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Determining nutritional status and food intake patterns of pre-school children in Empangeni, South Africa

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Abstract

The major goal of the assessment was to establish the prevalence of child malnutrition in two sampled pre-schools, in order to determine the resources and approaches required for an appropriate response to the concern, and with a view to finding sustainable solutions. The means of anthropometric measurement tools concurrently with socio-demographic and food frequency questionnaires were applied in conducting the survey to evaluate the food intake patterns of the 1-3 year old pre-school children. The cross-examination of the pre-school cycle menus was analysed. The combined results of the tools applied in data collection were also used to classify nutrient deficiencies of the sample group as well as detecting specific dietary requirements comparing with the World Health Organisation's standards. The findings of the assessment showed that malnutrition was prevalent among the 1-3 year olds in the sampled pre-schools and that these conditions resulted from persistent household and pre-school food insecurity in quantity, quality and diversity. The food intake patterns were inconsistent as in some instances children consumed either high or low intakes of macro or micro nutrients and that consumption habits were incompatible with required nutrient RDAs per child. The ultimate objective of the assessment was to form the core for implementing a more in-depth experimental study aimed at scientifically developing novel food products out of integrating traditional and modern processed foods. The researcher's primary objective is to improve the pre-school feeding menus in the hope of adding value to the nutritional status of the target population.

Keywords: Pre-school children, dietary intake, malnutrition

Introduction

Worldwide, food costs impact most deeply on the poorest populations of developing nations. The Action Aid G8 Blog Summit meeting in Hokkaido, Japan, observed the worsening global food crisis against the growing number of people facing hunger (Sterns 2008:2). South Africa is a multi-ethnic and multi-cultural country in which the majority of the population is shifting from traditional rural to urban modernised lifestyles. These changes are inter-related with and impact directly or indirectly on nutritional status. As such, they are partly responsible for differences in health and nutritional status between rural and urban South Africans. Concurrently, this transition brings about changes in the nutrient intakes, dietary patterns and physical activity levels, as well as changes in education and socio-economic status of the two communities(Vorster 2010:2).

Most nutrition-status surveys have singled out the unacceptably high frequency of insufficient dietary intake of essential micronutrients such as vitamin A, iron and iodine in children (Labadarios, Dhansay & Hendricks 2008:253; Vorster 2010:2). Section 28 (1) (C) of the South African Constitution makes provision for all children to have access to indispensable food (Berry & Hendricks 2009:1). Every year in South Africa 20 000 children die before reaching the age of one month and seventy-five thousand children die before reaching their fifth birthday (Klugman 2011:1).

The far-reaching impact of gross food insecurity among households in South Africa also affects pre-school children, retarding the nation's long-term plans for human resources capital development. Ultimately, the malnutrition status of the nation's pre-school children, let alone the Southern African Development Community (SADC) Region, has adverse implications for socio-economic planning, development and empowerment strategies (Altman, Hart & Jacobs 2009:5).

With a view to mitigating malnutrition and disease caused by hunger and food insecurity among pre-school children and households, the researcher was motivated to investigate the feeding habits and determine the nutritional status of children attending crèches and pre-schools where after, potential solutions could be investigated in a holistic and integrated approach combining both traditional and modern food sciences.

Materials and Methods

In South Africa, several studies on the nation's nutritional status have been conducted since 1995 (Labadarios *et al.* 2008:135). Numerous studies have all highlighted the prevalence of household food insecurity and lack of balanced dietary intake among children. The surveys included the Socio-Demographic Questionnaire (SQ), which was used in assessing the kind of family backgrounds to which the pre-school children or target population belonged. The Food Frequency Questionnaire (FFQ) was used to review the week-long eating habits of households in retrospect in order to assess the food frequency consumption of the families who nurtured the sampled population of the children aged 1-3 years attending the pre-schools. The cycle menus used at the pre-school were analysed at Durban University of Technology (DUT) and compared with the Estimated Average Requirement (EARs). Mean/EARs x 100 was the formulae used for calculation in the comparison. Using the World Health Organisation (WHO) ANTHRO PLUS 2007 software, the anthropometric data, namely height-for-age, weight-for-age and BMI-for age z-scores were assessed. The Z-scores considered to be normal were between -2 and +2 standard deviations. The Z-score of the children were then compared to the existing (WHO 2009:2) growth standards.

Objective

The main aim of this study was to determine the nutritional status and assess the dietary intake patterns of the target population of pre-school children attending both sampled pre-schools in terms of height, weight and age, as well as the children's households, applying anthropometric measurement instruments and survey questionnaires (SQs) and evaluating the menus used in the pre-schools. The results would allow the researcher to ascertain whether malnutrition existed and, from the data collected, determine approaches for improving the dietary intake in pre-schools through integrating traditional and modern processed foods, in order to reduce hunger, malnutrition and disease.

Research method and design

The common method used by the researcher in the survey to assess the dietary intake, nutritional status and health and livelihood conditions of a population or a group of people is the comparative study where a cross-sectional survey is conducted. This type of quantitative study design includes socio-demographic and food frequency questionnaires as well as anthropometric measurements. The research method used at the two pre-schools was an experimental design.

Sampling

All the data were collected at the two pre-schools and at households where the target population of children aged 1–3 and 4-5 years and attending the respective pre-schools resided. The following formula was used to determine the study population:

$$SS=\frac{Z^2X\ (p)\ X\ (1-p)}{}$$

$$= \frac{1.96^2 X (0.5)(0.5)}{0.15^2} = \frac{3.8416 \times 0.25}{0.0225} = \mathbf{42}$$

Where:
Z=Z value (e.g. 1.96 for 95% confidence level)
P= percentage picking a choice, expressed as decimal (.5 used for sample size needed of variables)
C= confidence interval, expressed as decimal (e.g., 0.14^2)

A pilot group of 4–5 year olds was randomly selected from the two pre-schools and a purposive sample of 42 subjects, which included all the children aged 1–3 years with completed consent forms, was also selected from the two pre-schools in Empangeni.

Materials

The researcher selected the Survey Questionnaires (SQs) in consultation with supervisors. The apparatus used in the study consisted of socio-demographic, food frequency SQs, anthropometric measurements and the menus were analysed at Durban University of Technology (DUT) and compared with the Estimated Average Requirement (EARs). DUT provided the tested and validated questionnaires, namely, socio-demographic and food frequency SQs, including anthropometric measurement forms which were employed as tools for the field study and relevant for use within the KZN Province. The digital scale and stadiometer were provided by the University of Zululand.

Socio-demographic questionnaire

Socio-demographic variables are repeatedly used as poverty indicators, as poverty is seen as the major contributing factor to malnutrition. A pre-tested and validated socio-demographic questionnaire (Napier 2006:71) was used in assessing the socio-economic status of the targeted population. The socio-demographic questionnaire included questions on personal information, accommodation and family composition, work, economic and income status. Also included was money spent on food per month, education, language and household assets. Fieldworkers assisted the guardians in the completion of the questionnaires where necessary to improve the understanding of the questionnaire.

Food Frequency Questionnaire (FFQ)

The FFQ reviews the intake frequency of the group per day, per week or per month, according to Margetts and Nelson (1997:139-140). In this study the seven-day (7-day) record of nutritional consumption was recorded. Fieldworkers were trained to explain and calculate the approximate weight of food prior to intake and to document the surplus. The FFQ is based on the 9 nutritious food groups as identified by the United Nations Food and Agricultural Organisation (FAO). The instrument is used to identify the Food Variety Score (FVS) and Food Group Diversity Score (FGDS) as consumed by a group of people (Oldewage-Theron & Kruger 2010:420). Applying the FFQ enabled the systematisation in arranging the food consumed by the children into groups of similar nutrient components since the tool concentrates on the rate of recurrence in using a certain group of food items. The FFQ enabled the researcher to determine specifically what the sample population in each pre-school ate in the period covered in the assessment while not at pre-school. Calculation and average of the nutritional consumption is done at the end of seven days and measured against the Recommended Dietary Allowance (RDA).

The pre-school cycle menus

The menus were analysed at DUT and compared with the EARs. The dietary intake analysis was characterised according to the following categories:

- The subjects' age group (1–3 years) in months of 12 to 18, 18 to 24 and 24 to 36;
- Macronutrients, minerals and vitamins consumed by the age group;
- Mean average and Standard deviation (SD) per age group; and
- The percentage calculated using the mean/EARs x 100 for comparisons to identify whether malnutrition existed.

Anthropometric measurements

The anthropometric measurements included determining the weight and height of sample respondents in order to calculate the body mass index (BMI) and were taken according to World Health Organisation (WHO) standard procedures. The anthropometric measurements of weight-for-age, and the percentage of the population with weight less than -2SD expected from the international growth reference for child sex and age were calculated to specify malnourished children (Abdulkadir, Sohoni & Agoi 2009:968).

Data analysis

The socio-demographic and FFQs were captured on Microsoft Excel spread sheet and analysed on the Statistical Package for the Social Sciences (SPSS) to enable the researcher to interpret descriptive statistics (frequencies, means, standard deviations and confidence intervals) for these variables. The dietary intake of the cycle menu was analysed and the macronutrients, vitamins and minerals were calculated in EARs while energy was calculated against the Estimated Energy Requirement (EER). Using WHO ANTHRO PLUS 2007 software, the anthropometric data, namely height-for-age, weight-for-age and BMI-for age z-scores were assessed. The Z-scores considered to be normal were between -2 and +2 standard deviations. The Z-scores of the children were then compared with the existing WHO (2009:2) growth standards.

Results

Socio-demographic data

Table 1 indicates that the majority of the respondents (95%) ate meals three times a day with the exception of the young children (1-3 years) who ate at least four times. Only 5% of the respondents had meals twice a day and the child would eat the third meal at the pre-school. Almost all the respondents ate at home except the respondent (2.5%) who ate mostly take-aways because both parents had busy work schedules and frequently ate at home in the evenings and over weekends. Both communities (100%) agree that electricity was the source of fuel used for cooking, lighting electrical appliances and ironing. The majority (37.5%) used stainless steel pots.

TABLE 1: Housing meal consumption patterns

Variables	**n=40**	**100%**
Number of meals per/day	**Frequency**	**Percentage**
2	2	5
3	38	95
Where meal was taken	**Frequency**	**Percentage**
Home	35	87.5
Home/work	4	10
Takeaways	1	2.5

Where children ate most meals	**Frequency**	**Percentage**
Home	40	100
Fuel preparation type	**Frequency**	**Percentage**
Electricity	40	100
Material of pots used	**Frequency**	**Percentage**
Stainless steel	15	37.5
Aluminium	14	35
Cast iron	11	27.5

TABLE 2: Household income and food security.

Variable	**n=40**	**100%**
Total household income per month	**Frequency**	**Percentage**
>2500	32	80%
R1501-2000	8	20%
Not enough money for food	**Frequency**	**Percentage**
Sometimes	5	12.5
Never	30	75
Seldom	5	12.5
Members contributing to household income	**Frequency**	**Percentage**
1	15	37.5
2	24	60
4	1	2.5

As presented in Table 2 the majority of the respondents (80%) disclosed that the monthly income was over R2500 whilst 20% had monthly income of R2000 and less. Virtually all households agreed that maintaining even the least possible food security in the home was difficult. Those respondents earning over R2500 still struggled to keep adequate quantity and quality of food provisions in the home.

Results of food frequency questionnaire

TABLE 3: **Household food access as measured by the Food Variety Score (FVS) and food group diversity (FGDS) consumed over a period of 1 week**

	FLESH GROUP	EGGS GROUP	DAIRY GROUP	CEREAL GROUP	LEGUME GROUP	VITAMIN A-RICH GROUP	FRUIT GROUP	VEGETABLE GROUP
№ OF ITEMS USED	(n=13)	(n=1)	(n=7)	(n=10)	(n=5)	(n=8)	(n=16)	(n=12)
MEAN ±SD	4.26±1.79	1±0	2.10±1.17	5.26±1.76	1.17±0.49	3±1.34	3.35±2.26	6.59±8

RANGE USED	0=3	0=6	0=5	0=1	0=19	0=3	0=3	0=2
BREAK DOWN	1=35	1=34	1=12	1=37	1=7	1=21	1=23	1=40
OF USAGE	2=33		2=2	2=35	2=3	2=30	2=2	2=38
	3=6		3=4	3=22	3=2	3=16	3=8	3=16
	4=5		4=25	4=38	4=14	4=38	4=2	4=39

In table 3, a total of 78 different foods were included by the respondents in the seven day data collection. The food variety score (FVS) mean was 31.25±25.8, indicating the food items consumed by an individual. Group 7 showed to have the most variety with (n=16) food items was for the fruits and juice (group 7). The flesh group followed with a range of (n=13) individual food items, other vegetables were third with (n=12) food items and cereals roots and tubers also showed to have a range of (n=10) food items. The rest of the food groups had individual food items less than 10 as shown above in the range column. The dietary intake results were presented in the food frequency questionnaires to determine FVS as well as dietary diversity (DD). Household food accessibility was measured by the food variety within the food groups consumed in the households (n=40) within a period of seven days at baseline.

The food frequency questionnaire clearly indicates that the children (n=42) consumed inadequate fresh fruit and vegetables in their households. The nine food groups obtainable in the FFQ were used to allocate food variety score (FVS) to assess dietary diversity. The households had insufficient fruits and vegetables which, principally, make available to the body 'vitamins A, B complex and C, iron, iodine, and zinc'. The researcher's view is that as long as most household food is purchased from food outlets, as all respondents (n=40) reported in the FFQ tool, the capacity for ensuring adequate household food security in South Africa will continue to reduce to a very low ebb.

Anthropometric measurements results

This study used the current WHO growth standards to determine the nutritional status of the children (WHO 2009:1-3). As shown in table 4, the anthropometric measurements of weight-for-age, and the percentage of the population with weight less than -2SD expected from the international growth reference for child sex and age were calculated to specify malnourished children (Abdulkadir, Sohoni & Agoi 2009:968).

Among the experimental group of boys and girls (n=42) aged 1-3 years in table 4:

- 2 boys (4.8%) and 1 (2.4%) showed signs of being stunted;
- 1 boy (2.4%) and 3 girls (7.1%) were wasted;
- 1 boy (2.4%) was overweight while 2 girls (4.8%) indicated risks of being overweight at later stages of life; and
- 2 boys (4.8%) and 3 girls (7.1%) were underweight.

However, despite the life-threatening risks, the majority of the children, both boys and girls, had normal height, BMI and weight-for-age compared to WHO standards.

TABLE 4: Distribution of sampled boys and girls based on WHO growth indicators (WHO 2009).

Growth indicators	**Classification n=42**	**Boys (n=25) 60%**	**Girls (n=17) 40%**	**Total %**
Stunting (Height-for-age)				

< -3 SD	Severely Stunted	0	0	**42 (100%)**
< - 2 SD	Stunted	2(4.8%)	1(2.4%)	
	Normal height-for-age	**23(54.7%)**	**16(38.1%)**	
Wasting/Thinness (BMI-for-age)				
< -3 SD	Severely wasted	0	0	
< - 2 SD	Wasted	1(2.4%)	3(7.1%)	**42(100%)**
≥ -2SD &<+1SD	Normal BMI-for-age	**24(57.2%)**	**14(33.3%)**	
Overweight weight-for-age				
> +1 SD	Risk of overweight	0	2(4.8%)	
> +2 SD	Overweight	1(2.4%	0	**42(100%)**
>+3 SD	Obese	0	0	
<+3SD	**Normal weight-for-age**	**24(57.1%)**	**15(35.7%)**	
Underweight weight-for-age				
< -3 SD	Severely underweight	0	0	**42(100%)**
< - 2 SD	Underweight	2(4.8%)	3(7.1%)	
<-2SD	Normal weight-for-age	23(54.8%)	14(33.3%)	

Results of the pre-school cycle menus

Table 5 indicates the mean macronutrient, mineral and vitamin intakes for both pre-schools for 12-36 months old. The energy contribution showed to be ≤100% of EARs, with the exception of the 24-36 months olds at Mhlathuze pre-school (MPS), which was slightly less than ≥100%. Total protein consumption was ≥100% of EARs for all the boys and girls. Carbohydrates for the age 12-18 months from both pre-schools and the 18-24 months at Phumlani pre-school (PPS) was ≤100%. Carbohydrates for the age group of 18-24 months at MPS and the 24-36 months for both pre-schools was ≥100%. Total fibre consumed by the pre-scholars aged 1-3 years was ≤100% of EARs. For most of the minerals consumed, the EARs constituted ≤100% while vitamin consumption for the pre-scholars was ≥100% for MPS and ≤100% for PPS Overall. Swart and Dhamsey (2008:407) observe similar findings for PMS and PPS that 'dietary quality for children in South Africa appears to be a more serious problem as, in general, the micronutrient status of children is inadequate.

TABLE 5: Analysis of the pre-school menus

		MHLATHUZE PRE-SCHOOL						PUMULANI PRE-SCHOOL						
Nutrient	**Unit**	**Mean± SD child 12-18 months**	**% of DRI**	**Mean± SD child 18-24 months**	**% of DRI**	**Mean± SD child 24-36 months**	**% of DRI**	**Mean± SD child 12-18 months**	**% of DRI**	**Mean± SD child 18-24 months**	**% of DRI**	**Mean± SD child 24-36 months**	**% of DRI**	**DRI (EAR)/(AI)** 1-3 years Boys & girls
MACRONUTRIENTS														
Energy	(KJ)	2640 ±720.23	60	3501 ±895.55	79.7	4416.7±36 .46	100	1807.33±4 2.0	41.14	2661.33±2 80.20	60.58	3384.33±3 84.59	77.04	4393 (EER)
Total protein	(g)	14.7±7.42	113.1	23.86±8.3 5	183.5	31.2±2.02	240	5.5±0.2	42.31	14.8±3.50	113.8 4	17.57±4.8 1	135.15	13.0
Total fat	(g)	19.1±0.95	*	22.26±15. 14	*	36.13±5.2 2	*	14.33±0.1 6	*	18.43±4.7 9	*	27.5±5.79	*	*
Carbohydrate	(g)	93.13±30. 29	93.13	123.7±16. 04	123.7	137.03±11 .77	137.0 3	67.7±2.43	67.7	95.03±2.8 5	95.03	113.53±4. 79	113.53	100
Total dietary fibre	(g)	5.83±2.65	30.7	9.86±2.17	51.9	12.86±0.1 6	67.7	1.97±0.15	10.37	6.6±0.53	34.74	7.47±0.68	39.32	19*
MINERALS														
Calcium	(mg)	152±60.67	30.4	123.66±42 .54	24.7	152±50.31	30.4	21.67±058	4.33	82.67±38. 39	16.53	84.33±64. 67	16.87	500
Iron	(mg)	1.87±0.80	62.3	3.63±0.94	121.1	5±0.26	166.7	0.57±0.05	19	2.03±0.29	67.67	2.4±0.35	80	3.0
Vitamin A	(mcg)	47.66±35. 57	22.69	95.5±119. 50	45.48	158±40.73	75.24	117±4.36	55.71	110.33±1. 53	52.53	176.33±3. 51	83.97	210

Ethical considerations

The ethics committee of the Vaal University of Technology approved the study. The protocol was submitted in accordance with the existing policy for research in the institution. The aspect of Intellectual Property Rights is covered in the Letters of Informed Consent. In each letter assurance was made to each crèche and parent that all responses would be kept private and confidential and would be used only for research purposes and for the future benefit of South African pre-schools.

Recruitment procedures

The researcher recruited five University of Zululand students residing at the University. An advertisement was placed on the student noticeboard in the hospitality department, requesting applications from those Zulu-speaking nutrition students who were interested in participating in the research.

Informed consent

One meeting was held with each pre-school association of parents and guardians to discuss the household survey. In each letter of informed consent issued to the guardian, reassurance was made to each crèche and parent that all responses would be kept private and confidential and would be used only for the research and the future benefit of South African pre-schools.

Data protection

Respondents were each allocated a number in place of name during the fieldwork period of the study. These are kept under lock and key at the Vaal University of Technology and can only be accessed by researchers.

Validity and reliability

The stability and accuracy of the instruments employed in this study have frequently been validated in many different investigations relating to nutrition at Durban University of Technology and other Universities such as the Vaal University of Technology. The validated SQs are adaptable for use where all age groupings in different circumstances are sampled, and their application in other countries has also been confirmed in similar studies. In this study all the questionnaires used face validity, implying reliance on the subjective judgement of the researcher (Martín-Moreno, Boyle, Gorgojo, Maisonneuve, Fernandez-Rodriguez & Salnini 1993:512-519).

Discussion

Literature has shown that household food inaccessibility is the dominant cause contributing to child malnutrition. The condition is accentuated by the ever-rising food costs, the global financial crisis and the high rate of unemployment (Sterns 2008:2). These aspects, to a large extent, dictate the child's eating habits by way of controlling the nutritional intake as well as the quantity and quality of food available for both the pre-schools and households to adequately provide for the children (Kuzwayo 2008:164). The findings have also complemented Nyathela's (2009:53) assertion that living standards such as inadequate water, housing, poor sanitation, poor personal hygiene and educational practices also contribute to the menace of malnutrition.

The food frequency questionnaire clearly indicates that the children (n=42) consumed inadequate fresh fruit and vegetables in their households. The households had insufficient

fruits and vegetables which, principally, make available to the body vitamins A, B complex and C, iron, iodine, and zinc.

Out of the target population comprising twenty-five boys (n=25) and seventeen girls (n=17), two boys (4.8%) and one girl (2.4%) were stunted; one boy (2.4%) and three girls (7.1%) were wasted; one boy (2.4%) was overweight while two girls (4.8%) showed the risk of overweight; two boys (4.8%) and three girls (7.1%) were underweight. The results also displayed no indications of children either severely stunted or wasting neither severely underweight nor obese. Globally, however, it is estimated that twenty (20) million children aged less than five years suffer from obesity due to varying dietary intake patterns and to lack of adequate bodily exercises, partially caused by rapid changes in the social order and surroundings (WHO 2006:5-6).

The nutritional consumption of the food groups on the pre-school cycle menus provided macronutrients (energy, protein, fat, carbohydrate and dietary fibre), varied minerals and vitamins. Data analyses showed that energy, calculated in estimated average requirements (EAR), was lower for the 12-18 (41.1%), the 18-24 (60.6%) and the 24-36(77%) at PPS comparing, respectively, with the counterpart age-groupings at MPS recording 60%, 79.7% and 100%. Overall, however, dietary quality for children in South Africa appears to be a more serious problem as, in general, the micronutrient status of children is inadequate (Swart & Dhansay 2008:407).

The anthropometric measurement or body measurements described by UNICEF (2007:1) as stunting or low height-for-age is caused by insufficient nutrient intake and frequent infections. The WHO (2009:1) growth standards were used to measure the BMI indicators according to height-for-age, weight-for-height and weight-for-age. Accordingly, ‘an infant was defined as stunted, wasted or underweight if his or her length-for-age, weight-for-length or weight-for-age z-score, respectively, was less than -2’ (WHO 2009:3).

Out of the target population comprising twenty-five boys (n=25) and seventeen girls (n=17), two boys (4.8%) and one girl (2.4%) were stunted; one boy (2.4%) and three girls (7.1%) were wasted; one boy (2.4%) was overweight while two girls (4.8%) showed the risk of overweight; two boys (4.8%) and three girls (7.1%) were underweight. The results also displayed no indications of children either severely stunted or wasted neither severely underweight nor obese. Globally, however, it is estimated that twenty (20) million children aged less than five years suffer from obesity due to varying dietary intake patterns and to lack of adequate bodily exercises, partially caused by rapid changes in the social order and surroundings (WHO 2006:5-6).

Conclusion

The findings of the study have significant suggestions for nutritional interventions in pre-schools. The results showed a percentage of child malnutrition with symptoms of either inadequate or inappropriate feeding habits among the 1-3 year olds reflecting both at pre-school and household levels. The food intake patterns were inconsistent as in some instances children consumed either high or low intakes of macro or micro nutrients which consumption habits were incompatible with required nutrient RDAs per child. As observed in this study, children aged 1-3 years are the most fragile human beings as the age group is also most vulnerable to malnourishment-related diseases (Klugman 2011:1). Some of the diseases cause instant ill-health leading to immediate death while some ailments gradually retard the intellectual capacities and physical growth of the affected children usually apparent at either adolescence or adulthood stages (DOH 2007:4; Wenhold, Kruger & Muehlhoff 2008:442). Consequently, the malnourished children passing through lifelong phases of growth and maturity will, most likely, become economically, socially and educationally unproductive (Hays & Elee 2006:1). The critical and realistic questions remain questions to answer: what are

children eating and what should they be eating (Boyle & Holben 2010: 365; Bowley & Marino 2012:1).

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