cases of seizures, liver damage and kidney failure associated with the consumption of energy drinks [3].

There has been concern with regards to the safety of energy drinks for general consumption and there are implications for public health in young adults. Measuring consumption patterns has largely been done by marketers of energy drinks. In Jamaica, there has been an increase in the number of brands of energy drinks over the past few years but there are no available data on the prevalence of energy drink consumption. There is therefore a need to identify the demographics of young adult energy drink consumption and its effects in Jamaica. This study determined the prevalence of the use of energy drinks among a sample of university students; the patterns of consumption, adverse effects and students' perceptions regarding the benefits of energy drink consumption were also evaluated.

2. METHODOLOGY

The study was a cross-sectional survey of students from the six halls of residence at the University of the West Indies (UWI), Mona campus, in Jamaica. A list of all students residing on the halls of residence at the UWI was obtained. All students were assigned a special

number for sampling purposes and was entered into an Excel file and then imported into Stata[®] statistical software [8]. The Stata[®] software was used to select a sex stratified random sample of participants. Assuming a 10% non-response rate and to allow for students who would be eliminated due to exclusion criteria, 800 participants were selected in order to achieve the desired sample of 675. Selected participants were contacted and invited to participate in the study. The study was approved by the University of the West Indies/Faculty of Medical Sciences Ethics Committee. All participants provided written informed consent.

The instrument for data collection was a self-administered questionnaire. Data obtained included demographics, use of energy drinks, frequency of use, adverse symptoms associated with use and perception of benefits. Questionnaires were issued from October 2011 to January 2012. The questionnaires were distributed by trained student volunteers and nurses who were required to observe all ethical standards. Students were asked to complete and sign a consent form prior to being given the questionnaire. Students were provided with an envelope in which they placed the completed questionnaire. The sealed envelope was then returned to the student volunteers. No identifying information was on the questionnaires.

Students aged 17-45 years old were eligible for participation, as this age range would include the majority of university students but excluding older persons who may be more likely to have chronic illness with symptoms unrelated to energy drink consumption. Exclusion criteria also included individuals with pre existing cardiac disease, endocrine diseases such as thyroid disease and pheochromocytoma. Also excluded were individuals with pre-existing anxiety disorder diagnosed by a physician or on anxiolytics. Participants who were taking prescribed medications such as beta 2 agonists (salbutamol), beta blockers, anxiolytics and antidepressants were also excluded. These exclusion criteria were used as these conditions may be associated with symptoms similar to the adverse effects of energy drinks.

The sample size was computed using Stata[®] statistical software [8]. Estimates for sample size calculations were based on previous studies which report prevalence estimates for energy drink consumption ranging from 24% to 56% and one study among college students reported a 19% prevalence of palpitations among energy drink users [2,4]. Using an estimated 20% prevalence of energy drink consumption (allowing for a prevalence slightly below the reported range 24-56%) and a 2 fold higher frequency of palpitations among energy drink users (9.5% vs. 19%) a sample of 675 would be required to have a power of 80% to detect a two-fold difference in the frequency of palpitations using the traditional level of statistical significance of $P < 0.05$. This sample size would have 88% power to estimate a prevalence of energy drink consumption of 20% with a margin of error of 5%.

Data collected were entered into an electronic database using Excel software and were analysed using Stata[®] statistical software [9]. Means and proportions for participants' characteristics by sex were obtained with comparison of means using t-test and comparison of proportions using the chi squared tests or Fisher's exact test as appropriate.

3. RESULTS

Six hundred and seven (607) of the 800 students returned completed questionnaires resulting in a response rate of 76%. Among the non-responders, 67 persons refused to participate and 134 failed to submit their questionnaires. Demographic characteristics of the participants are shown in Table 1. The final sample comprised 336 females (55.4%) and 271

males (44.6%) males. The mean age was 20.7 ± 2.7 years with no significant difference by sex ($P=0.37$). Jamaicans constituted 80.0% of responders, 12.9% were Trinidadians, 2.8% Barbadians, while the remaining 4.3% were from other Caribbean Islands.

Of the 607 students, 450 (74.1%) reported energy drink consumption and 145 (23.9%) reported that they did not consume energy drinks, while 12 (2.0%) did not respond to the question. Frequency of energy drink use is shown in Table 2. Among the 450 energy drink users, 288 (64%), were once per week users, with females 128 (54.2%) and males 160 (74.8%). There were 20 responders (4.4%) who used energy drinks 2-3 times/week, with females 12 (5.1%) and males 8 (3.7%). Eleven responders (2.4%) used energy drinks 4-6 times weekly including 4 females (1.5%) and 7 males (3.3%). Three (0.7%) were daily users consisting of 2 females and 1 male. With regards to number of cans of energy drink consumed, 83% reported consuming 1-3 cans per week, 2.9% consumed 4-6 cans per week, while only 0.9% reported consuming 7 or more cans per week. Most energy drink users (62%, $n=280$) were between the age of 20 – 24 years (Fig. 1). Redbull® was the most well recognized of the energy drinks with 89% of study participants reporting that they considered it an energy drink. Monster® was similarly identified by 77% of participants and Boom® by 66% of participants. The proportion of participants recognising other drinks as energy drinks is shown in Fig. 2.

The frequency of adverse symptoms among energy drink users is shown in Fig. 3. Palpitations were reported by 133 (29.6%), headache occurred in 64 (14.2%), and nervousness was reported by 58 (12.9%). More than half of the responders reported that energy drink caused insomnia, 236 (52.4%) while chest pain was reported by 27 (6.0%), Fainting occurred in 2 responders after energy drink consumption, both were female.

Table 1. Characteristics of study participant by sex

Characteristic	Male n=271	Female n=336	Total N=607
^a Age (years, mean \pm SD ^b)	20.8 \pm 2.3	20.6 \pm 2.9	20.7 \pm 2.7
Age group (%)			
<20 years	26.6	35.4	31.5
20-24 years	64.9	56.9	60.5
\geq 25 years	5.5	5.7	5.6
Missing	3.0	2.1	2.5
^c Nationality (%)			
Jamaican	83.6	77.0	78.0
Trinidadian	9.3	15.2	12.6
Barbadian	2.6	3.0	2.8
Other	4.5	4.8	4.6
Energy drink consumption ^d (%)			
Consumed energy drink*	79.0 (74.1-83.8)	70.2 (65.3-75.1)	74.1 (70.6-77.6)
No energy drink consumption**	18.5 (13.8-23.1)	28.3 (23.4-33.1)	23.9 (20.5-27.3)
No response	2.6 (0.7-4.5)	1.5 (0.2-2.8)	2.0 (0.9-3.1)

* $P<0.05$ for male to female difference; ** $P<0.01$; *** $P<0.001$

^a Age data from 592 participants; 15 participants did not report their age; ^b SD = standard deviation; ^c 604 participants provided data on nationality; ^d 95% confidence interval in brackets.

There were several perceptions reported regarding the use of energy drinks by the responders (Fig. 4). Sixty percent (60%) of participants reported that energy drinks improved academic performance, 38.9% reported enhanced sport performance, 21.8% claimed that energy drinks improves sexual performance whilst 22.3% of the study population reported improvement in their daily activities, both mental and physical.

Table 2. Frequency of energy drink consumption among study participants

Characteristic	Male n=214 n (%)	Female n=236 n (%)	Total N=450 n (%)
Number of days per week ^a			
Once per week	160 (74.8)	128 (54.2)	288 (64.0)
2-3 days/week	8 (3.7)	12 (5.1)	20 (4.4)
4-6 days per week	7 (3.3)	4 (1.7)	11 (2.4)
Every Day	1 (0.5)	2 (0.9)	3 (0.7)
Missing	38 (17.8)	90 (38.1)	128 (28.4)
Number of cans per week ^b			
1-3 cans per week	178 (83.2)	197 (83.5)	375 (83.3)
4-6 cans per week	10 (4.7)	3 (1.3)	13 (2.9)
7 or more cans per week	2 (0.9)	2 (0.9)	4 (0.9)
Missing	24 (11.2)	34 (14.4)	58 (12.9)

^a P < 0.001 for male to female difference; ^b P = 0.13 for male to female difference

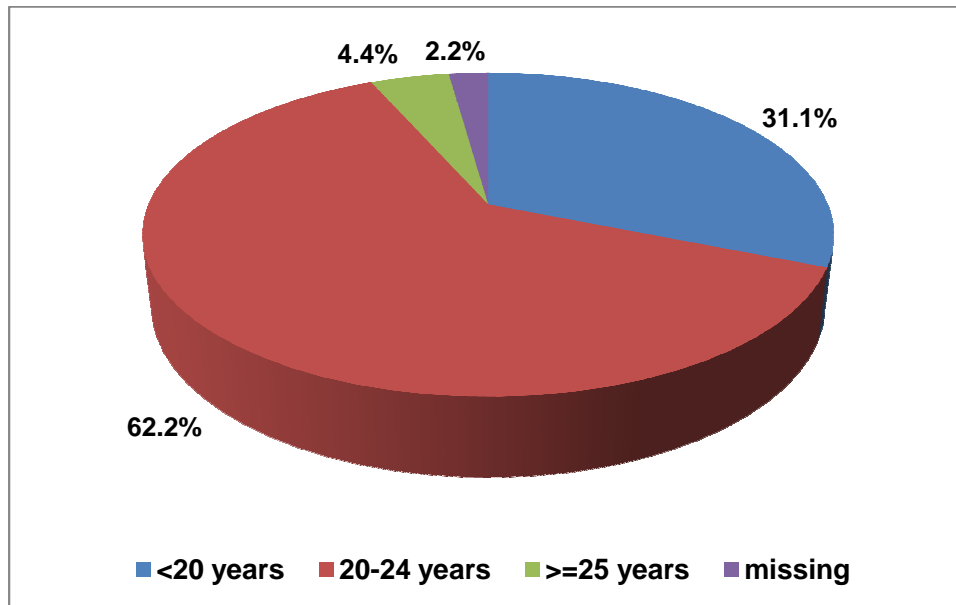


Fig. 1. Distribution energy drink use by age category

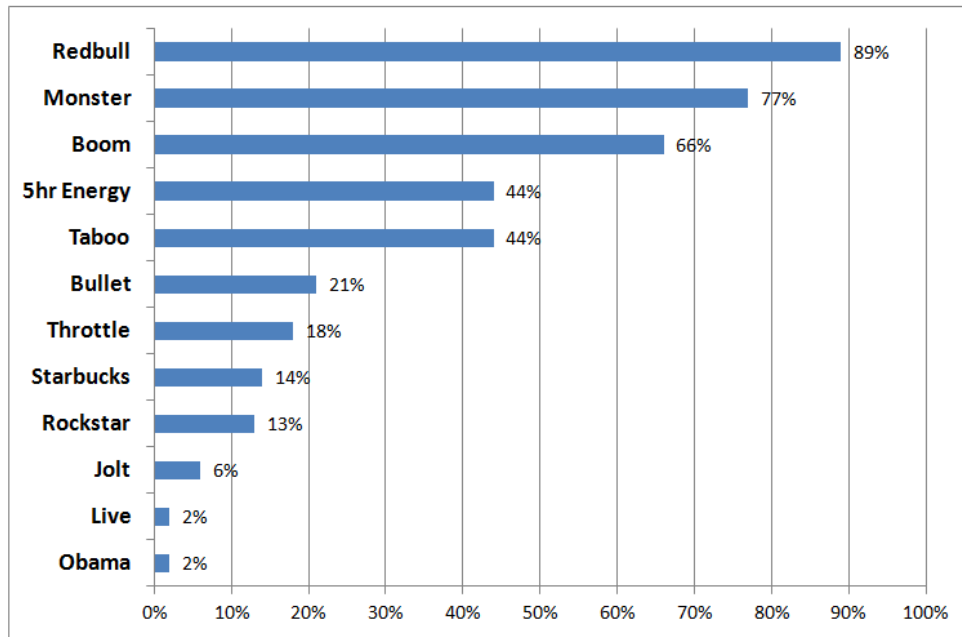


Fig. 2. Proportion of study participants who recognised given drinks as energy drinks
Boom® is a locally produced energy drink.

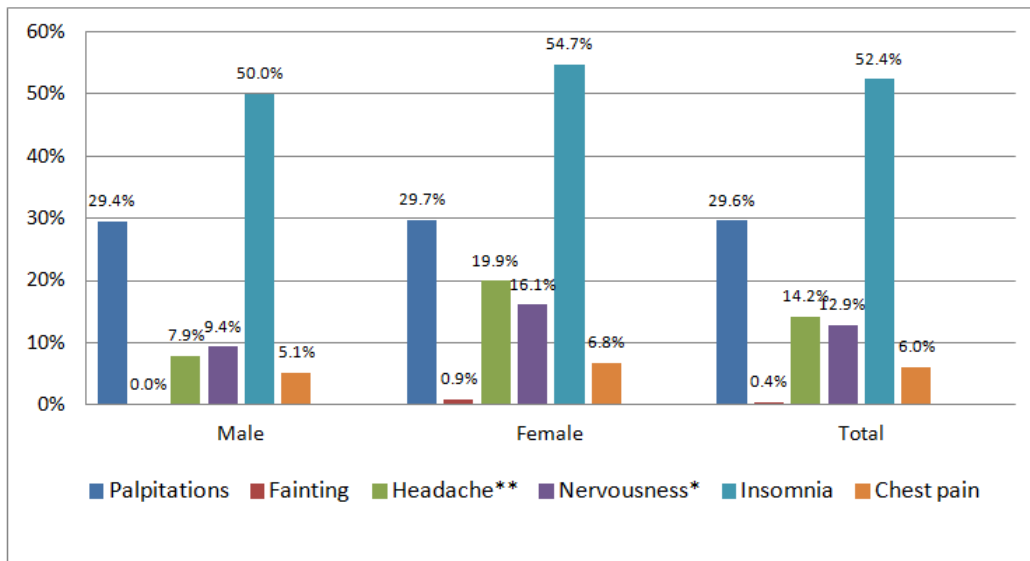


Fig. 3. Frequency of symptoms post energy drink consumption for males, females and all participants

* $p < 0.05$; ** $p < 0.01$ for male: female difference

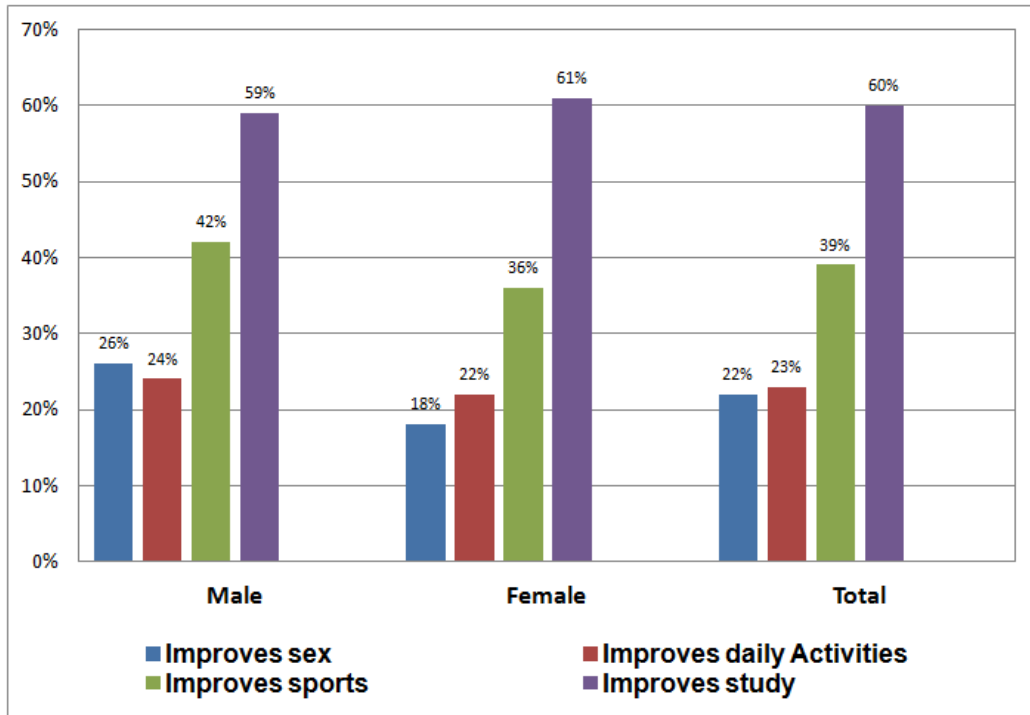


Fig. 4. Perception of benefits of energy drink for males, females and all participants

4. DISCUSSION

The energy drink market has grown exponentially worldwide over the past decade and hundreds of different brands are now marketed, with varying caffeine content [1]. Regulation of energy drinks, including content labeling and health warnings, differs across countries [1]. The absence of regulatory oversight in many countries has resulted in aggressive marketing of energy drinks, especially to young adults [1,10]. Energy drink consumption by university students in the present study population was high (74%) compared to 51% in a previous study conducted in similar populations in the U.S.A and 57% in Italy [2,11]. The UWI student population is similar to the student population at other universities in Jamaica as they all admit students age 17 years and older from all parts of Jamaica. The ethnicity in Jamaica is relatively uniform consisting of over 90% with African descent of low to middle income.

As with any pharmacologically active substance, energy drinks may be associated with adverse effects in healthy individuals. Commonly reported adverse effects seen with energy drinks are insomnia, nervousness, headache, and tachycardia [10]. In another study in college students, 29% of energy drink users reported "weekly jolt and crash episodes", 22% reported headaches, and 19% reported heart palpitations from drinking energy drinks [2]. In the present study, the most common symptom with energy drink use was insomnia, occurring in 55% in females and 50% in males. The prevalence of insomnia in the population was reported by 37.2% of respondents in France and Italy, 6.6% in Japan, and 27.1% in the USA [12]. Excess consumption also can increase sleep problems and daytime sleepiness, which can impair performance. In a report in army troops, service members drinking three or more energy drinks daily were significantly more likely to report sleeping less than 4 hours a

night on average than those consuming two drinks or fewer. Also, those who drank three or more drinks daily were more likely to report sleep disruption related to stress and illness and were more likely to fall asleep during briefings or on guard duty [13]. Caffeine has been demonstrated to increase the number of awakenings during sleep, sleep latency (the time to onset of sleep), and sleep interruptions [14]. The magnitude and long-term effects of caffeine-induced insomnia in young adults are unknown.

Palpitation was the second most prominent symptom (29%) in this study and is significantly higher than the 19% previously reported in another study [2]. The prevalence of palpitation is expected to be lower in the study population as most of the participants are young. The main concern with the use of energy drinks is the effect of adverse cardiac events in individuals with either known or unsuspected heart disease [5]. Patients with preexisting cardiac pathology or a history of seizures may be at greater risk [14]. The role of caffeine in triggering arrhythmia is well established. In the setting of caffeine toxicity, sinus tachycardia is almost always present, and supraventricular tachycardia has been commonly described. Several tachyarrhythmias have been described in caffeine-poisoned patients as well as cardiac arrest and fatalities [10,14-17]. Of particular concern are cardiac ion channelopathies (arrhythmia syndromes) and hypertrophic cardiomyopathy, which are the most prevalent genetic cardiomyopathy in children and young adults, because of the risk of hypertension, syncope, arrhythmias, and sudden death [3].

There were several perceptions in the study population regarding the use of energy drinks including improvement in their academic performances, sports performance, sexual performance and daily activities. These perceptions may be the motivations for energy drink consumption and will likely result in increased energy drink consumption during periods of examination and partying. Energy drinks are advertised for their stimulant effects and several benefits including increased attention, endurance and performance and weight loss. However, the majority of these claims remain to be substantiated [1].

In light of the potential adverse effects of energy drinks highlighted in this study and elsewhere in the literature, we suggest that the following recommendations be considered by all regulatory authorities. There should be safety warnings on the label of energy drinks and the contents should be clearly documented, including precise quantities of caffeine and other ingredients. Recommended use should be limited to no more than 1 - 2 drinks per day in adults [5]. Children under 16 should not be allowed to purchase and consume these drinks [3]. Adults should be warned on the risk of mixing these drinks with alcohol [11]. Patients with known cardiac conditions should be warned not to consume these energy drinks [5].

This study is the first to evaluate energy drink consumption with the Jamaica population and has demonstrated some of the public health issues that may arise from this largely unregulated industry. We acknowledge however that there are some limitations to the generalizability of the findings in that we studied only students living on the campus of one university. The proportion males and females in the sample would be representative of students on the halls of residence from which we sampled but may be a bit different from the overall university sample which had a female to male ratio of approximately 7:3 in 2010. In the general population of Jamaica the female: male ratio is approximately 51%:49%. Further studies will be required to estimate the prevalence and adverse effects of energy drink consumption in the general population.

5. CONCLUSION

In conclusion, the use of energy drinks is common among students on the Mona campus of the University of the West Indies and may be associated with several adverse effects including insomnia, palpitations, nervousness, headache and chest pain. Further studies are needed in our population to explore the effects of energy drinks and further define the adverse effects and long term safety.

CONSENT

All authors declare that written informed consent was obtained from all participants prior to being included in the study.

ETHICAL APPROVAL

All authors hereby declare that the study has been examined and approved by the Ethics committee of the University of the West Indies and appropriate permission was obtained from the University administration.

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COMPETING INTERESTS

The authors have declared that there are no competing interests.

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