

PRIMARY SCHOOL CHILDREN'S NUTRITION KNOWLEDGE, SELF-EFFICACY, AND BEHAVIOR, AFTER A THREE-YEAR HEALTHY LIFESTYLE INTERVENTION (HEALTHKICK)

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Objectives: This study aimed to evaluate the effects of HealthKick(HK), a healthy lifestyle intervention, on nutrition knowledge, behavior, and dietary self-efficacy of school children in the Western Cape Province of South Africa.

Design: A three-year cluster randomized control trial at primary schools in low socioeconomic settings with a baseline study in 2009 and follow-up in 2010 and 2011.

Participants: Participants were Grade four children (n=500) at eight schools in the intervention group and at eight schools in the control group (n=498).

Methods: An action planning process was followed with educators whereby they identified their own school health priorities and ways to address them. Schools were provided with nutrition resources, including curriculum guidelines and the South African food-based dietary guidelines. Children completed a questionnaire comprising nutrition knowledge, self-efficacy and behavioral items.

Results: The intervention significantly improved the knowledge of the intervention group at the first (mean difference = 1.88, 95%CI: .32 to 3.43, P=.021) and second follow-up (mean difference=1.92, 95%CI: .24 to 3.60, P=.031) compared with the control group. The intervention effect for self-efficacy was not significant at the first follow-up (mean difference=.32, 95%CI: -.029 to .94, P=.281) whereas a significant effect was observed at the second follow-up (mean difference=.71, 95%CI: .04 to 1.38, P=.039). There were no significant differences between the intervention and control groups for nutritional behavior scores at any of the follow-up time points.

INTRODUCTION

Over the past three decades, there have been a multitude of school-based interventions aimed at improving lifestyle with regard to nutrition and/or physical activity (PA).¹⁻¹⁵ These interventions have frequently been theory-based and often included a nutrition education component aimed at improving nutrition knowledge,^{2,5,8,14} a physical activity component,^{5,6,14} and/or a food service component.^{2-4,6,11} Some interventions also involved parents or community members.^{4,5,8,9,11,13} Most of the interventions made significant improvements in nutrition knowledge and/or behavior.^{1,2,5,6,14} There is, however, little evidence of interventions published in developing countries; although a num-

ber have taken place in developed countries in low-income settings.^{1,6,9} The lifestyle intervention study, HealthKick (HK) described in this article comprised various components including food and nutrition resources, physical activity, teacher and parental involvement, along with a specific focus on improving the school environment.^{16,17} The intervention was implemented in low socio-economic areas in a lower-middle income country setting.

It was regarded as important to test a nutrition and physical activity intervention at schools in the Western Cape Province since, firstly, physical education was phased out as a stand-alone subject in 2004, and secondly, an earlier study in the province found that school stores (tuck shops) were selling a vast array

Conclusion: The HK intervention improved nutrition knowledge and self-efficacy significantly in primary schoolchildren; however, it did not improve their eating behavior. *Ethn Dis.* 2016;26(2):171-180; doi:10.18865/ed.26.2.171

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of energy-dense foods and beverages high in fat and sugar and low in fiber and micronutrients.¹⁸ The need for such an intervention was confirmed in a recent national study that found that a large proportion of primary school children in South Africa were overweight, and their basic nutrition knowledge was regarded as being poor.¹⁹ For example, 22.3% and 26.3% boys and girls (2-14 years) were found to be overweight (body mass index [BMI] = 25 to <30) or obese (BMI ≥30), respectively in the Western Cape Province.¹⁹ The study further determined that more than 60% of 10 to 14 year old children in this province had a low nutrition knowledge score (mean 1.9, CI 1.70-2.10), falling within a range of 0-2 out of a total score of six.¹⁹ Our study aimed to determine whether nutrition knowledge, self-efficacy and eating behavior in children improved over the three-year healthy lifestyle (HK) intervention.

METHODS

Participants

The HK study comprised 16 eligible schools selected from a representative sample of 100 primary schools surveyed in two conveniently selected education districts (one urban and one rural) in the Western Cape Province during the formative phase of the study.^{16,17} Because of long distances involved in travelling to schools, the two districts closest to the Medical Research Council were selected. The type (located in lower socio-economic areas) as well as the number of schools included in the in-

tervention study was predetermined by the study protocol and the available budget. The eligibility criteria for the selection of the schools was described in detail elsewhere.²⁰ Thirty-five of the original 100 schools were eligible for inclusion in the study. These schools were stratified by 1) site (urban vs rural); 2) poverty level (quintile 1 and 2 vs quintile 3 schools); and 3) school size (schools

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with <100 grade 4 learners vs schools with >100 grade 4 learners). This resulted in seven distinct strata. Due to the small number of schools in each stratum it was decided to make use of manual allocation and four schools were randomly selected from the largest strata (nine schools) and two schools each from the smaller strata by drawing lots. The project coordinator (AdeV) together with a field coordinator (LD) were responsible for the random allocation; this process is described elsewhere.^{16,17,20}

Consent from the principals of

the selected schools was obtained after the random allocation. One school in the largest stratum refused participation; this school was replaced randomly. The selected schools were then randomized to intervention and control arms within each stratum, with the person doing the selection blinded to whether the selected school would be allocated to intervention or control. The project coordinator decided on the allocation sequence before the selection took place. All the schools were located in different educational divisions and very little possibility existed for information to have been shared between parents and school staff from the various participating schools.

In 2009, 1002 Grade 4 children who gave consent in the eight intervention and the control schools participated in this part of the study, ie, anthropometrical, as well as, nutrition knowledge, self-efficacy and behavior assessment. This process was repeated during 2010 and 2011 when the children were in Grades 5 and 6 when 1002 and 1088 children, respectively, participated in the assessment. Children were not followed up as a cohort but 453 children participated in all 3 assessment points. The HK intervention took place between 2009 and 2011.

The Intervention

The HK intervention comprised three phases, with the first phase having been described in some detail elsewhere.^{16,17,20} Briefly, intervention mapping was undertaken as the first phase of the process. The formative assessment undertaken during this phase included a situational analysis

Table 1: Nutrition related material included in the HealthKick toolkit

Toolkit Component	Specific Intervention Material	Specific Content
Educator's manual	Action Planning (APP) material: <i>The HealthKick (HK) Planning Guide</i> Four planning booklets: 1. School Food and Nutrition Environment 2. School Physical Activity and Sport Environment 3. Staff Health 4. Chronic Diseases and Diabetes Awareness Additional material: South African Food Based Dietary Guidelines Planning to Live Healthy: A Guide for School Staff	Content of the "School food and Nutrition Environment" booklet: 1. Tuck shop 2. Vendors 3. Fundraising or foods for special events 4. Lunchboxes 5. Food as a reward for good behavior 6. Nutrition education 7. National School Nutrition Programme 8. Vegetable garden
A resource box	Printed materials supporting the content of the four booklets including brochures from organizations promoting healthy lifestyle and guidelines for implementing vegetable gardens and healthy tuck shops	
Curriculum support document	A curriculum guide for each year of the intervention (Grades 4 to 6), integrating the HK goals with the existing Life Orientation curriculum, developed by an expert in a format familiar to educators.	

of the physical and policy environment of schools related to nutrition and physical activity (PA) of 100 primary schools in two education districts of the Western Cape.¹⁷ Intervention development and implementation took place during phase two; during this phase, a baseline study was conducted in eight intervention and eight control schools to collect basic data (socioeconomic, diet, physical activity, health, and knowledge) on learners, educators, parents, and on the school environment. The data were then compared with the data collected during a first follow up (FU1) and the last follow up (FU2) conducted after three years of intervention (phase 3).

The action planning component of the HK intervention took place immediately following the baseline assessment. This process was based on the framework of the Action Schools! BC (AS! BC) intervention model for schools and educators,²¹⁻²³

and the Centres for Disease Control School Health Index,²⁴ which is a self-assessment and planning guide.

The action planning component involved training educators on how to complete the action planning process (APP) and to equip them with resources to assist them in their task (Table 1). The training was conducted as a one-day workshop provided by the research team. The aim was to guide the designated school staff at the HK schools through a process that enabled them to assess areas for action related to nutrition and PA, identify priorities and to set feasible goals to address these priorities. During the three-year intervention period, the schools were supposed to plan and implement the activities they had identified with the support of the research team. The research team did not carry out the activities for them and it was up to the individual educators to identify priorities and decide when to undertake these.

Only nutrition-related activities and results will be presented in this article. These included: nutrition activities related to developing healthy school nutrition policies; improving tuck shops by making healthier options available; providing nutrition education; encouraging learners to bring healthy lunch boxes to school; encouraging the promotion of healthy foods at special events; and the initiation of vegetable gardens at schools.

To assist schools with implementing strategies selected as part of the action planning process, a toolkit was provided for the educators to use (Table 1). Optional intervention support was offered to the intervention schools in all four action areas during the three years of the intervention. The nutrition-related support took the form of: 1) additional training and assistance with the APP; 2) curriculum and South African Food Based Dietary Guide-

Table 2. Questions included in scores for nutritional knowledge, self-efficacy and behavior

Nutrition knowledge score, total score =29

Food groups	<p>Choose the food group that you should eat the MOST of every day</p> <p>Choose a food group that contains foods with LOTS OF FIBER (roughage)</p> <p>Choose the food group that gives your body the best ENERGY</p> <p>Choose the food group that your BODY uses to BUILD MUSCLES</p> <p>Choose the food group that best PROTECTS THE BODY AGAINST ILLNESSES</p>
Fruit and vegetable	<p>To keep your body healthy, how many helpings of fruit and vegetables should you eat every day? (options given)</p> <p>Why do you think eating fruit and vegetables every day is important?</p> <p>-Because they help our bodies to fight against illnesses like colds and flu</p> <p>-Because they help to protect our bodies against illness such as heart disease and diabetes</p>
Fats and oils	<p>Is it important to eat small amounts of healthy fats and oils because ...</p> <p>-Fats give you energy and keep you warm?</p> <p>-Fats help your body to build muscle?</p> <p>-Fats help you to absorb certain important nutrients?</p> <p>When you eat too much fat you can ...</p> <p>-become fat (overweight)</p> <p>-get high blood pressure when you are older</p> <p>-have a heart attack when you are older</p> <p>-develop diabetes as you get older</p> <p>A series of 8 pictures are provided and the question asked: Which of the following foods contain HEALTHY fats?</p>
Sugar	<p>Eating a lot of sugar, sweets and sweet food...</p> <p>-Is good for health</p> <p>-Can make you fat</p> <p>-Is bad for your teeth</p> <p>-Can cause diabetes</p>
Fiber	<p>Is it important to eat enough fiber (roughage) because...</p> <p>-fiber helps you go to the toilet regularly</p> <p>-fiber protects you against diseases like heart disease and diabetes</p>

Nutrition behavior, total score = 8

Fruit and vegetables	<p>Do you eat vegetables?</p> <p>Do you eat fruit?</p>
Snacks	<p>When you feel like a snack, what do you eat?</p> <p>-Chips</p> <p>-Sweets</p> <p>-Fruit</p> <p>-Sandwich or cereal</p>
Healthy eating before school	<p>Do you eat breakfast before school?</p> <p>Do you bring a lunchbox to school?</p>

Self-efficacy, total score = 12

- Do you think you can make changes to your diet by...
- Putting less margarine on your bread?
- Eating fewer chips?
- Buying fruit instead of chips?
- Putting less sugar in your tea or coffee?
- Putting less sugar on your cereal/porridge?
- Eating sweets less often?
- Drinking cool drinks less often?
- Eating brown bread instead of white bread?
- Eating more vegetables?
- Eating more fruit?
- Can you make your own breakfast?
- Can you get up early enough to eat breakfast at home?

lines (SAFBDG) workshops; and 3) assistance in the form of training and basic resources from the Provincial Department of Agriculture in starting up vegetable gardens. All schools in the intervention arm participated in the SAFBDG workshop while educators from five schools attended the curriculum workshop.²⁵ Furthermore, the research team visited the schools at least quarterly and schools were encouraged to call for assistance/support from the research team at any time. Attempts were also made to include parents in the intervention by arranging meetings with parents. However, attendance at these meetings was very poor.

Knowledge, Self-Efficacy and Behavior Questionnaire

Learners completed a questionnaire assessing their nutritional knowledge, self-efficacy (attitudes) and behavior (KAB). The questionnaire was developed by the research team and was informed by questionnaires from Pathways,⁶ other studies conducted in the Western Cape,²⁶ and a study of applicable text books used in the first four years of schooling of the study participants. The questions included in the questionnaire were informed by the behavior outcomes that were formulated during the Intervention Mapping (IM) process. The English questionnaires were translated into two local languages, Afrikaans and Xhosa. Each learner completed a questionnaire that was administered by trained fieldworkers in the classroom and in the learner's first language.

The questionnaire was first piloted in 2008 in a sample of 717 girls

and boys between the ages of 10 and 12 years. Since the pilot took place in the HK study schools the year before the implementation commenced, the pilot sample did not include any children from the final HK sample. As described in an earlier publication,²⁷ a multiple correspondence analysis was carried out on all questions contributing to the nutritional knowledge and nutritional self-efficacy constructs during the analysis of this pilot data. The Burt matrix approach²⁸ was applied and the percentage of variability in the first two dimensions of each score was assessed. Questions that contributed very little to the variability were excluded and the adapted questionnaire was then used during the HK study. Table 2 shows the nutrition knowledge, self-efficacy and behavior questions that were included in the final questionnaire. The same questionnaire was administered three times over the 3-year intervention period.

Data Analysis

The analysis of this cluster randomized study was done at the school level using summary statistics due to the small number of clusters. The nutrition knowledge and other scores were calculated for learners present in each school at each of the three time points. The mean score was then calculated for each school at each of three time points. The mean difference between baseline and first follow-up in 2010(FU1) and between baseline and second follow-up in 2011(FU2) was then calculated for each school. The nutrition knowledge score changes for both FU1 and FU2 were then

compared between the intervention and control schools using a 2-sample test. The intervention effect and 95% CIs are reported. An unmatched school level analysis was done since the number of schools per arm were small ($n < 10$ schools).

Ethics

Ethical approval for this study was obtained from the Human Research Ethics Committee in the Faculty of Health Sciences, University of Cape Town (HREC REF: 486/2005). In addition, approval for intervention in primary schools was obtained from the Western Cape Department of Basic Education. Parental consent was obtained for learners participating in the study.

RESULTS

Table 3 presents data on changes in knowledge, self-efficacy, behavior and BMI of the children in the intervention and control groups over the intervention period. The mean and standard deviation (SD) knowledge score of the intervention group was 10.8 (3.4) at baseline, 13.1 (3.4) at FU1 and 13.4 (3.4) at FU2. The mean knowledge score of the control group was 12.6 (3.2) at baseline, 13.0 (3.7) at FU1 and 13.4 (3.5) at FU2. The intervention significantly improved knowledge of the intervention group at FU1 (mean difference = 1.88, 95%CI: .32 to 3.43, $P = .021$) and FU2 (mean difference = 1.92, 95%CI: .24 to 3.60, $P = .031$), compared with the control group. The intervention effect for knowledge was a mod-

Table 3. The mean profile and effects of the HealthKick intervention on nutrition knowledge, behavior and self-efficacy

Variable	Intervention, n=500	Control, n=498	Estimated intervention effect	P
NKS	Mean (SD)	Mean (SD)	Mean (95%CI)	
Baseline (2009)	10.8 (3.4)	12.6 (3.2)		
Follow-up 1 (2010)	13.1 (3.4)	13.0 (3.7)		
Follow-up 2 (2011)	13.4 (3.4)	13.4 (3.5)		
	Mean (95%CI)	Mean (95%CI)		
BSL to FU1	2.02 (.84, 3.20)	.15 (-1.11, 1.40)	1.88 (.32, 3.43)	.022
BSL to FU2	2.52 (1.43, 3.60)	.60 (-0.51, 1.71)	1.92 (.51, 3.32)	.011
NBS	Mean (SD)	Mean (SD)		
Baseline (2009)	4.9 (1.6)	5.1 (1.5)		
Follow-up 1 (2010)	4.9 (1.4)	4.8 (1.4)		
Follow-up 2 (2011)	4.4 (1.5)	4.5 (1.5)		
	Mean (95%CI)	Mean (95%CI)		
BSL to FU1	-.11 (-.60, .38)	-.39 (-.60, -0.18)	.28 (-.20, .76)	.226
BSL to FU2	-.52 (-1.03, .01)	-.60 (-.94, -0.27)	.09 (.47, .64)	.743
SES	Mean (SD)	Mean (SD)		
Baseline (2009)	6.3 (1.9)	6.7 (1.9)		
Follow-up 1 (2010)	6.7 (1.8)	6.8 (1.8)		
Follow-up 2 (2011)	6.5 (1.8)	6.4 (1.9)		
	Mean (95%CI)	Mean (95%CI)		
BSL to FU1	.38 (-.19, 1.00)	.06 (-.31, .43)	.32 (-.29, .94)	.281
BSL to FU2	.36 (-.28, 1.01)	-.35 (-.71, .01)	.71 (.04, 1.38)	.039

NKS, nutrition knowledge score; NBS, nutrition behavior score; SES, self-efficacy score; BSL, baseline 2009; FU1, follow-up 2010; FU2, follow-up 2011.

est 16% on overall baseline score.

The mean self-efficacy score of the intervention group was 6.3 (1.9) at baseline, 6.7 (1.8) at FU1 and 6.5 (1.8) at FU2. The mean self-efficacy score of the control group was 6.7 (1.9) at baseline, 6.8 (1.8) at FU1 and 6.4 (1.9) at FU2. The intervention effect for self-efficacy was not significant at FU1 (mean difference=.32, 95% CI: -.29 to .94, $P=.281$), whereas a significant effect was observed at FU2 (mean difference=.71, 95% CI: .04 to 1.38, $P=.039$). There were no significant differences between the intervention and control groups for nutritional behavior scores or BMI at any of the follow-up time points.

Table 4 indicates that in 2009, 30% of children in the intervention group and 26% in the control

group were overweight or obese.

In 2011, 27% in the intervention group and 34% in the control group were overweight or obese.

DISCUSSION

Overall, the HK intervention showed a significant improvement in children's nutrition knowledge and self-efficacy, but not in nutritional behavior. The intervention effect achieved in knowledge was from a low baseline and was a modest effect (16% on overall baseline score). This effect was achieved within the first year of intervention and sustained for two years. There are various components of the HK intervention that could have contributed to this increase in knowl-

edge, with the adapted Life Orientation curriculum and greater teacher awareness and knowledge of basic nutrition principles being the most likely influence as described in earlier HK publications.^{20,29}

Three primary school interventions apart from HK have been evaluated in South Africa.³⁰⁻³² One of these was undertaken by Jacobs et al³⁰ in Grade 4 learners in the Western Cape, where an existing and ongoing intervention was evaluated. Four intervention and five control schools were randomly selected from two school districts. The nutrition curriculum component of the intervention used a modular approach (small bits of information presented at a time) and while these were delivered by educators, dietitians also gave additional talks

on various nutrition topics. This is in contrast to the HK intervention where educators undertook actions on their own according to priorities identified by them during the action planning process. The study by Jacobs et al³⁰ showed a small but significant improvement in nutrition behavior with more participants eating vegetables and bringing lunch boxes to school. However, there was no significant improvement in nutrition knowledge or in self-ef-

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ficacy, in contrast to the HK study.

A nutrition education intervention was implemented at a school in a peri-urban area in the Vaal area of South Africa and compared with a control school in a similar area.³¹ In the intervention school, weekly nutrition education sessions, based on the SAFBDG,²⁵ were conducted after school over a period of nine weeks with children aged 9 to 13 years. Nutrition knowledge of the children in the intervention group improved significantly ($P<.001$) after the intervention with

Table 4. Weight status^a of learners over the three-year intervention period, %

	Intervention			Control		
	Boys	Girls	Total	Boys	Girls	Total
Year 1	n=242	n=261	n=503	n=232	n=267	n=499
Severe thinness	1	0	1	0	0	0
Thinness	2	4	3	3	3	3
Normal weight	62	69	66	74	69	71
Overweight	9	9	9	6	13	10
Obese	26	17	21	16	15	16
Year 2	n=236	n=290	n=526	n=233	n=314	n=547
Severe thinness	0	1	1	0	1	1
Thinness	6	4	5	3	2	3
Normal weight	77	71	74	80	70	74
Overweight	8	11	10	6	15	11
Obese	9	13	11	11	11	11
Year 3	n=213	n=320	n=533	n=256	n=299	n=555
Severe thinness	1	1	1	2	1	1
Thinness	3	3	3	6	4	6
Normal weight	70	68	69	58	62	60
Overweight	6	12	10	9	13	11
Obese	20	15	17	25	20	23

a. BMI WHO cut-offs: severe thinness: WHO z-score < -3; thinness: WHO z-score ≥ -3 and < -2; normal weight: WHO z-score ≥ -2 and ≤ 1; overweight: WHO z-score > 1 and ≤ 2; obese: WHO z-score > 2.

a mean score of 45.4% increasing to 58.8%. No significant difference was found in the control group.

The third study by Jemmott et al³² reviewed a health education program for Grade 6 children in the Eastern Cape Province of South Africa. The sample included 17 matched pairs of schools. The health promotion arm of the study included 12 one-hour modules on nutrition, physical activity, alcohol and smoking cessation. The nutrition education component was based on the SAFBDG. After the intervention period, there was a significant improvement in nutrition behaviors regarding meeting the “5-a-day” recommendation ($P<.01$): increased servings of fruit ($P=.003$) and increased servings of vegetables ($P<.001$). Health knowledge (including nutrition) also increased significantly ($P<.001$).

These South African studies all implemented intensive nutrition education programs but raised the question of sustainability. In contrast, HK used a program that was imbedded in the curriculum and educators could decide how to apply it in their teaching. Generally, the SAFBDG were used as a framework for the nutrition curriculum.

A recent systematic review of teaching approaches and strategies that promote healthy eating in primary school children included 12 studies that adopted enhanced curricula approaches (such as provided to Life Orientation teachers in the Health-Kick program) to improve the nutritional knowledge of the children.³³ The authors reported 13 nutritional knowledge outcomes that achieved a statistically significant improvement of $P<.05$ or better. Our findings

support the authors' conclusion that quality curriculum interventions are capable of achieving improvements in learners' nutritional knowledge.

While knowledge and self-efficacy in the intervention arm of HK improved significantly, no similar effect was observed in the behaviors contained in the KAB questionnaire or in the quantified 24-hour recall data reported elsewhere.³⁴ Although some school-based interventions have shown behavior change in similar age groups,^{2,5,6,30,32,35} the low intensity of the intervention, the lack of significant changes in the school environment and the poor involvement of parents as described earlier²⁰ could have hindered children from making changes in their eating behavior. The improvement of nutrition knowledge is, however, an important achievement, and although nutrition knowledge on its own is not sufficient for behavior change, Worsley,³⁶ after a review of the literature, suggests that nutrition knowledge "may play a small but pivotal role in the adoption of healthier food habits."

There were various limitations to our study. The limitations in the implementation process were discussed in detail in a previous publication²⁰ but those that were specifically important to attempts to change the children's nutrition behavior were poor uptake of actions that could have led to healthier nutrition environments at the participating schools and failure to get parents to engage with the program. Furthermore, there was no evaluation of classroom activities and the translational effect of

curriculum and other nutrition-related training and support received by educators across the school has therefore not been measured.

CONCLUSION

The HK study and other studies undertaken in South Africa showed a significant improvement in nutrition knowledge and/or behavior. In view of the increasing prevalence of obesity in children and the high prevalence of non-communicable diseases such as hypertension and diabetes in the South African population,¹⁹ there is a need to address nutrition issues in early childhood. The primary school setting appears to be an accessible place to educate children regarding the importance of nutrition and physical activity. This may mean that the education authorities have to re-assess how the latter are introduced into the school curriculum. All the studies examined have tried to change children's knowledge and behavior regarding nutrition on an extra-curricular basis and usually by having outside facilitators. In contrast, HK managed to achieve a modest improvement in children's knowledge and self-efficacy through a multicomponent program including a curriculum component embedded in an existing learning area. Our findings provide some evidence that nutrition knowledge and self-efficacy in children could be improved with a program mostly driven by school staff but with specific guidelines on how to integrate it with the curriculum. The HK intervention, however, did not improve eating behavior in

the children pointing to a need for more effort to get parents involved and creating healthier food environments in and around schools.

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CONFLICT OF INTEREST

No conflicts of interest to report.

AUTHOR CONTRIBUTIONS

Research concept and design: de Villiers, Steyn, Draper, Hill, Lambert, Lombard; Acquisition of data: de Villiers, Steyn, Draper, Hill, Lambert; Data analysis and interpretation: Steyn, Draper, Gwebushe, Lambert, Lombard; Manuscript draft: de Villiers, Steyn, Draper, Hill, Gwebushe, Lambert, Lombard; Funding acquisition: Lambert; Statistical expertise: Steyn, Gwebushe, Lambert, Lombard; Administrative: de Villiers, Steyn, Draper, Hill; Supervision: de Villiers, Steyn, Draper, Lambert

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