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About the African Journal of Nutrition

Scientific mouthpiece for the African Nutrition Society.
Forum for dialogue on African Food and nutrition challenges.
Showcasing cutting edge research and innovative solutions in nutrition.
A collaborative effort of Africans and the global community.
Highlighting African perspectives on food and nutrition issues.

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Editorial:
Welcome message from Editor-In-Chief
Prof. Paul Amuna

Welcome to the African Journal of Nutrition (AJN). At long last the first volume of our long-awaited African Journal of Nutrition is now out! After two decades of the formation of the African Nutrition Society, the African Nutrition Journal was launched at the 9th African Nutrition Conference in Cape Coast, Ghana on October 11, 2024. This is the culmination of a decades-long vision by a group of African scientists on the continent with their colleagues in the diaspora, and inspired by mentors and eminent nutritional scientists, researchers, teachers and colleagues in the global nutrition community.

This biannual peer-reviewed journal joins other world class journals to provide a platform for sharing academic research going on in Africa. It is the scientific mouthpiece of the African nutrition Society and a forum for dialogue on food systems and nutrition in Africa. The journal will showcase cutting edge research outputs and innovative solutions in nutrition across Africa and globally. It fills a gap by highlighting perspectives on food and nutrition issues from the African perspective, whilst at the same time being all-embracing as a collaborative of Africans and the international nutrition community.

Though long overdue, this first volume seeks to send a clear signal that the AJN is now fully in publication and ready to receive manuscripts on subjects relating to food, nutrition, health and development issues. We recognize the vast number of good original research activities currently ongoing throughout the continent of Africa. The time has come for the nutrition fraternity on the continent to have its own mouthpiece to articulate the nutrition and food security issues as investigated by nutritionists, food scientists, and health development experts across Africa. Though authors may have other avenues to share the results of these studies, AJN provides another option for dissemination. Over the decades, the African Nutrition Society through its biennial conferences across all parts of the continent, has mounted scientific writing symposia, workshops and seminars in order to support especially young scientists to develop skills and competencies in scientific writing for publication. We hope that the beneficiaries of those symposia and workshops will patronise this journal too.

In this first volume, subjects span a range of areas including the socio-cultural, public health and clinical nutrition and food science. Topics covered include: cultural perspectives on breastfeeding; and nutrition support practices in intensive care units in hospitals in Ghana. Others are knowledge and awareness of Type II Diabetes Mellitus among undergraduate students on health-related courses; feeding and nutritional problems in children with developmental challenges in a low-resource setting; and the effects of cooking methods on vegetable nitrates and their implications for blood pressure and lipid management. The lived experiences of patients with type II diabetes making dietary choices during the Covid-19 lockdown as well as dietary diversity and the intake of Iron, Folate, and Vitamin B12 among pregnant adolescents are also covered.

Finally, in this first volume of the AJN, we are especially delighted and privileged to publish the Proceedings of an African Nutrition Society pre-conference Consultative Workshop on School Health and Nutrition held on 5-6 October 2024, University of Cape Coast Ghana. Participants in this workshop included leading experts and advocates in the field of child health, and the school

health and nutrition coalition across Africa and globally. Publishing these proceedings in this maiden edition of the AJN is testament to the seriousness of our intent as a journal to set a high standard of authorship.
We wish to acknowledge the support of the Catholic Relief Services, the major sponsor of the Workshop, and all the eminent persons who participated and have co-authored the proceedings.

We are indebted to our entire editorial team and the peer reviewers through whose hard work and perseverance we have got thus far. Africa and the global nutrition community, here we come! The African Journal of Nutrition is now official! We welcome you to join us to inform, educate and promote Africa's nutrition agenda.

The second volume is currently under preparation and will be out in December 2025. We invite manuscripts from nutritionist, dieticians, food scientists, health and development scientists and those working in the agriculture-nutrition-health interphase our AJN journal for effective and thorough peer review and publication. The OJS for the journal is www.ajn.ansnet.org. Login to the website and register and upload your article. It will be worked on as soon as possible and responses sent to you. You can monitor the progress of your paper on the website.

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Original Research Article
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NUTRITION SUPPORT PRACTICES IN INTENSIVE CARE UNITS (ICUS) IN HEALTH FACILITIES IN GHANA

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Key words: Knowledge, Awareness, Undergraduate students, Diabetes mellitus, Attitude

Abstract

Introduction: Hospital Malnutrition has a direct impact on high death rates and increased healthcare expenses worldwide. Malnutrition in critical care units can be prevented with effective nutrition support, however, under prescription and under feeding, lack of protocols and guidelines and poor competences of the health staff are challenges that impede its effective implementation. Globally, evidence on nutrition support practices is not frequently reported.

Objective: To assess nutrition support practices and systems in ICUs in Ghanaian hospitals.

Methods: A cross-sectional study was conducted in 17 health facilities across Ghana. A total of 137 participants which included dietitians, doctors and nurses were recruited to participate in the study. Data were collected using structured questionnaires and analysed using SPSS software version 23.0. Descriptive statistics were used to summarize data and Pearson's Chi-square was used to determine the association between categorical variables and statistical significance was set at $p<0.05$

Results: The study had a response rate of 86.1%. Majority of the respondents (n= 110, 93.2%) worked in public hospitals and were based in Greater Accra region. The majority of respondents (51, 43.2%) indicated that they were unaware of the existence of a nutrition support protocol. Only 22.0% (26) of the respondents reported having an official nutrition support guideline or protocol in their facility. More than half of the respondents (54.9%) indicated that their facility had a formal nutrition support team. There was a significant association between the presence of formal nutrition support guidelines and the existence of a nutrition support team (95% CI: p=0.001).

Conclusion: It is imperative for stakeholders to urgently review the current state of nutrition support practices, and plan for institution of effective nutrition support teams, written guidelines and the provision of appropriate resources for nutrition assessment in critical care settings.

INTRODUCTION

Globally, hospital malnutrition is a significant issue in health institutions, often linked to high mortality and morbidity, functional decline, prolonged hospital stays, increased healthcare costs, and the overburdening of already limited resources (Corkins et al., 2014). However, the effects of hospital malnutrition can be mitigated or prevented through routine patient screening and the identification and provision of necessary nutrition support (NS).

According to McDougall (2015), nutrition support should be managed by a multidisciplinary team due to the complex nature of caring for critically ill patients. Bhagavatula & Tuthill (2011) further emphasize that early involvement and intervention by a Nutrition Support Team (NST) can prevent and treat malnutrition through appropriate nutritional interventions, aiding in the early identification and prevention of infections. Nutrition support team members have historically played varied roles in patient care, often relying on positive clinical outcomes as the gold standard for assessing their effectiveness (ASPEN Practice Management Task Force et al., 2010). However, nutrition support in many intensive care units (ICUs) face challenges such as under-prescription and underfeeding, lack of protocols and guidelines, and poor competencies among health staff (Marshall et al., 2012).

Evidence on nutrition support practices is not frequently

reported. A study in Europe highlighted inconsistent nutrition support practices and compliance with published guidelines across hospitals (Roynette et al., 2008), while a study in South Africa reported inconsistencies in the administration, delivery, and monitoring of nutrition support among clinicians (Hill, 2015). Consequently, there is limited documented data on nutrition support practices globally, in Africa, and specifically in Ghana. This study, therefore, aims to investigate nutrition support practices in Ghana.

METHODS

Study Design, Setting, and Participants

A cross-sectional study was conducted in 17 health facilities across Ghana. The selection process for these facilities was as follows: a list of all dietitians in Ghana was obtained from the Ghana Dietetic Association (now Ghana Academy of Nutrition and Dietetics) register in June 2018. Dietitians were contacted to identify those working in hospitals that offered nutrition support. Those involved in nutrition support were then selected. With their assistance, other health professionals involved in nutrition support within the facility were also identified. The study population included dietitians, doctors, and nurses working in health facilities that offered nutrition support at the time of recruitment. A total of 137 participants were recruited from these 17 health facilities, which comprised 13 public hospitals (5 teaching hospitals, 5 regional hospitals, 1 military hospital, 1 paediatric/children's hospital) and 4 private hospitals.

DATA COLLECTION PROCEDURES

A structured questionnaire, adapted from the South African study by Hill (2015), was validated and used to collect data from participants. The questionnaire was distributed either by email (for participants in remote areas) or via hard copy, which was hand-delivered to respondents and collected after completion. The questionnaire gathered demographic data about the hospitals, including their classification, bed capacity, and the number of dietitians. It also collected information on the profiles of health professionals, their areas of specialty, the presence of a nutrition support team, and the existence of nutrition support guidelines or any documented policy documents used in the facilities. Additionally, data on nutrition support practices, as well as the assessment and monitoring of nutritional status, were collected.

DATA ANALYSES

Data were entered into and analysed using SPSS software version 23.0. Descriptive statistics such as mean, standard deviation, frequencies and percentages were used to summarize data. Pearson's Chi-square was used to determine the association between categorical variables and statistical significance was set at $p<0.05$.

ETHICAL CONSIDERATIONS

Approval for the study was obtained from the Ethics and Protocol Review Committee of the College of Health Sciences, University of Ghana with protocol identification number - CHS/Et-M.7- 4.8/2018-2019. Written permission and ethical clearance were also obtained from the hospitals. Informed consent was sought from participants before they were recruited into the study. Participants' involvement in the study was solely voluntary.

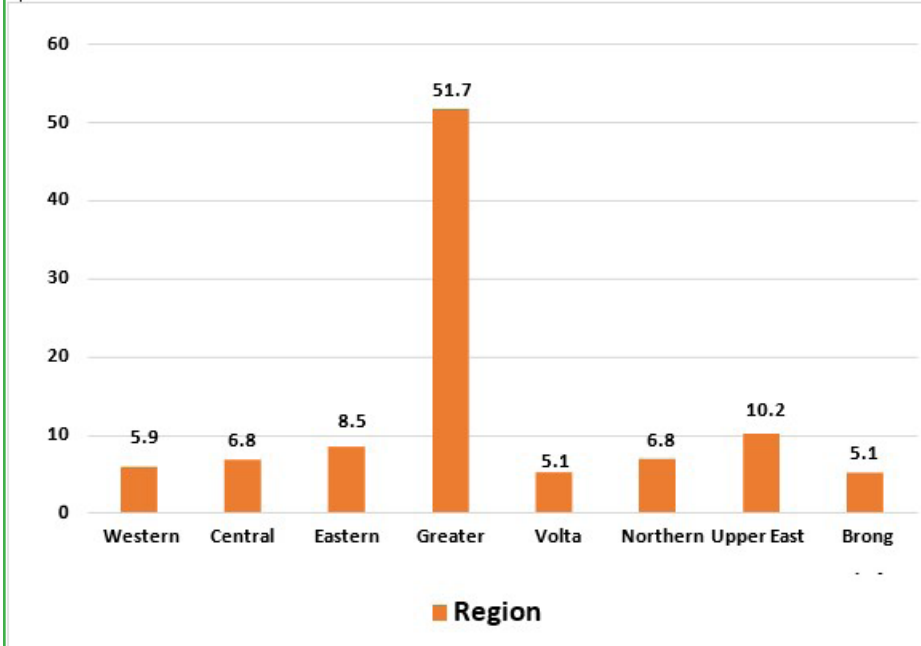
RESULTS

Table 1 presents the background characteristics of health professionals and hospital demographics. Out of 137 participants from 17 hospitals, 118 completed the questionnaires, resulting in a response rate of 86.1%. Most respondents (n=110, 93.2%) worked in public hospitals, with 41.5% (n=49) being nurses. Majority of respondents (n=78, 66.0%) were employed in the medical unit of their facility. Approximately half of the respondents (51.7%) were based in the Greater Accra region, followed by the Upper East region (10.2%) and the Eastern region (8.5%) (Figure 1).

Table 1: Respondent Characteristics and Hospital Demographics (N = 118)

Characteristics	Frequency, n (%)
Hospital Type	
Public	110 (93.2)
Private	8 (6.8)
Bed Capacity	
Less than 100	14 (12.0)
100-500	70 (59.3)
More than 500 but less than 1000	12 (10.2)
Above 1000	22 (18.6)
Specialty Area	
General OPD	56 (47.5)
Surgical	43 (36.2)
Medical	78 (66.1)
Cardiothoracic	1 (9.3)
Neuro	14 (11.9)
Burns	19 (16.1)
Trauma	14 (11.9)
ICU / Emergency	38 (32.2)
Obstetrics and Gynaecology	1 (0.8)
Paediatrics	8 (6.8)
Oncology	1(0.8)
Renal	1 (0.8)
Neonatal ICU	1 (0.8)
Other (Not specified)	4 (3.4)
Profession	
Nurse	49 (41.5)
Dietitian	41 (34.7)
Doctor	28 (23.7)

Figure 1: Distribution of respondents by region



EXISTENCE OF NUTRITION SUPPORT PROTOCOLS

The majority of respondents (51, 43.3%) indicated that they were unaware of or had no knowledge of the existence of a nutrition support protocol. Only 22.0% (26) of the respondents reported that their facility had an official nutrition support guideline or protocol (Table 2).

Existence of a Nutrition Support Protocol	Dietitians n (%)	Doctors n (%)	Nurses n (%)	Total n (%)
No	19 (46.3)	6 (21.4)	16(32.7)	41 (34.7)
Yes	6 (14.6)	4 (14.3)	16(32.7)	26 (22.0)
Not aware	16 (39.1)	18 (64.3)	17(34.7)	51 (43.3)

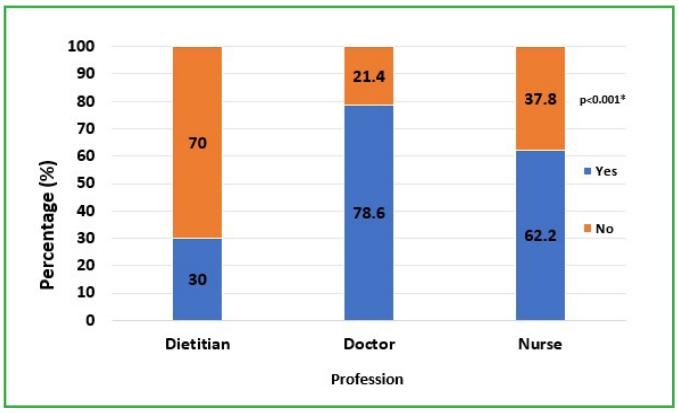


Figure 2: Presence of a formal Nutrition support team by respondents

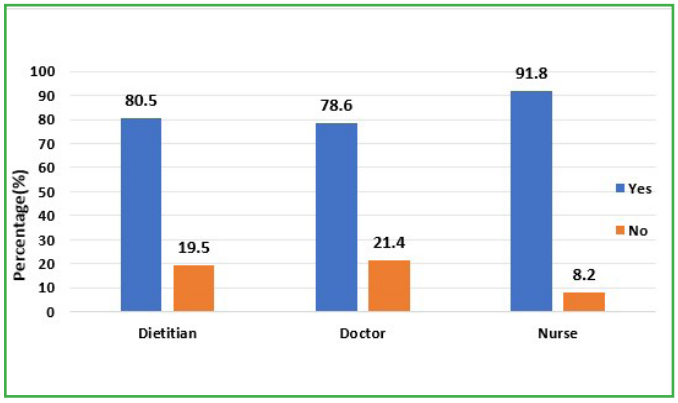


Figure 3: Routine Nutrition Screening Practice

PRESENCE OF A NUTRITION SUPPORT TEAM

Figure 2 shows the responses regarding the presence of a formal nutrition support team. More than half of the respondents (54.9%) indicated that their facility had a formal nutrition support team. Pearson's Chi-square analysis showed a significant association between the presence of formal nutrition support guidelines and the existence of a nutrition support team (95% CI: p=0.001).

NUTRITION SCREENING AND ASSESSMENT PRACTICES

Figure 3 illustrates the nutrition screening practices of respondents. The majority (84.7%) indicated that they routinely screened patients in their facility. Notably, a higher proportion of nurses (91.8%) reported routinely screening patients compared to other professionals.

FIGURE 3: ROUTINE NUTRITION SCREENING PRACTICE

Table 3 provides details about the respondents' nutrition screening and assessment practices. Professionals reported to be primarily involved in nutrition screening were doctors, nurses and dietitians, with dietitians being the majority (n=84, 85.7%). Regarding the tools used, most respondents reported using body mass index (n=95, 80.5%) and the combined nutrition assessment methods (ABCD approach) (n=93, 78.8%) for nutritional screening of patients. Among the professionals, a higher proportion of dietitians (n=32, 78.0%) utilized the combined more-detailed nutrition assessment methods (ABCD approach) in their screening/assessment practices.

Table 3: Nutrition Screening and Assessment Practices

Variables	Dietitians n (%)	Doctors n (%)	Nurses n (%)	Total n (%)
Profession mainly involved in nutrition screening,	**31 (100)**	**22 (100)**	**45 (100)**	**98 (100)**
Dietitian	29 (93.6)	19 (86.5)	37 (82.2)	85 (87.0)
Nurse	1 (3.2)	2 (9.0)	4 (8.9)	7 (7.0)
Doctor	1 (3.2)	1 (4.5)	4 (8.9)	6 (6.0)
Nutrition screening/assessment tools used	**41 (100)**	**28 (100)**	**49 (100)**	**118 (100)**
BMI / Body weight assessment	35 (85.4)	19 (67.9)	41 (83.7)	95 (80.5)
Subjective Global Assessment	7 (17.1)	2 (7.1)	4 (8.2)	13 (11.0)
Nutrition Risk Index	5 (12.2)	2 (7.1)	10 (20.4)	17 (14.4)
Prognostic Nutrition Index	1 (2.4)	0 (0.0)	0 (0.0)	1 (0.8)
Hospital Prognostic Index	2 (4.9)	0 (0.0)	5 (10.2)	7 (5.9)
ABCD Approach	32 (78.0)	14 (50.0)	15 (30.6)	93 (78.8)
Don't know	0 (0.0)	4 (14.3)	6 (12.2)	10 (8.5)
Other (Nutrition Risk Screening Tools)	1 (2.4)	0 (0.0)	0 (0.0)	1 (0.85)

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FIGURE 3: ROUTINE NUTRITION SCREENING PRACTICE

Table 4a outlines the methods used to calculate nutritional requirements and the factors influencing the initiation of enteral feeding. The primary methods employed by participants for estimating patients' nutritional needs were body weight-based methods (70, 59.3%), clinical judgement (59, 50%), and formulas (39, 33.1%). Additionally, more than half of the respondents identified unsuccessful oral nutrition (76, 64.0%) and poor nutritional status (64, 54.2%) as key determinants for starting enteral feeding. Among healthcare professionals, a higher proportion of doctors (17, 60.7%) reported using the presence of bowel sounds as a criterion for initiating enteral feeding.

Table 4a: Factors influencing Nutrition Support Decision-Making of the Respondents (N=118)

Variables	Dietitians, n (%)	Doctors, n (%)	Nurses, n (%)	Total N (%)
Methods of calculating nutritional requirements	**41(100)**	**28 (100)**	**49 (100)**	**118 (100)**
ESPEN/ASPEN or other published guidelines	12 (29.3)	0 (0.0)	6 (12.2)	18 (15.3)
Clinical judgement	26 (63.3)	10 (35.7)	23 (47)	59 (50)
Illness severity	10 (24.4)	5 (17.9)	15 (30.6)	30 (25.4)
Body weight-based methods	30 (73.2)	13 (46.4)	27 (55.1)	70 (59.3)
Formulas	28 (68.3)	3 (10.7)	8 (16.3)	39 (33.1)
Don't know	0 (0.0)	12 (42.9)	11 (22.4)	29 (19.5)
Determinants of enteral feed initiation,	**41(100)**	**28 (100)**	**49 (100)**	**118 (100)**
First day in ICU	2 (4.9)	4 (14.3)	9 (18.4)	15 (12.7)
Low gastric residual volume / aspirate volume	9 (22.0)	5 (17.9)	11 (22.4)	25 (21.2)
Haemodynamic stability	3 (7.3)	7 (25.0)	6 (12.2)	16 (13.6)
Reasonable gastrointestinal function	12 (29.3)	14 (50.0)	16 (32.7)	42 (35.6)
Presence of bowel sounds	8 (19.5)	17 (60.7)	15 (30.6)	40 (33.9)
Low intra-abdominal pressure	0 (0.0)	1 (3.6)	2 (4.1)	3 (2.5)
Reasonable nutritional status	8 (19.5)	2 (7.1)	8 (16.3)	18 (15.3)
Presence of any gastrointestinal symptoms	8 (19.5)	3 (10.7)	6 (12.2)	17 (14.4)
Poor nutritional status of patient	24 (58.5)	15 (53.6)	25 (51.0)	64 (54.2)
Unsuccessful oral nutrition	29 (70.7)	15 (53.6)	32 (65.3)	76 (64.0)

Table 4b: Time of Initiation of Parenteral Nutrition Support (N=41)

Variables	Dietitians, n (%)	Doctors, n (%)	Nurses, n (%)	Total N (%)
Parenteral nutrition support initiation	**9 (100)**	**11(100)**	**21(100)**	**41 (100)**
Mainly within 24 hours of ICU admission	1 (11.1)	3 (27.3)	8 (38.1)	12 (29.3)
As soon as a clinical indication becomes apparent	4 (36.4)	6 (54.5)	9 (42.9)	19 (46.3)
Within 3 days if enteral feeding unsuccessful	5 (55.6)	4 (36.4)	6 (28.6)	15 (36.6)
After 7 days if enteral feeding unsuccessful	1 (11.1)	0 (0.0)	3 (14.3)	4 (9.8)
Immediately in malnourished patients	0 (0.0)	3 (27.3)	4 (19.0)	7 (17.1)

Table 4b presents factors influencing the initiation of enteral feeding for the respondents whose facilities provided parenteral nutrition. Majority of respondents reported using clear clinical indications (19, 46.3%) or initiating parenteral feeding when enteral nutrition fails within three days (15, 36.6%).

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Self-Report of Skills and Competence in Providing Nutrition Support

Table 5 highlights the skills and competence of health professionals in providing nutrition support. Fewer than half of the respondents (48 participants, 42.0%) reported having above-average competence in this area. However, majority of dietitians (27 participants, 69.2%) indicated that they possessed above-average competence in providing nutrition support.

Table 5: Rating of **Skills and Competence in Nutrition Support (N =114)**

Level of competence / skills	Dietitians, n (%)	Doctors, n (%)	Nurses, n (%)	Total
Expert / Highly skilled Above	2(5.1)	1(3.7)	3(6.1)	6(5.3)
Above average	27 (69.2)	6 (22.2)	15 (30.6)	48(42.0)
Satisfactory / average	8 (20.5)	16 (59.3)	20 (40.8)	44(38.6)
Below average	2 (5.1)	3 (11.1)	10 (20.4)	15(13.2)
Totally unskilled	0 (0.0)	2 (7.4)	1 (2.0)	3 (2.6)

Pearson's chi-square test, p-value < 0.05 was considered significant.

DISCUSSION

The study aimed to investigate nutrition support practices critical care units in Ghanaian hospitals. The health professionals involved in the study were nurses, dietitians and doctors. More than half of these health professionals worked in the Greater Accra Region. This is consistent with reports of an uneven distribution of dietitians in Ghana with majority working in Greater Accra Region (Aryeetey et al., 2014; Boateng et al., 2016). Also, most health professionals worked in the medical units of their facilities. Our study found that few of the health facilities surveyed had a formal nutrition support guideline. Another notable finding in this study was that most study respondents had no knowledge of the presence of a formal nutrition support guideline/protocol in their respective health facilities. These findings present a peculiar challenge in implementing nutrition support as there are no clear guidelines, unclear responsibilities and a lack of knowledge. Factors such as lack of knowledge, no clear guidelines or unclear responsibilities were cited by majority of respondents in a United Kingdom study as barriers to implementing nutrition support (Lane et al, 2014). The limited number of nutrition support guidelines revealed in this study may have been as a result of only half of the health facilities surveyed having a formal nutrition support team (NST). The presence of a NST and how effectively it functions may contribute to the development of guidelines to enhance feeding critically ill patients. Our study showed that the presence of a formal nutrition guideline was significantly associated with the presence of a nutrition support team. This is consistent with findings from Roynette et al (2008) who asserted that intensive care units with NST were most likely to have a nutrition support guideline compared to those without NST. Also, facilities that used a formal, written enteral feeding guideline recorded significant improvements in nutrition support their facilities compared to those that do not (Heyland et al., 2010).

A higher number of nurses in this study reported screening patients routinely for malnutrition. This calls for more collaboration between dietitians and nurses as well as other health professionals in the development of effective nutrition screening protocols suitable for critically ill patients in low resourced settings. Currently the low numbers of dietitians in Ghanaian hospitals may require capacity building for the nurses to ensure that evidence-based nutrition screening is performed by them as they play a central role in critical care. Early identification of patients at risk of malnutrition or who are malnourished is essential for an adequate and timely initiation of nutrition support (Reber et al., 2019). Organizational factors have been found to be major and preventable sources of malnutrition risk. These factors include failure to recognize malnutrition,

lack of nutritional screening, lack of training, confusion regarding responsibility, and failure to record height and weight (Tignanelli et al., 2017).

Body mass index (BMI) and the combined nutrition assessment methods (ABCD approach) were the commonest nutrition screening tools used by health professionals in this study. Majority of dietitians were found in this study to use the combined nutrition assessment methods in screening patients with a significant association among health professionals. Majority of respondents reported that dietitians were the professionals mainly involved in nutrition screening. Similarly, a Ghanaian study indicated that dietitians were the most ranked as the main professionals performing nutrition screening in health facilities (Ayande et al., 2023). There is the potential difficulty in using BMI in critical care settings in Ghana particularly when majority of patients are immobile, and bed bound coupled with the fact that most health facilities are not equipped with weight measuring devices for such populations. A study in Malawi found that it was not possible to take patients weights as standard hospital beds used in critical care do not have weighing scales (Barcus et al., 2021).

The mid-upper arm circumference (MUAC) has been successfully used in resource-limited setting to screen for malnutrition for both hospitalized and critical care patients. MUAC was used recently among critically ill patients in Malawi to determine malnutrition and found 62% of adult critical care patients had moderate to severe malnutrition (Barcus et al., 2021). Additionally, the main methods used by the participants in estimating nutritional requirements of patients were body weight-based methods, clinical judgement and formulas. There is evidence of the use of ulna length and calf circumference to estimate ideal body weights and nutrition focused physical examinations to assess nutritional status of critical care patients (Singer et al, 2019).

These methods and practices should be explored in the light of current nutrition guidelines for feeding critically ill patients in the Ghanaian context. Further, current evidence recommends indirect calorimetry (IC) as the gold standard in determining calorie requirements. Anecdotal evidence however indicates that none of the health facilities in Ghana presently uses indirectly calorimetry. De Waele and Van Zanten (2022) have highlighted the high costs associated with the device, consumables, calibration gas, and service, along with the time required for measurements. However, considering the usefulness of indirect calorimetry, it is perhaps time for a critical look at the feasibility of this particular equipment in the tertiary and quaternary levels of healthcare in Ghana. Therefore, in the absence of indirect calorimetry, weight-based predictive equation is the accepted alternative with clinical judgment (Sioson et al., 2018).

Unsuccessful oral nutrition and poor nutritional status were used as determinants of initiating enteral feeding by majority of respondents in this study. A higher proportion of doctors also reported using presence of bowel sounds in initiating enteral feeding. However, according to McClave et al., (2016), bowel sounds are only indicative of contractility of the GIT and not related to mucosal integrity, barrier functions and absorptive capacity of the GIT, thus some of these practices contribute to delay in feeding and withholding feeds when unwarranted. Few respondents in this study reported early initiation of nutrition support. Current feeding guidelines for critically ill patients recommend early initiation of enteral feeding preferably within 24-48 hours (Singer et al, 2019). The constitution of NST and provision of nutrition support guidelines for nutrition screening, assessment, diagnosis, intervention, monitoring and evaluation right from admission to discharge will likely eliminate most barriers to implementing nutrition support for the critically ill.

For parenteral nutrition (PN) decision-making, less than half of the respondents indicated using apparent/obvious clinical indications and when enteral feeding is unsuccessful within 3 days to initiate parenteral feeding. These observations can be attributed to the absence of a documented nutrition support guideline and the lack of cross inter-disciplinary collaboration among the nutrition support team members. Current literature indicates that if the energy and nutrient requirements of critically ill patients cannot be met by oral and enteral intake alone (<50% of caloric requirement) for more than seven days, a combination of enteral and parenteral nutrition is recommended. PN shall be administered as soon as possible if nutrition therapy is indicated and there is a contraindication for enteral nutrition (EN), such as in intestinal obstruction (Martinez-Ortega et al., 2022).

This study showed that less than half of health professions reported that they had an above average competence in nutrition support. Compared to doctors and nurses, a higher number of dietitians reported that they had an above average competence in providing nutrition support among the professionals. This finding may be attributed to lack of time and knowledge deficits specific to nutrition

therapy for the other health professionals in critical care. This agrees with evidence from recent studies on the nutrition knowledge of physicians (Adamski, Gibson, Leech & Truby, 2018; Aggarwal et al., 2018; Mogre et al., 2018). The differences in nutrition support competence confirms the need for training and or certification as the process of validating an individual's qualification and level of knowledge to be involved in nutrition support based on regulated standards (Itzhaki & Singer, 2020).

Strengths and limitations of study

To the best of our knowledge, this study is the first to describe nutrition support practices in Ghana among different health professionals across different levels of health care in 17 health facilities. It has contributed new data to aid the planning and provision of nutrition support in intensive care units. It has also highlighted various gaps in nutrition support practices that call for stakeholder consultation to improve the delivery of nutrition support to critically ill patients. The study had some limitations. There may have been selection bias of participants, the years of work experience of health professionals in relation to nutrition support competence assessment was not considered as well as the different roles played by members of the nutrition support team. Notwithstanding, our study provides a basis for future research in nutrition support among critically ill.

CONCLUSION

This study investigated nutrition support practices in Ghana at the ICU in 17 health facilities There was an inadequate number of health facilities with nutrition support teams, no formal written nutrition support guideline and a lack of knowledge of the existence of such a guideline among health professionals. The majority of dietitians and nurses were involved in nutrition screening, however the common methods of screening required weight measures which is difficult in critical care settings. It is imperative for stakeholders to urgently review the current state of nutrition support systems and practices, and plan for institution for an effective nutrition support teams, written guidelines and the provision of appropriate resources for nutrition assessment in critical care settings.

Competing Interests

The authors declare that they have no competing interests.

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Acknowledgement

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Statement of authorship

L.B. and P.Y.A. conceived, designed, and carried out the study. P.Y.A. and M.A. carried out the data analysis and interpretation. L.B., P.K.G and A.Z. provided critical revisions and wrote the manuscript. All authors have reviewed and approved the final manuscript.

Data availability statement

The data supporting this study will be made available upon reasonable request.

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EXPLORING THE CONNECTION OF CULTURE, BREASTFEEDING PRACTICES AND BREASTFEEDING ATTITUDE: A QUALITATIVE STUDY OF WOMEN IN DAMATURU, YOLA STATE, NIGERIA

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Abstract

Breastfeeding practice is key in maintaining child survival especially in the first 1,000days of life. Studies have identified cultural, religion and traditional belief to affects this practice across the country. However, there is paucity of information on interconnection of this practice in Nigeria. Therefore, this study assessed the connection of culture, breastfeeding practices and attitude of women in Damaturu, Yola State, Nigeria.

A qualitative study involving Five focus group discussion (FGDs) comprising 6-10 lactating mothers per group out of which five (5) women were also identified for In-depth interviews. A purposively sampling method was used to select five communities in Damaturu, Yola State. All the interviews were conducted under the tree in the communities for 45 minutes to one hour. All the recorded responses were listened to and transcribed from Hausa into the English Language. The transcribed responses were then compared with the field note for triangulation. The transcription was coded and put into themes and subthemes and all of this was thematically analysed.

In Fulani community, women withhold breast milk from the newborn for the first three days and fed the infant with cooked cow or goat milk. In Kari-Karai Community, baby are given *ruwa zamzam* (holy water) and dates before breastfeeding is initiated. Also in Jersusalem community there is also initiation of honey, sugar, salt and water during baby christening

Cultural norms and religious beliefs significantly influence how and when mothers initiate breastfeeding, with a strong emphasis on rituals and traditions that delay or alter the process.

INTRODUCTION

Breastfeeding is widely acknowledged as the ideal method for providing newborns with the nutrition they require for healthy growth and development (WHO, 2020a). It has remained a key strategy for improving public health, benefiting infants, mothers, and the entire community. The World Health Organization (WHO) and the United Nations International Children's Emergency Fund (UNICEF) have actively promoted exclusive breastfeeding for the first six months of life and recommended continued breastfeeding along with proper complementary foods for up to two years or beyond (WHO, 2020a; UNICEF, 2018). The WHO's target by 2025 is to scale up exclusive breastfeeding for the first 6 months to at least 50% globally (WHO, 2024). Breastfeeding is one of the most important elements influencing a child's survival and long-term health outcomes. Beyond supplying the required nutrition, breastfeeding promotes immunity, cognitive development and a strong mother-to-child bond (Victora et al., 2016).

The WHO in 2019 estimated 5.2 million deaths of children under five years of age which were mostly from preventable and

treatable causes. Among these deaths were children aged 1 to 11 months which accounted for 1.5 million and newborns under 28 days for 2.4 million deaths. Furthermore, among the countries with the highest deaths of children under the age of 5, Nigeria topped the chart with 858,000 deaths (WHO, 2020b)

Recent evidences show that infant mortality can be lowered and diseases like pneumonia and diarrhoea which are the top causes of death for children under five could be prevented by exclusive breastfeeding therefore leading to an intensive promotion of exclusive breastfeeding for the first six months of life globally (UNICEF, 2018). There are indications that early initiation and exclusive breastfeeding for six months; continued breastfeeding accompanied by adequate complementary feeding for up to two years is crucial for child survival, healthy development, and maternal health, with the potential to save over 820,000 children annually and prevent 20,000 maternal deaths from breast cancer, making it a vital practice for promoting global health and development (UNICEF, 2018).

However, despite these global recommendations, breastfeeding practices are significantly influenced by several sociocultural, economic, and individual factors that affect women's attitudes and decisions regarding breastfeeding thereby relatively impacting their breastfeeding habits. Worldwide in different countries including Nigeria, there is wide variability in breastfeeding practices due to cultural beliefs, norms, and the level of community support received. Aborigo et al., (2012) revealed that customs and traditions are associated significantly with breastfeeding habits which could either promote or deter breastfeeding practices.

In northern Nigeria, a region where traditional practices are deeply ingrained; maternal education, family influences and societal norms are important elements that play a crucial role in shaping the breastfeeding patterns among mothers (Joseph and Earland, 2019). Specifically, the city of Damaturu in Yobe State offers a distinctive setting where diverse ethnic groups, religious beliefs, and traditional practices influence women's decisions to breastfeed. In particular, certain cultural practices, such as the use of pre-lacteal feeds, beliefs about colostrum, and the introduction of herbal concoctions, may interfere with optimal breastfeeding practices (Lawal et al., 2020). Cultural norms, religious beliefs, and community expectations often shape breastfeeding practices, including when and how breastfeeding is initiated, the duration of breastfeeding, and whether supplementary feeding is introduced (Muhammed and Hassan, 2018). These cultural dimensions are deeply embedded in family structures, where elders and community leaders play significant roles in influencing maternal decisions regarding infant feeding.

Given the high rates of infant mortality and malnutrition in northern Nigeria (National Population Commission, 2019), developing successful public health initiatives will require an understanding of the existing cultural factors that influence breastfeeding. Moreover, maternal attitudes toward breastfeeding are shaped by personal experiences, knowledge, social pressures, and economic considerations (Rollins et al., 2016). These complex factors underscore the need for a comprehensive understanding of breastfeeding behaviour, which cannot be fully captured through quantitative approaches alone. Qualitative research offers valuable insights into the construction, negotiation, and practice of cultural values and attitudes about breastfeeding throughout communities. This research investigates the connection between culture, breastfeeding practice and breastfeeding attitude of women in Damaturu, Yola State, Nigeria.

METHODOLOGY

This qualitative study used a focus group discussion (FGDs) to obtain in-depth information from mothers of infants from 0-12 months from five (5) purposively selected communities in Damaturu, Yobe State, Nigeria. The communities include Dikumari Karai karai, Dikumari Fulani, Pompomari, Nayinawa, and Jerusalem. Thirty-six women who had their infant between the ages 0-12 months, willing and gave their voluntary consent were recruited into the study. This category of women was recruited because of their ability to recall their exclusive breastfeeding practice and the socio-cultural influences affecting this practice. Five FGDs comprised 6-10 lactating mothers per group out of which five (5) women were identified for In-depth interviews. All the interviews lasted for 45 minutes to one hour and it was conducted under trees in the communities.

DATA COLLECTION

An FGDs guide with probe questions was used to obtain information from the women during the interview. The guide was categorized into themes and subthemes. Participants were informed that their responses would be recorded and this will be used solely for research purposes. Field note was also taken down for non-verbal conservation and which used for triangulation. A debriefing section was conducted after the interview with all the research participants. Observations were

also noted down during the interview session.

Table 1: Interview Questions Guidelines

Was your baby given anything during the naming ceremony to eat or taste? If yes,
What was that and why?
What is your religious view on water and herbs given to a child?
What is your cultural belief on breastfeeding without water and herbs for the first six months?,
Do you have any restrictions based on a particular food while breastfeeding? If yes, Why?,
What do you think about the first milk flow from your breast after delivery?,
What other things have you given your baby except for breast milk?,
What month did you introduce water/herb to your baby? ,
Was there any month you had to give your baby herbs or water for one reason or the other?
What month was that and Why?,
Are there foods that should be introduced to your baby before six months and why?
What are the other liquids your religion believes you should give an infant less than six months old.
Has anyone advised you on how to breastfeed your child, who was that and Why?,
Does anyone has an influence on you regarding EBF practice? Why?,
As a father, what is your perception on EBF?

Data Analysis

All the recorded responses were listened to and transcribed from Hausa into the English Language. The transcribed responses were then compared with the field note for triangulation. The transcription was coded and put into themes and subthemes and all of this was thematically analysed.

ETHICAL CONSIDERATION

Ethical approval was obtained from Yobe State Ministry of Health ethical review committee. Permission was also obtained from the community heads before the commencement of the study. A signed informed consent was obtained before the interview from each of the participants.

RESULTS

Table 4.1: Socio-demographic Characteristics of mother's

A total of Thirty-six women were interviewed for the qualitative findings. The mean age of the women was 58.9% falling between the age range of 18-30 years. The majority were multiparous mothers and almost all (92%) were also married. About one-third (47%) attained their highest level of education at the Koranic School, 39.1% had small-scale business as their occupation and 28.5% had their monthly income lesser than the minimum wage. The table below explains the socio-demographics of these women.

Table 4. 1: Socio-demographic Characteristics

Variables	Frequency(N)	Percentages (%)
Age		
18-30	89	58.9
31-45	62	41.1
Ethnicity		
Hausa	25	16.6
Igbo	6	4
Yoruba	11	7.3
Others	109	72.2
Religion		
Christianity	43	28.5
Islam	108	71.5
Pagan	0	0
Marital Status		
Single	3	2
Married	139	92.1
Divorced	7	4.6
Widow	2	1.3
Separated	0	0
Educational Status		
None	13	8.6
Primary	16	10.6
Secondary	40	26.5
Tertiary	71	47
Koranic School	11	7.3
Occupation		
House Wife	40	26.5
Business Woman	59	39.1
Civil Servant	52	34.4
Artisan	0	0
Monthly Income		
5,000-10,000	26	17.2
11,000-20,000	20	13.2
25,000-30,000	22	14.6
31,000 and above	43	28.5
H/wife without Income	40	26.5

Table 4. 1: Socio-demographic Characteristics Continued

Table 2:

Interviewee	Age/ Occupation	Community	Topic/ Question	Response
P1	40/Petty Trader	Dikamari Village	Influence of Culture & Religion on EBF	Fulani culture delays breastfeeding for 3 days. Cow or goat milk is given before breastfeeding. Health workers are encouraging immediate breastfeeding.
P2	29/House wife	Dikamari Village	Influence of Culture & Religion on EBF	Older mothers advise washing breasts with a hot hoe blade before breastfeeding. Friend advised against giving water to babies.
P3	45/Petty Trader	Dikamari Village	Naming Ceremonies	Herbs and water are given to ease pain when removing the uvula.
P4	25/House wife	Dikamari Village	Religion's Influence on EBF	Religion encourages breastfeeding and giving water but does not emphasize breastfeeding without water.
P5	35/Petty Trader	Dikamari Village	Naming Ceremonies	Herbs and water are given on the naming day.
All Participants	-	Dikamari Village	On Day of Delivery	Zamzam water and dates are given for protection and intelligence before breastfeeding.
P8	24/House wife	Dikamari Village	Food Restriction During Lactation	Draw soups and foods made from beans and Bambara nut are restricted due to cultural beliefs.
P9	22/House wife	Dikamari Village	After 40 Days Bath	After 40 days, mothers perform a sacrifice, do henna, braid hair, and visit family and friends.
P10	40/Petty Trader	Dikamari Village	Insufficient Breast Milk Flow	Millet cooked with dates, ghee, and honey is given to make the baby shiny and plump.
P11	25/Gatekeeper	Fulani Community	Cultural/Religion Influence on EBF	Repeated the same cultural influences on EBF as mentioned by Mallama Hauwa Halilu.
P12	19/House wife	Fulani Community	Insufficient Breast Milk Flow	Millet cooked with dates, ghee, Bambara nut, and sugar is given to babies.
P13	22/House wife	Fulani Community	Food Restriction	Mothers are not allowed to eat beans-based food or drink cooked water to avoid causing swelling or catarrh in the baby.
P14	27/Henna Stylist	Fulani Community	Cultural View on Colostrum	Belief that colostrum is unhealthy for babies; breastfeeding starts after 3 days, and the mother washes her breasts with potash.

Table 4. 1: Socio-demographic Characteristics Continued

P15	34/Soft Drink Business	Fulani Community	Herbs Given Before 6 Months	Herbs like majanfari and mango tree bark are given to babies to prevent or treat infections.
All Mothers (Chorus Response)	-	Fulani Community	After 40 Days Bath	Mothers perform a sacrifice, do henna, and visit family and friends after 40 days.
P1	36/House wife	Pompomari Community	Cultural View on Breast Washing	Breast washing with potash is practiced before breastfeeding.
P18	33/CS	Pompomari Community	Food Restriction	Spicy foods, moimoi, Bambara nut, and draw soup are restricted post-delivery to avoid affecting the baby through breast milk.
P19	38/CS	Pompomari Community	Herbs Given Before 6 Months	Herbs are given to treat conditions like gedigedi caused by the mother's sugar intake during pregnancy.
P20	23/Henna Stylist	Pompomari Community	Cultural View on Colostrum	Same beliefs on colostrum as other communities.
P21	25/Hair Stylist	Pompomari Community	After 40 Days Bath	Same cultural practices as other communities regarding 40 days bath and celebration.
P22	42/House wife	Pompomari Community	Religion Influence on EBF	Dates are soaked in holy water instead of being chewed to prevent passing on the character of the chewer to the child.
All Participants	-	Nayinawa Community	General Cultural and Religious Practices	All reported similar practices as other Muslim communities.
P24	40/Teacher	Jerusalem Community	NGO Influence on EBF	NGOs encourage not giving infants water before 6 months, but many women still do not practice EBF strictly.
P25	34/Provision Store	Jerusalem Community	Naming Ceremonies	Due to denominational doctrines, honey, sugar, salt, and water are given to the baby.
P26	36/Teacher	Jerusalem Community	Naming Ceremonies	Anointing oil is given to the baby for protection and blessings.
P2	33/Boutique	Jerusalem Community	After 40 Days Bath	The baby is dedicated in church before the mother resumes normal activities. Some share food, while others do not.
P28	33/Provision Store	Jerusalem Community	Food Restriction	Some Yoruba families restrict spicy food, pepper, and salt for 7-9 days post-delivery based on the baby's gender.
P29	38/Security	Jerusalem Community	Colostrum	Colostrum is considered bad, so her baby was on infant formula for the first 3 days.

Table 4. 1: Socio-demographic Characteristics Continued

P30	-	Jerusalem Community	Herbs Given Before 6 Months	Gedigedi herbs are given to babies from 3 months.
P31	35/Teacher	Fathers	EBF Practices	Encourages EBF during cool seasons but not during hot seasons.
P32	35/Teacher	Fathers	Practical Support	Provides food for lactation and helps with the baby when the wife is busy with house chores.
P33	45/Provisions/Food Seller	Fathers	EBF Practices	Provides food for lactation and encourages giving water to babies, believing it makes them kind-hearted.
P34	40/Security	Fathers	EBF Practices	Does not support EBF strictly, as per cultural beliefs. Provides food for lactation.
P35	35 & 36/NGO & Gatekeeper	Fathers	EBF Practices	Encourages EBF regardless of the weather, influenced by the International Rescue Commission. Provides food including fruits and vegetables when possible.

The interviews conducted across various communities, including the Dikimari Village (Kari-Karai Community), Dikimari Village (Fulani Community), Pompomari Community, Nayimawa Community, Jerusalem Community, and interviews with fathers, reveal deep-seated cultural and religious beliefs that influence breastfeeding practices, particularly Exclusive Breastfeeding (EBF). The responses provided by interviewees from these communities shed light on how traditions, cultural norms, and religious teachings intertwine to shape the practices of new mothers regarding infant feeding.

Cultural Influence on Exclusive Breastfeeding (EBF)

In the Kari-Karai Community, the practice of delaying breastfeeding for three days after delivery is a significant cultural norm. Mallama Hauwa Halilu, a 40-year-old petty trader, shared that within the Fulani culture, it is customary to withhold breast milk from the newborn for the first three days. Instead, the baby is fed cooked cow or goat milk. This practice is rooted in the belief that the yellowish milk, known as colostrum, is unhealthy for the baby. To initiate breastfeeding, the mother is instructed to wash her breast with *kuwan wake* (beans husk), believing it cleanses the "dirt" on the nipple. (P1,4Oyears, IDI)

Similarly, Aisha Sha'aban, a 29-year-old health worker, described a practice where older women in the community encourage new mothers to press breast milk onto a hot hoe blade before initiating breastfeeding. This ritual, meant to purify the milk, further emphasizes the cultural beliefs that interfere with immediate breastfeeding after birth (P2,29Years, IDI).

In contrast, the Fulani Community echoes similar sentiments, where colostrum is not considered suitable for newborns. Hauwa Adamu, a 27-year-old henna stylist, recounted those mothers in her community also delay breastfeeding for three days, during which the baby is fed cooked cow or goat milk. The practice of washing the breast with *kanwa* (potash) before initiating breastfeeding is also prevalent, illustrating the widespread cultural practices that hinder EBF (P3,27Years, FGDs).

The Pompomari Community mirrors these practices, where mothers are instructed to wash their breasts with potash after delivery to remove "dirt" before breastfeeding. This cultural norm highlights the deep-rooted misconceptions surrounding colostrum and the initiation of breastfeeding.

Religious Influence on Exclusive Breastfeeding:

Religion also plays a crucial role in shaping breastfeeding practices. Islam, the dominant religion in these communities, encourages breastfeeding but does not explicitly prohibit giving water to babies. This is evident in the responses from the Dikimari

Village (Fulani Community), where the women acknowledged that while Islam emphasizes breastfeeding, it also permits giving water to babies. Maryam Abubakar, a 25-year-old gatekeeper, emphasized that the religious influence aligns with cultural practices, further reinforcing the community's resistance to EBF (P4,25Years, FGDs).

In the Kari-Karai Community, religion also dictates that on the day of delivery, the baby should be given *ruwa zamzam* (holy water) and dates before breastfeeding is initiated. This practice, believed to provide protection and enhance the baby's intelligence, demonstrates the interplay between religious rituals and breastfeeding practices. However, it also introduces delays in initiating breastfeeding, which can impact the baby's health.

Similarly, in the Jerusalem Community, religious practices dictate the administration of honey, sugar, salt, and water to the baby during naming ceremonies. Mrs. Bolarinwa, a 34-year-old provision store owner, explained that these items are given to the baby to ensure a sweet life and preserve the baby's well-being. While these practices are rooted in denominational doctrines, they interfere with the principles of EBF (P5,34years, IDI).

FOOD RESTRICTIONS DURING LACTATION

Cultural beliefs also influence the dietary practices of lactating mothers, which are believed to impact both the mother and the baby. In the Dikimari Village (Kari-Karai Community), Aisha Hamisu, a 24-year-old health worker, mentioned that draw soups like okra and *karkashi* (related to the ewedu family) are restricted because they are believed to cause stomach pain and bloating in the baby. Foods made from beans and Bambara nuts are also restricted. This belief is consistent across the Fulani Community, where Farida Umar, a 22-year-old health worker, noted that mothers are not allowed to eat food made with beans or drink cold water, as it is believed to cause swelling in the baby's tummy or lead to catarrh. (P6/7, 24/22Years, FGDs)

In the Pompomari Community, the restrictions are similar. Aisha Goni, a 33-year-old community seller, explained that mothers are prohibited from eating spicy foods, *moimoi* (a dish made from beans), Bambara nuts, and draw soups, as these foods are believed to affect the baby through breast milk, causing gas and bloating (P8,33years, FGDs.)

These dietary restrictions, though culturally ingrained, may limit the nutritional intake of lactating mothers, potentially affecting milk production and the overall health of both the mother and the baby.

Rituals and Practices after 40 Days Bath

The ritual of the 40-days bath is another significant cultural practice observed across the communities. This practice marks the end of the postpartum period, during which the mother is secluded and cared for by family members. After the 40-days bath, the mother engages in several cultural rituals, including giving *sadaka* (sacrifice) by sharing food like *masa* (rice cakes) and groundnut balls with neighbours and loved ones. This ritual, as described by Mrs. Maryam, a 22-year-old health worker from the Kari-Karai Community, is a way of expressing gratitude for a successful bath and seclusion period (P9, 22 Years, FGDs).

In the Fulani Community, the 40-day bath is followed by similar rituals, where the mother decorates her hands and feet with henna, braids her hair, and visits family and friends. This practice is consistent with the Pompomari Community, where mothers engage in henna decoration and other celebratory activities after the 40-days bath.

These rituals reflect the cultural significance of the postpartum period and the community's collective support for new mothers. However, they also highlight the delay in the mother's return to regular activities, including the potential impact on breastfeeding practices.

Fathers' Role in Supporting Breastfeeding

The interviews with fathers reveal varying degrees of involvement in supporting breastfeeding practices. Mr. Allabazam Musa, a 35-year-old teacher, expressed his support for EBF during the cool season but noted that in the hot season, they do not practice EBF. He also mentioned providing food to encourage lactation and helping with the baby when his wife is busy with house chores (P10, 35Years, IDI).

On the other hand, Mallam Uban Marayu, a 45-year-old provisions and food seller, emphasized his role in providing food for lactation but insisted on giving water to the baby, as he believes it makes the child kind-hearted. Despite hearing about the benefits of EBF, he continues to follow cultural practices (P11,45 years, FGDs).

DISCUSSION

The qualitative results reveal the influence of sociocultural and religion on exclusive breastfeeding practices. Among the Fulani women, there is usually a cultural-traditional delay of breastfeeding initiation until after the third day of the infant life as colostrum is often seen as unhealthy and dirty. Thus during this

period of delay, the baby is often fed with other food like cow or goat milk. The lactating mother is then asked to wash her breast with kuwan wake* (bean husk) on the third day before lactation. These cultural practices align with previous studies findings of Joseph et al., 2023; Wanjobi et al., 2017; Salasibew et al., 2015, Legesse et al., 2015; Titaleye et al., 2014; Subbiah and Jeganathan, 2012 and Rogers et al., 2011.

Additionally, most Muslim mothers introduced water to their infants before six months old as this as this practice is believed as an act of showing kindness to the child and this in line with their religious teachings. Few Christians also gave water to their infant before six months owning to the belief that the weather is harsh and the child needs water to quench the thirst. These finding agrees with studies conducted in Kastina, Nigeria by Joseph and Earland, 2019, Kware, Nigeria by Mo et al., 2011; Northern Ghana by Aborigo et al., 2012; Memarian et al., 2020. Victoria et al., 2016 and Mehrpisheh et al., 2020.

The forty days of regular bathing and seclusion of mother and infant in is line with other studies among rural kanyan (Matsuyama A, Karama M, Tanaka J and Kaneko S, 2013). Despite the optimal knowledge of exclusive breastfeeding, due to sociocultural and religious influences, the practice is low in line with a conducted study by Aborigo RA et al (2012), awareness of optimal breastfeeding messages does not necessarily translate into practice, and this situation indicates confounding sociocultural / religion factors influencing a mother's decisions on exclusive breastfeeding practice.
Limitation of the Study: One key limitation of this study is that it did not explore some of the confounding factors that may influence exclusive breastfeeding practices.

CONCLUSION

The interviews conducted across the various communities highlight the complex interplay of culture, religion, and breastfeeding practices. Cultural norms and religious beliefs significantly influence how and when mothers initiate breastfeeding, with a strong emphasis on rituals and traditions that delay or alter the process. Despite the ongoing efforts by health workers and NGOs to promote exclusive breastfeeding, these cultural and religious practices remain deeply ingrained within the communities.

Additionally, challenges such as food restrictions during lactation further impact the nutritional well-being of both mothers and infants. The 40-days postpartum bathing ritual emphasizes the cultural significance of mothers' delays in return to normal activities, including breastfeeding.

Hence, the role of fathers in supporting breastfeeding varies, with some adhering strictly to cultural practices, while others, influenced by education and exposure, actively promote EBF. These insights underscore the need for culturally sensitive approaches to health education and interventions aimed at promoting EBF and improving maternal and child health in these communities. The key challenge lies in balancing respect for cultural and religious practices while advocating for practices that are scientifically proven to benefit both mothers and babies.

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FEEDING AND NUTRITIONAL PROBLEMS IN CHILDREN WITH DEVELOPMENTAL CONDITIONS FROM A LOW-RESOURCE SETTING

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Abstract

Introduction:Feeding problems frequently occur in children with developmental conditions but may go unrecognised resulting in malnutrition and its complications. Furthermore, data on the frequency, pattern, and capacity for early detection and management in low-resource settings

Objective: The study examined feeding and nutritional problems affecting children with developmental conditions to determine the pattern and associated factors and to inform management. This study aimed at providing baseline information for the first five years of operations at the facility for later monitoring of outcomes at the clinic.

Methodology: This was a cross-sectional study at Princess Marie Louise Children's Hospital, Accra, involving a retrospective review of medical records of patients attending a Child Development Clinic spanning the first five years of its establishment. Data on feeding and nutrition-related problems were collected using a record form and analysed.

Conclusion: Underweight, anaemia, swallowing and feeding difficulties were the main problems identified. Raising awareness among primary care workers and screening to facilitate early detection, referral and dietetic support is essential. Further study of dietary adequacy, causes of anaemia and indications and practicality of enteral feeding, among these patients need to be explored.

INTRODUCTION

Developmental disabilities refer to a group of conditions resulting from impairments in physical, learning, language, or behavioural development [1]. They include cerebral palsy, autism, attention deficit hyperactivity disorder, learning disability, genetic syndromes, visual, hearing, and speech impairment, among others [2]. Children with developmental disorders often suffer from inadequate food intake leading to faltering growth, chronic malnutrition and micronutrient deficiencies [3,4,5]. Those with motor problems such as cerebral palsy are most affected by these problems and up to 90% of preschool children with this condition may be affected [3]. A 40% prevalence of malnutrition globally has also been reported

in children with cerebral palsy [4]. These children may present with chewing and swallowing difficulties (dysphagia), gastro-oesophageal reflux, oral sensitivity and other issues [3,4,5,6]. Some children may also, present with overweight and obesity resulting from the effect of medications, feeding problems, food preferences and behaviour problems such as sedentary behaviour and lack of physical activity [7]. In contrast, children with genetic syndromes tend to present with short stature [8], whereas, children with autism and similar behaviour disorders may develop a restricted pattern of eating or fussy eating [9]. Therefore, careful assessment and diagnosis is necessary as many of these conditions can be ameliorated with appropriate feeding techniques, oral sensitisation, special feeds, medication, dietetic counselling or surgery as part of their multidisciplinary care [10].

Poor dietary intake is the main nutritional factor that affects children with developmental conditions [3]. This may result in inadequate intake leading to protein-calorie malnutrition, stunting and micronutrient deficiencies. Among the micronutrient deficiencies, low iron, folate, calcium, magnesium, vitamin D, niacin, vitamin E, selenium, carnitine, Vitamin A, copper, and zinc have been reported in these children [3,4] Additionally, some of the children have altered energy requirements resulting from reduced mobility, motor movements such as choreoathetosis, changes in muscle tone and altered metabolism [3,11]. Gastrointestinal or nutritive factors such as swallowing problems or dysphagia, gastro-oesophageal reflux presenting as vomiting and regurgitation, as well as an aversion to nutritional factors or textures such as solids, also occur. This can result in coughing, choking episodes and recurrent aspiration, affecting intake and increasing losses [3,5,11]. Chronic constipation also affects dietary intake and is determined by dietary fibre consumption [3,6].

Additionally, non-nutritional factors such as cognitive ability and anti-epileptic medication affect nutrition in children with developmental conditions [3]. The presence of hearing, speech and visual impairment, behaviour disorders, inability to communicate hunger, satiety, preferences, attention and concentration skills also affect these children. [3, 5, 11, 12]. Furthermore, attraction to food as well as disruption of the sensitive learning period, dystonia and postural problems affect food intake. Besides this, the psychosocial impact of these feeding and nutritional problems can be enormous as feeding may be difficult, messy, and time-consuming, resulting in social exclusion and affecting caregiving [5,13,14]. Early recognition and management of feeding and nutritional problems are therefore crucial, as malnutrition can worsen the prognosis, increase the risk of mortality, reduce cognition, and affect general health and participation [4,11,15]. Quantitative studies from resource-poor settings are few and often limited to children with cerebral palsy. A systematic review of feeding and nutrition problems of children with developmental conditions in low and middle-income countries revealed that lack of policies, funding, referral systems, intervention services and difficulty identifying feeding problems are barriers to resolving the nutritional problems faced by children with developmental conditions [16]. This study examined nutritional and feeding problems affecting children with developmental conditions attending a child development clinic in a low-resource setting to determine the spectrum of presentations and inform measures needed to identify, manage and prevent them.

METHODS

Study Design

The study was a 5-year retrospective review of records of children attending the Child Development Clinic at Princess Marie Louise Children's Hospital, Accra between 1st August 2010 and 31st July 2015, the first five years of its establishment. Patients whose records were available were included in the study. Data collection was done between March and May 2017. The anaemia profile of patients was obtained using haemoglobin concentration (Hb). Feeding problems and other nutrition-related problems were identified however a dietary analysis was not included.

Study Area

Princess Marie Louise Hospital (PML) was an 84-bed hospital at the time of the study but is now a 110-bed hospital run by the Ghana Health Service. It is located at the commercial centre of the capital, Accra, along the coast of the southern border of the country. The hospital serves an inner-city population but also sees patients from the rest of the capital and other parts of the country as it is regarded as a hospital for malnourished children and it hosts a large centre for rehabilitating children with malnutrition and treating a variety of childhood illnesses. Patients are either self-referred by their parents or referred from other health facilities. Patients were recruited from the Child Development Clinic at the hospital.

The Child Development Clinic was established in 2010 and sees approximately 60-80 new patients in a year. The clinic was run weekly by a Paediatrician, supported by a clinic nurse with the last week of the month covering administration activities. The hospital also runs another neurodevelopmental

clinic once a week which also sees children with developmental conditions but mostly epilepsy and is run by medical officers. Services of a dietician, nutrition officer, eye nurse, physiotherapists and social workers are available at the hospital to complement work at these clinics. Speech and language therapy, occupational therapy and other specialist services are available at Korle Bu Teaching Hospital which is 15 to 30-minute drive from PML.

Study Population

Children attending the child development clinic of the hospital between 1st August 2010 and 31st July 2015 were eligible for the study, however, we only enrolled children whose medical records were available. Patients whose weight measurement at presentation could not be located were excluded from the study. This study provides baseline data for the first five years of the activities at the child development clinic. It serves as the basis for comparison and monitoring of the performance of the children thereafter.

Data collection methods and instruments

Data collection was conducted using a record form, completed by a research assistant, a recently qualified medical doctor, who was trained, assisted and supervised by the principal investigator. A record form was used to obtain information on nutritional status, haemoglobin level, feeding and nutrition-related problems. The data collected included information on the developmental condition, date of first contact, age at presentation, weight, and other details regarding the referral and child's presentation. Weight measurements are routinely done at the outpatient department by nurses trained to do them at every visit using standard methods. During the study period a Salter Pan Scale, and Kenlee Standing scale and height measure were used for the measurements. These measurements were carried out to one decimal place.

Malnutrition in this context referred to undernutrition alone which is defined as deficiencies and imbalances in a person's intake of energy and/or nutrients. It was reported as part of the children's initial presentation or as underweight, low weight-for-age, stunting or low length/height-for-age, wasting or low weight-for-length/height or acute malnutrition, low weight-for-length/height or low mid-upper arm circumference or bilateral pitting oedema and micronutrient deficiencies or insufficiencies (a lack of important vitamins and minerals). Thus, malnutrition was classified as [17,18,19] Moderate underweight: Weight-for-age < -2SD and ≥-3SD of the Median; Severe Underweight: Weight-for-age <-3 SD of the Median; Moderate acute malnutrition (MAM): Weight-for-length/height ≤ -2SD and ≥ -3SD of the median or Mid-upper Arm Circumference ≥ 115mm and <125mm Severe Acute Malnutrition (SAM): Weight-for-length/height < -3 SD of the median or Mid-upper Arm Circumference < 115mm or bilateral pitting oedema.

Data handling and analysis

Each questionnaire was edited for completion and accuracy. The data was then entered into the computer by data entry personnel. The data was analysed with Stata version 14.2 software and frequencies, percentages, medians and interquartile range of relevant data were computed. Selected results were presented graphically and in a table. SPSS version 26 and R-STUDIO 4.2.3 were used to determine and present nutritional status using weight-for-age anthropometry. UK Growth charts were used to classify Body Mass index (BMI) in patients.

Ethical clearance

Ethical clearance was obtained from the Ghana Health Service Ethical Review Committee, Protocol ID No: GHS_ERC 03/03/16

RESULTS

Altogether, information was obtained on 324 patients who attended the clinic during the study period. Males were 199 (61.4%) whereas females were 125(38.6%). The median age was 26 months (IQR 14-41) months and majority, 69.5% (225) were under the age of 3 years and 84.1% (272) were less than 5 years old. The age range was 15 days to 182 months. The age and sex distribution of the patients are presented in Table 1. The five most common developmental conditions the children presented with were Cerebral Palsy, 24.7%, Speech and Language Delays and Social Communication Disorders (SCD), 17.0%, Genetic Syndromes and Congenital Malformations 12.7%, Global Developmental Delay (GDD) 9.6% and Epilepsy, 10.8%. Altogether, they formed about three quarters (74.8%) of the patients. Further details of the conditions the patients presented with are provided in Table 1.

Table 1 Age, Gender and Developmental conditions of patients

Characteristic		Frequency	Percentage
Age group			
	0-11 months	56	17.3
	12-35 months	169	52.2
	36-59 months	47	14.5
	≥60 months	52	16.0
Gender			
	Male	199	61.4
	Female	125	38.6
Developmental condition*			
	Cerebral palsy	80	24.7
	Autism and Speech and language delay	55	17.0
	Genetic Syndromes/Malformations	41	12.7
	Global developmental delay	31	9.6
	Epilepsy	35	10.8
	Other developmental conditions	82	25.2

*Percentages need not add up to 100 as a study participant may belong to >1 group

The feeding and nutritional problems reported by the patients and detected in the clinic are presented in Table 2. Altogether, there were 42 study participants (13.0%) who reported at least one (1) feeding problem, while the nutrition-related problems at presentation were reported in 51(15.7%) study participants. Among the feeding problems, 10 (23.8%) reported cases of delays or inability to take in solid food, 8(19.1%) reported cases of swallowing and feeding difficulties, and 8(19.1%) reported cases of vomiting or gastro-oesophageal reflux. In addition, 7(16.7%) reported cases of poor feeding including sucking problems, while 4(9.5%) reported cases of food refusal and 11 (26.2%) others reported cases of overfeeding, drooling, constipation, forced feeding and formula feeding in a child for a medical reason. Among the nutritional problems reported, malnutrition formed the highest proportion 22(43.1%), followed by poor weight gain 15(29.4%), and 6 (11.8%) reported growth problems, 4 (7.8%) had been or were being managed for severe acute malnutrition (SAM), 4(7.8%) were overweight or obese and 7(13.7%) had other growth-related problems such as intrauterine growth retardation from birth.

About a quarter of the children, 25.6% (83) were underweight, with 11.7% being mildly affected, 7.1% being moderately affected and 6.8% being severely affected as shown in Table 2. More than half, 102 (53.7%) of the 190 patients who had their haemoglobin levels checked were anaemic. Of those with anaemia, the majority were moderately anaemic, 57(30.0%), and 3(1.6%) were severely anaemic as reported in Table 2. Out of the 24 patients with feeding problems who had their haemoglobin level checked, 16 patients (66.7%) were anaemic and out of the 51 patients with nutritional problems, 36 had their haemoglobin checked and 23(63.9%) were anaemic. Anaemia was present in about a third, 30 (36.1%) out of the 83 children who were underweight with 72 out of 143 (50.4%) children with normal anthropometry.

Table 2. Feeding and Nutritional Problems of patients

Characteristic		Frequency	Percentage
Reported Feeding Problem(N=42)			
	Delayed/unable to take solids	10	3.1
	Swallowing & feeding difficulties	8	2.5
	Vomiting/GOR	8	2.5
	Poor feeding/sucking difficulties	7	2.2
	Food refusal	4	1.2
	Others	11	3.4
Nutritional problems (N=51)			
	Malnutrition	22	6.8
	Poor weight gain	16	4.9
	SAM	4	1.2
	Obesity/Overweight	4	1.2
	Growth and others	7	2.2
Nutritional status (weight for age)			
	Normal	241	74.4
	Mildly underweight	38	11.7
	Moderately underweight	23	7.1
	Severely underweight	22	6.8
Anaemia status (N=190)			
	Hb <11.0 g/dL	102	53.7
	Hb ≥11.0 g/dL	88	46.3
Anaemia status (N=190)			
	Normal	88	46.3
	Mild anaemia	42	22.1
	Moderate anaemia	57	30.0
	Severe anaemia	3	1.6

Table 3 presents further details on the weight-for-age of the children. It shows that there was no association between age less than five years (p = 0.198), anaemia status (p = 0.340), the severity of the anaemia (p=0.182) and any of the low weight-for-age categories (undernutrition). However, Table 4 shows a statistically significant association between cerebral palsy and delayed or inability to take in solids (p<0.001) as well as swallowing and feeding difficulties (p<0.001). The study also found a statistically significant association between cerebral palsy and malnutrition (p <0.001) but there was also no statistically significant association between Global Developmental Delay, Epilepsy or Genetic syndrome/ malformations or Social communication disorders and Speech and Language Delay and any of the feeding or nutritional problems. In addition, there was also no statistically significant association between Cerebral Palsy, Global Developmental delay, Epilepsy, Genetic syndromes/malformations, Social communication and Speech and language problems and anaemia status p=0.740, p=0.295. p=0.162, p=0.687 and p=0.826 respectively.

Table 3. Weight-for-age and Anaemia status of Children with Developmental conditions

	Weight-for-age category				
	Severe underweight	Moderate underweight	Mild underweight	Normal	p-value*
Age	n, %[1]	n, %[1]	n, %[1]	n, %[1]	0.198
<5 years	20 (7.4)	22 (8.1)	34 (12.5)	196 (72.1)	
≥5 years	2 (3.9)	1 (1.9)	4 (7.7)	45 (86.5)	
Hb category	n, %[2]	n, %[2]	n, %[2]	n, %[2]	0.340
Hb ≥11.0 g/dL	5 (33.3)	4 (28.6)	8 (44.4)	71 (49.6)	
Hb <11.0 g/dL	10 (66.7)	10 (71.4)	10 (55.6)	72 (50.4)	
Anaemia status	n, %[2]	n, %[2]	n, %[2]	n, %[2]	0.182
Normal	5 (33.3)	4 (28.6)	8 (44.4)	71 (49.6)	
Mild anaemia	1 (6.7)	5 (35.7)	6 (33.3)	30 (21.0)	
Moderate anaemia	8 (53.3)	5 (35.7)	4 (22.2)	40 (28.0)	
Severe anaemia	1 (6.7)	0 (0)	0 (0)	2 (1.4)	

*Fisher's exact test; [1]Row percentages; [2]Column percentages

Table 4. Relationship between developmental conditions and feeding problems

		Delayed/inability to take			Swallowing & feeding			Vomiting/GOR		
		Present n, %[1]	Absent n, %[1]	p-value *	Present n, %[1]	Absent n, %[1]	p-value *	Prese n, %[1]	Absent n, %[1]	p-value *
CP	Prese	8 (10.0)	72	***<0.00***	7 (8.8)	73	***<0.00***	3	77	0.41
	Absent	2 (0.8)	242 (99.2)		1 (0.4)	243 (99.6)		5 (2.1)	239 (97.9)	
GDD	Prese	1 (3.2)	30	1.000	1 (3.2)	30	1.000	1	30	0.55
	Absent	9 (3.1)	284 (96.9)		9 (3.1)	284 (96.9)		7 (2.4)	286 (97.6)	
Epilepsy	Prese	0 (0)	35 (100)	0.608	0 (0)	35 (100)	0.608	0 (0)	35	1.00
	Absent	10 (3.5)	279 (96.5)		10 (3.5)	279 (96.5)		8 (2.8)	281 (97.2)	
GS/ Malformation	Prese	1 (2.4)	40	1.000	1 (2.4)	40	1.000	2	39	0.26
	Absent	9 (3.2)	274 (96.8)		9 (3.2)	274 (96.8)		6 (2.1)	277 (97.9)	
Autism and SLD	Prese	0 (0)	55 (100)	0.222	0 (0)	55 (100)	0.222	1	54	1.00
	Absent	10 (3.7)	259 (96.3)		10 (3.7)	259 (96.3)		7 (2.6)	262 (97.4)	

*Fisher's exact test; [1]Row percentages

DISCUSSION

Feeding difficulties, underweight, anaemia and other nutrition-related problems were reported among these children with developmental problems. Nutritional problems such as malnutrition, treatment of SAM, poor weight gain, being overweight or obese and growth- related problems reported by the caregiver or as part of the children's presentation occurred in 15.7%, of study participants whereas feeding problems occurred in 13.0%. The reported feeding problems were mainly delay or inability to take in solid food, swallowing and feeding difficulties (dysphagia), vomiting and gastro-oesophageal reflux, poor feeding including difficulties sucking at the breast, food refusal and a case of overfeeding. Other conditions which aggravate the effect of the feeding problems such as drooling and constipation were also found. Varying degrees of malnutrition and poor weight gain were the most common presenting nutritional problems. A study of 75 children with cerebral palsy in rural Bangladesh reported undernutrition among 53.6% of them and feeding difficulties among 12% of the children [20]. Another study of children with cerebral palsy by Hariprasad et al. who studied 41 children with cerebral palsy in India, reported that 35 (85.4%) were severely underweight and moderate anaemia was present in 26(63.4%) [21]. Additionally, a study of 30 Italian children with severe neuromotor impairment revealed that 44% were

at risk of malnutrition and 4 out of the 30 had iron deficiency anaemia [22].

Having cerebral palsy was significantly associated with delayed or inability to take in solids ($p<0.001$), swallowing and feeding difficulties ($p<0.001$). Cerebral Palsy was also significantly associated with malnutrition ($p<0.001$). A study of 40 children with severe cerebral palsy from Northern Africa, reported dysphagia, constipation and gastro-oesophageal reflux in more than half of them [23]. Another study of 40 children reported mild anaemia with normal ferritin, dysphagia with low energy intake, gastroesophageal reflux and constipation among children with cerebral palsy [6]. Similar observations were made by a study of children with cerebral palsy in 4 regions of Ghana which showed that 65% of children they studied under the age of 5 years with the condition were underweight, 54% were stunted and 58% were wasted [24]. The study also reported that feeding difficulties were common and associated with poor nutritional status and poor caregiver quality of life in that study. Another study done in Ghana and a study in Kenya also made similar observations [25, 26]. The main difference was that the proportion of our patients with malnutrition was much smaller possibly because we included all patients irrespective of severity. We were unable to demonstrate a significant association between the feeding and nutrition problems and other developmental conditions possibly due to the small numbers of patients who had these problems among these groups of patients.

Low iron is one of the common micronutrient deficiencies occurring in children with developmental problems [3,27] More than half (53.2%) of the 194 patients who had their haemoglobin levels checked were anaemic and the majority were moderately or mildly affected while 3(1.5%) were severely affected. The children with anaemia were also proportionately more common in moderately and severely malnourished children suggesting nutritional anaemia due to iron deficiency. However, it also affected half of those who were not undernourished suggesting that it might also be a reflection of childhood anaemia in the population attending the clinic. A microcytic hypochromic picture of anaemia suggestive of iron deficiency anaemia due to inadequate intake is common among Ghanaian children. Although studies have reported anaemia in children with cerebral palsy [21, 22], one study reported mild anaemia with normal ferritin in some patients [6]. Therefore, it is important to determine the types of anaemia these children have. In this setting, other common causes of anaemia are malaria, haemoglobinopathies and iron deficiency due to worm infestation.

Unfortunately, iron studies such as, serum ferritin, serum iron, transferrin saturation and total iron binding capacity are not routinely done at the hospital and come at an extra cost to patients as they have to do this at KBTH or private laboratories away from the hospital. Due to these logistic and cost challenges, they are not regularly requested, thus the red cell indices are used to determine the presence of iron deficiency anaemia and the sickling test to screen for haemoglobinopathies at the clinic. Further studies to confirm the types of anaemia in these children are needed and improving the laboratory service so that all children can be properly screened for iron deficiency anaemia is necessary. Dietary advice is usually given with iron supplements when managing iron deficiency anaemia in this setting.

It is also worth noting that some of the children who did not report any nutritional problems were moderately and severely underweight or anaemic emphasising the need for screening all patients. It also implies that general measures to prevent malnutrition at the child welfare clinics are insufficient to forestall malnutrition in some of these children. The amount and quality of food eaten in infancy and childhood affect a child's growth and development and determine cognitive function and intellectual capacity [11,13]. Malnutrition further predisposes these children to immune dysfunction and reduced muscle strength, increasing the risk of aspiration pneumonia [13]. Thus, targeting these children for early detection of faltering growth and referral by training health professionals and increasing parental awareness is essential.

There have been several recommendations for managing nutritional problems in children with developmental conditions [3, 11, 10]. The European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) guidelines on dietetic management of children with neurological impairment recommend a thorough assessment to identify the gastrointestinal problems affecting each child [28]. After this, optimising oral intake is advised together with individualised care considering the child's diagnosis, mobility and nutritional status if oral feeding is safe. This is achieved by increasing the energy content of meals while minimising increases in volume and adding fat or oils, dry milk powders, cream, or ice cream. Normal fibre intake is also encouraged while medically treating constipation and gastroesophageal reflux if they occur.

It is advised that nutritional rehabilitation using the enteral route such as tube feeding and percutaneous gastrostomy/ jejunostomy should be considered if feeding is unsafe, Surgical interventions such as Nissen Fundoplication have also been suggested to treat severe gastroesophageal reflux if the indications are met. Currently, the oral route is used to rehabilitate our patients, and food supplements are mainly

provided through the Community Management of Acute Malnutrition Programme for those who meet the criteria for Severe Acute Malnutrition (SAM) and the daily feeding programme for those who meet the criteria for Moderate Acute Malnutrition (MAM). The others are given dietetic advice and a prescription for supplements such as PediaSure if they can afford it. Gastroesophageal reflux and constipation are treated with medications and patients with severe disease are referred to the Paediatric gastroenrterologist at KBTH for an endoscopy and further treatment. The enteral route has not been explored for feeding due to logistics and resource challenges in this setting, such as access to diagnostic facilities like video fluoroscopy, supplements and support from specialist nurses. However, given the findings of this study, particularly the prevalence of swallowing and feeding difficulties, to optimise dietary intake and growth, improve the quality of life of caregivers, and adhere to current international guidelines, it seems prudent to consider enteral feeding for specific patients who meet this criteria and have the necessary logistic support to sustain it. However, guidance specific to this setting will be needed to overcome the barriers.

We encountered some problems with misplaced records and missing data since this was a retrospective study thus the number of events reported was fewer than reports from other studies. The lower prevalence of malnutrition may also be because we studied patients will all conditions including those with low risk of feeding problems. We did not classify the children with cerebral palsy according to the type of gross motor function classification system, (GMFCS) as severity is reported to be associated with nutritional problems since we felt this would be more appropriate for a study on children with cerebral palsy patients alone. In addition, information on the dietary intakes of the children would have been a useful complement to this study but this was not done as this was an exploratory study. Similarly, we did not do iron studies to specifically confirm iron deficiency anaemia.

CONCLUSION

Underweight, anaemia, swallowing and feeding difficulties were the main problems identified in this current study which is similar to studies done elsewhere, however, anaemia was common. Implying that children with developmental conditions in this setting need to be targeted and screened for anaemia and other nutritional and feeding problems as early detection and dietetic support are necessary and to mitigate their effect on growth, development, and general health. Thus, raising awareness among caregivers and training health professionals to facilitate screening, identification and referral is necessary especially at the child welfare clinic. In addition, the development of appropriate guidelines for managing feeding and nutritional problems particularly regarding the indications for enteral feeding given the logistic and cost constraints is necessary as there may be a need for this service. Further study of these problems including identifying the causes of anaemia and the adequacy of dietary intake as well as making provision to investigate the safety of swallowing in those with difficulty are warranted.

Abbreviations

BMI: Body Mass Index
CDC: Centre for Disease Control
ESPGHAN: European Society for Paediatric Gastroenterological Hepatology and Nutrition
GDD: Global Developmental Delay
Hb: Haemoglobin concentration
IQR: interquartile range
PML: Princess Marie Louise Hospital
SAM: Severe Acute Malnutrition
SPSS: Statistical Package for Social Sciences
WHO: World Health Organization

Declarations

Ethics approval and consent to participate
Permission to carry out this research was obtained from the Medical Superintendent of the Princess Marie Louise Children's hospital. Ethical clearance was obtained from the Ghana Health Service Ethical Review Committee, Protocol ID No: GHS_ERC 03/03/16. As this was a retrospective study, consent forms were not administered.

Availability of data and material

The datasets used and/or analysed during the current study belong to Princess Marie Louise Children's Hospital and are available from the corresponding author on reasonable request.

Conflict of interest

The authors, EMAT, PTD, RD, JQ, CT, TAN, ETN declare no conflict of interest.

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The research was self-funded with EMAT's research allowance from University of Ghana.

Author's contribution

The contributions made by Authors were as follows: "Conceptualization, EMAT, PTD; Methodology, EMAT,

PTD, JQ, RD; Software, JQ, ETN, CT TAN; Validation, ETN, JQ, CT, TAN, EMAT; Formal Analysis: ETN, JQ, CT, TAN, EMA; Investigation, EMAT, RD.; Resources, EMAT; Data Curation, RD, ETN, JQ, CT, TN, EMAT; Writing – Original Draft Preparation, EMAT; Writing – Review & Editing, EMAT, ETN, TAN, RD , JQ, PTD, CT.; Visualization, EMAT RD, TAN, PTD, ETN, JQ, CT.; Supervision, EMAT; Project Administration, EMAT; Funding Acquisition, EMAT".

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THE EFFECT OF DIFFERENT COOKING METHODS ON VEGETABLE NITRATE CONTENT AND THE IMPLICATIONS FOR BLOOD PRESSURE AND LIPID MANAGEMENT

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Key words: Dietary nitrates; vegetables; cooking methods; blood pressure; blood lipids

Abstract

Background: Vegetables are major sources of dietary nitrates beneficial for lowering blood pressure and lipid levels. Nitrate content of vegetables can be affected by numerous factors notably by the cooking methods.

Objective: The study aimed to determine and compare the nitrate content of commonly consumed vegetables in their raw state and after undergoing different cooking methods.

Methodology: The vegetables commonly consumed by patients with non-communicable diseases were identified via 24-hour dietary recall from secondary data. The nitrate concentrations of the raw vegetables and after undergoing different cooking methods (boiling, shallow-frying, stewing, soup and abom) were determined using the steam distillation-titration method and compared using analysis of variance and Bonferroni test at a 95% confidence interval. Significance was set at $p \leq 0.05$.

Results: The highest nitrate content was recorded for raw green leafy vegetables; kontomire followed by cabbage, (171.04 ± 13.37 mg/kg and 168.24 ± 14.65 mg/kg, respectively). The lowest was onions (101.60 ± 30.41 mg/kg). All cooking methods significantly reduced nitrate content ($p < 0.05$). Boiling especially resulted in the highest percentage of nitrate losses (52% -78% compared to shallow-frying 0.39% - 37 %). All composite vegetable foods, soups, stews and abom resulted in significant nitrate losses ($p < 0.05$) compared to raw vegetables but did not differ among each other. Cabbage stew and kontomire abom recorded the highest losses (78% and 76% respectively).

INTRODUCTION

Vegetables are the most important sources of nitrate in the human diet. They contribute to the intake of more than 80% of dietary nitrates [1]. Nitrate contents in vegetables vary considerably. Dark green leafy vegetables and beetroot are especially rich sources of dietary nitrates [2], whilst fruit and vegetables are reportedly lower in nitrates compared to leafy, stem, and root vegetables [1,3]. These differences have been attributed to factors such as plant species, the part of plant consumed, environmental conditions, agricultural practices and post-harvest activities such as storage, pre-preparation, cooking, and preservation techniques [4]. Exposure to light and fertilizer applications have been recognized as the main environmental condition and agricultural practice that greatly influence nitrate accumulation in vegetables [5]. The application of nitrogen-containing fertilizers is associated with high nitrate accumulation in vegetables [1,6,7].

Apart from the nitrate loses that occur during the washing and removal of non-edible parts of vegetables, different cooking methods affect vegetable nitrate levels differently. Boiling results in the reduction of nitrate content in vegetables [1,8, 9], whilst steaming, baking and drying (oven and freeze-drying) cause insignificant losses [9, 10]. Frying tends to decrease moisture content in vegetables, as a result, higher nitrate concentrations are retained in fried vegetables [1,8].

The prevalence of non-communicable diseases (NCDs) and their risk factors are on the rise both globally [11,12] and among Ghanaians [13,14]. Over 70% of deaths relating to cardiovascular diseases are preventable through a healthy lifestyle [15]. A significant part of this is the intake of healthy diets. Vegetables form a significant part of a healthy diet. They are good sources of vitamins and minerals needed for normal body function [16], as well as nitrates that enhance vascular function and help lower blood pressure and lipids [17, 18, 19].

Accurate estimation of vegetable nitrate intake is a challenge due to the lack of a comprehensive database of nitrate contents of vegetables grown in Ghana. The use of a food database from other countries may not be applicable as the nitrate concentrations in vegetables from different locations vary. In addition, a vegetable's nitrate content is greatly influenced by how it is consumed—raw or cooked. Experimental studies investigating the nitrate contents of vegetables after undergoing various cooking methods are scarce in Ghana. This knowledge is critical for dietetic counselling on appropriate cooking methods to retain nitrate in vegetables and to provide the baseline data needed to advance research in the field of nitrate from vegetables and chronic diseases. Thus, the aim of this study was to determine and compare the nitrate content of commonly consumed vegetables in their raw state and after undergoing different cooking methods. Findings will be applied in patient counselling to assist in the management of blood pressure and lipids.

METHODS

Study participants

The types of vegetables consumed by patients with chronic non-communicable diseases were identified from 24-hour recall interviews of two hundred and seven two (272) NCD patients recruited from the Dietherapy Department of Korle-Bu Teaching Hospital (KBTH). This was obtained from secondary data [20]. The initial study determined the effectiveness of dietary and lifestyle intervention on clinical indicators of patients with chronic diseases.

The secondary data showed that patients consumed vegetables in various forms. Some vegetables were consumed in their raw state, boiled or shallow fried as salads. As salads, they could be consumed as single or mixed vegetable salads, depending on availability or preference. Others were consumed as composite vegetable foods based on traditional Ghanaian cuisine as vegetable stews, soups or abom (boiled and ground with other vegetables and served with fish and oil). This current study thus determined the nitrate content of the identified vegetables in their raw state and after undergoing the different cooking methods.

Study site

Samples of the identified vegetables were obtained from three major markets in Accra, i.e., Agblogbloshie Market, Dome Market and Shoprite at the Accra Mall. Agblogbloshie and Dome markets were selected because they are major markets in the central and eastern parts of Accra respectively. Vegetables produced from the hinterlands of Ghana are brought in and sold at these markets. Shoprite at the Accra Mall was selected to represent vegetables imported from

other countries. Cleaning, preparation, cooking and storage were carried out at the Therapeutic Catering Laboratory of the Department of Dietetics at the University of Ghana Korle Bu Campus. Determination of nitrate content using the steam distillation-titration method was carried out at the Ecological Laboratory of the Geography Department at the University of Ghana, Legon Campus.

Sampling and data collection

Vegetables were purchased on market days when new fresh produce from the farms were brought to the market. Each sample was purchased from three different vendors each day for three consecutive market days to ensure the representativeness of vegetables sold in that market. Purchased samples were immediately transported to the Therapeutic Catering Laboratory for cleaning, preparation and storage. Samples of each vegetable from each market were combined prior to preliminary processing. The samples were cleaned thoroughly under running tap water to remove dirt particles. Root vegetables were gently brushed using a vegetable brush. Green leafy vegetables were allowed to soak for a minute (1) in a 2% brine solution after washing [21]. The cleaned samples were drained off in a colander for two (2) minutes. Non-edible parts (e.g. stalks, stems damaged outer parts) of the cleaned and dried vegetables were trimmed off. Carrots were peeled as thinly as possible using a vegetable peeler. The trimmed and peeled vegetables were cut into uniform pieces using a multipurpose vegetable cutter to ensure even cooking.

Procedure for boiling, frying and preparing the vegetable stews, soups and abom

A uniform weight (25g) of each vegetable sample from each market was measured. The weighed samples were boiled, shallow fried or left uncooked/raw (control) in separate experiment groups. Procedure for Boiling
The vegetables were boiled using 50 ml boiling water (at 100°C), under medium heat (gas stove mark 160°C) in a small steel saucepan. Green leafy vegetables (lettuce, cabbage, and ayoyo) were boiled for three (3) minutes, firm vegetables (tomatoes, sweet pepper, and green beans) for six (6) minutes, and hard vegetables (carrot, onion, and garlic) for eight (8) minutes based on recommended protocol [9, 22].

Procedure for shallow frying

The vegetables were fried in 7 ml of sunflower oil over medium heat in a preheated non-stick pan. Green leafy, firm and hard vegetables were cooked for two (2), three (3) and four (4) minutes, respectively [1, 22]. The boiled and fried vegetables were allowed to drain and cool for two minutes.

Procedure for preparing the raw vegetables (control)

Raw vegetables did not undergo any further treatment after the cleaning process. Raw onion, lettuce, and cucumber (25g each) were combined in a vegetable salad and 25g was sampled for analysis.
Procedure for preparing stews, soups and abom
Stews, soups and abom (boiled vegetables ground with onions and pepper with added palm oil) were prepared utilizing knowledge of Ghanaian cuisine acquired through personal communication. Table 1 shows recipes used in preparing vegetable stews, soups and abom.

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Table 1: Recipes for preparing abom, soups, and stews.

Ingredients	Directions
Kontomire abom	Place a saucepan on medium heat, bring water to a boil, add washed cocoyam leaves, and allow boiling for 5 minutes, drain for a minute in a colander and set aside.
100 g *Kontomire* (cocoyam leaves)	
10 g *kpakpo* shito (petite bell chilli)	
60 g onion	Grind charred *momone*, *kpakpo shito*, onion, charred tomato and salt in an earthenware bowl into a smooth mixture.
30 g charred tomato	
3 g charred *momone* (fermented salted fish),	Add cooked *Kontomire*, grind until smooth, and set aside.
15 g *koobi* (salted dried tilapia)	Heat palm oil in a small saucepan over medium heat.
62 ml (¼ cups,) palm oil	Add *koobi*, stir and allow frying for a minute.
2 g salt	Pour oil onto the ground mixture and mix well.
Garden egg *abom*	Place a saucepan on medium heat, bring water to a boil add washed garden eggs and allow to boil for 10 minutes, drain for a minute in a colander and set aside.
100 g African garden eggs	
10 g *kpakpo shito* (petite bell chilli)	
60 g onion	Grind charred *momone*, *kpakpo shito*, onion, charred tomato and salt in an earthenware bowl into a smooth mixture.
30 g charred tomato	
3 g charred *momone* (fermented salted fish),	Add cooked garden eggs, grind until smooth, and set aside.
15 g *koobi* (salted dried tilapia)	Heat palm oil in a small saucepan over medium heat.
62 ml (¼ cups,) palm oil	Add *koobi*, stir and let it sweat for a minute.
2 g salt	Pour oil onto the ground mixture and mix well.
Tomato *abom*	
100 g tomato	Combine ingredients in an earthenware bowl and grind into a smooth mixture.
60 g onion	
10 g *kpakpo shito* (petite bell chilli)	
2 g salt	
***Kontomire* soup**	
100 g *Kontomire* (cocoyam leaves)	Pour beef into a saucepan over medium heat; add blended ginger, garlic and onion, salt, a cup of water, stir and let cook for 10 minutes.
60 g garden eggs	
30 g onion	Add smoked mackerel *Kontomire*, tomatoes, onion, *kpakpo shito* and let boil for 5 minutes.
10 g *kpakpo shito* (petite bell chilli)	
15 g beef	Take out boiled vegetables, blend and pour back into the mixture allow to simmer for 2 minutes.
15 g smoked mackerel	
3 g garlic	
3 g ginger	
2 g of salt	
Tomato soup	Pour beef into a saucepan over medium heat; add blended ginger, garlic and onion, salt, a cup of water, stir and let cook for 10 minutes.
100 g tomatoes	
60 g garden eggs	Add smoked mackerel, garden eggs, tomatoes, onion, and petite *kpakpo shito*, stir and allow vegetables to boil for 5 minutes then take out and blend.
30 g onion	
10 g *kpakpo shito* (petite bell chilli)	
15 g beef	Strain the blended mixture into the saucepan, stir and let simmer for 2 minutes.
15 g smoked mackerel	
3 g garlic	
3 g ginger	
2 g of salt	
***Okro* soup**	Boil grated okro in 250 ml of boiling water for 3 minutes.
100 g okro, grated	Add *Ayoyo* leaves, stir and cook for another 2 minutes and set aside.
30 g tomato	Pour beef into a saucepan over medium heat; add blended ginger, garlic and onion, salt, a cup of water, stir and let cook for 10 minutes.
30 g onion	
20 g *Ayoyo* (jute leaves)	Add smoked mackerel, tomatoes, onion, and *kpakpo shito* stir and allow vegetables to boil for 5 minutes,
10 g *kpakpo shito* (petite bell chilli)	
15 g beef	Take out boiled vegetables, blend and pour back into the mixture allow to simmer for 2 minutes and pour in boiled okro, add salt, stir and let cook for 3 minutes.
15 g smoked mackerel	
3 g garlic	
3 g ginger	
2 g of salt	

Table 1: Recipes for preparing abom, soups, and stews.

Ingredients	Directions
***Kontomire* stew** 100 g *Kontomire* (cocoyam leaves), julienned 75 g tomatoes 60 g sliced onion 10 g *kpakpo shito* (petite bell chilli) 15 g smoked mackerel 30 g ground *agushie* (white melon seeds) 44 ml (3 tbsp) palm oil 3 g garlic 3 g ginger 2 g fresh *momone* (fermented salted fish)	Pour oil into a warmed saucepan. Add *momone*, and sliced onions and let sweat for a minute under medium heat. Add blended tomatoes, pepper and garlic, stir and let simmer for 8 minutes. Add smoked salmon, stir and let simmer for 2 minutes. Mix *agushie* with water stir, pour the mixture into the sauce, cover, and let it cook for 4 minutes. Add *Kontomire*, cover and let wilt for 5 minutes and stir. Add salt, mix thoroughly, and allow to simmer for a minute.
Mixed vegetable stew 200 g tomatoes 60 g onions, sliced 30 g carrots, sliced 30 g green bell pepper, diced 30 g French beans, sliced 10 g *kpakpo shito* (petite bell chilli) 44 ml (3 tbsp) soya bean oil 3 g garlic 3 g ginger 2 g of salt	Pour oil into a warmed saucepan. Add onion, stir and let sweat for a minute over medium heat. Add blended tomatoes, *kpakpo shito*, garlic and ginger, stir and let simmer down for 10 minutes. Add carrots, cover and let it cook for 2 minutes. Add green bell pepper, French beans, and salt. Stir and allow to cook for 2 minutes.
Garden egg stew 100 g garden eggs, cubed 75 g tomatoes 60 g onion, sliced 10 g *kpakpo shito* (petite bell chilli) 15 g smoked salmon 44 ml (3 tbsp) palm oil 3 g garlic 3 g ginger 2 g *momone* (fermented salted fish) 2 g of salt	Pour palm oil into a warmed saucepan, add onions, *momone*, stir and sweat for a minute over medium heat. Add blended tomatoes, garlic, ginger and *kpakpo shito* stir and let it simmer for 8 minutes. Add smoked mackerel and allow to cook for 2 minutes Add garden eggs, stir and cover and let it cook for 7 minutes. Add salt and let it simmer for another 3 minutes.
Tomato stew 200 g tomatoes 60 g onions, sliced 10 g *kpakpo shito* (petite bell chilli) 44 ml (3 tbsp) soya bean oil 3 g garlic 3 g ginger 2 g of salt	Pour oil into a warmed saucepan. Add onion, stir and let sweat for a minute over medium heat. Add blended tomatoes, petite bell peppers, garlic and ginger, stir and let simmer down for 14 minutes. Add salt and allow to simmer for a minute.
Okro stew 100 g okro, grated 75 g tomatoes 60 g onions 20 g *Ayoyo* (jute leaves) 10 g *kpakpo shito* (petite bell chilli) 15 g smoked mackerel 44 ml (3 tbs) palm oil 3 g garlic 3 g ginger 2 g *momone* (fermented salted fish) 2 g of salt	Pour oil into a heated saucepan. Add *momone*, and sliced onions and let sweat for a minute under medium heat. Add blended tomatoes, garlic, ginger and *kpakpo shito* stir and let it simmer for 8 minutes. Add smoked mackerel, allow to cook for 2 minutes Add okro, stir and cover and let it cook for 5 minutes then add *Ayoyo* allowing simmering for 2 minutes. Add salt and let it simmer for another 3 minutes.

Table 1: Recipes for preparing abom, soups, and stews.

Ingredients	Directions
Cabbage stew	Pour oil into a warmed saucepan.
100 g cabbage, shredded	Add blended tomatoes, onion, petite bell peppers, garlic and ginger, stir and let simmer down for 7 minutes.
75 g tomatoes	
60 g onion, sliced	Add smoked mackerel and allow to cook for 3 minutes.
10 g *kpakpo shito* (petite bell chilli)	Add cabbage, cover and allow to cook for 4 minutes.
15 g smoked salmon	Add salt and allow to cook for a minute.
44 ml (3 tbs) palm oil	
3 g garlic	
3 g ginger	
2 g salt	

Determination of nitrate concentrations using the steam distillation-titration method.

The raw and cooked samples (25g each) were homogenized separately in 50 ml sterile distilled water separately for one minute using a kitchen blender (Kenwood, model: CY-440S), transferred into a zip lock bag and frozen for further analysis. Each lot was analysed in triplicates. Nitrate content in the vegetables was determined using the steam distillation-titration method [23].

Forty millilitres (40 ml) of 2 M potassium chloride (KCl) extraction solution was added to 10 g of the homogenised samples in a plastic bottle. The mixture was then shaken on an orbital shaker (Gallenkamp, model: SG95/05/087) for 30 minutes and filtered through a filter paper to obtain a clear filtrate. Using steam distillation apparatus (Buchi, model: K-314) 10 ml aliquot of the filtrate was measured into a distillation flask and mixed with 2 g of cooled ignited magnesium oxide (MgO). The mixture was distilled, and ammonium was collected into a conical flask. After distilling off the ammonium-nitrogen (NH4-N) from the filtrate in the above procedure, 0.2 g of Dervarda's alloy was added to the remaining contents in the distillation flask to reduce existing nitrate-nitrogen (NO3-N) to ammonium nitrogen (NH4-N). The mixture was distilled into a 250 ml conical flask containing 10 ml boric acid solution. The distillate was titrated against 0.01 M hydrochloric acid (HCl) until a colour change of faint pink was observed indicating the endpoint and the titre value recorded. The formula used for calculating nitrate content is as follows:

Nitrate (mg/kg) = (titre value ×0.01M HCl × 18 × volume of extract ×1000)/((weight of extract)×(volume of aliquot))

DATA ANALYSIS

Data entry, calculations and cleaning were done using Microsoft Excel version 19 after which the data were exported to and analysed using Statistical Package for Social Sciences (SPSS) version 21.0. Frequencies and percentages were used to report the types of vegetables consumed by the study participants. The mean nitrate concentration of each vegetable was computed in mg/kg ± standard deviation. One-way Analysis of Variance (ANOVA) and Independent Sample T-Test were used to analyse the variations in nitrate contents of vegetables after undergoing the different treatments at a confidence interval of 95%. Significance was set at $p < 0.05$. Post Hoc, Bonferroni test was used to identify the particular treatments which resulted in the significant difference in nitrate concentrations.

3. RESULTS

Mean Nitrate content of raw vegetables.
The mean nitrate content of raw vegetables is presented in Table 2. Kontomire recorded the highest nitrate content (171.04 ± 13.37 mg/kg) and onion the lowest (101.60 ± 30.41 mg/kg). Vegetable salad contained raw onion, lettuce, and cucumber

Table 2: Mean nitrate content of raw vegetables

Vegetable	Average Nitrate Content (mg/kg)
Kontomire (cocoyam leaves)	171.04 ± 13.37
Cabbage	168.24 ± 14.65
Green Beans	156.00 ± 11.07
Vegetable Salad	154.40 ± 23.88
Ayoyo (jute leaves)	147.72 ± 18.50
Sweet Pepper	147.20 ± 14.61
Garlic	144.00 ± 12.16
Lettuce	139.92 ± 26.22
Okro	138.72 ± 10.68
Cucumber	133.68 ± 11.66
Tomatoes	121.44 ± 25.58
Carrot	119.36 ± 23.97
Onion	101.60 ± 30.41

Nitrate contents of boiled and fried vegetables compared to raw vegetables.
The nitrate contents of boiled and fried vegetables are compared to that of raw vegetables in Table 3. Generally, boiling and frying resulted in losses of vegetable nitrate compared to raw vegetables ($p<0.05$). The losses were more significant in boiled vegetables than in fried vegetables.

Table 3: Nitrate content of different vegetables in the raw state compared to boiled and fried.

Vegetable	Mean ± SD	P-Value	95% CI		% Change
			Lower	Upper	
Cabbage		0.003*			
Raw	168.24 ± 14.65[a]		131.84	204.63	
Boiled	44.32 ± 7.17[ab]		26.51	62.12	-73.66
Fried	125.92 ± 40.75[b]		24.68	227.15	-25.15
Green Beans		0.001*			
Raw	156.00 ± 11.07[a]		128.49	183.50	
Boiled	47.92 ± 10.43[ab]		22.00	73.83	-69.28
Fried	124.32 ± 24.74[b]		62.87	185.76	-20.31
Mixed Vegetable Salad		0.005*			
Raw	154.40 ± 23.88[a]		95.07	213.72	
Boiled	52.96 ± 16.80[ab]		11.22	94.69	-65.70
Fried	122.40 ± 27.59[b]		53.87	190.92	-20.73
Ayoyo		0.078			
Raw	147.72 ± 18.50		-18.47	313.91	
Boiled	42.60 ± 25.63		-187.63	272.83	-71.16
Fried	110.40 ± 39.37		-243.34	464.14	-25.26
Sweet Pepper		0.001*			
Raw	147.20 ± 14.61[ac]		110.90	83.49	
Boiled	43.28 ± 3.64[ab]		34.23	52.32	-70.60
Fried	92.64 ± 26.96[bc]		25.66	159.61	-37.07
Garlic		0.004*			
Raw	144.00 ± 12.16[a]		113.78	174.21	
Boiled	41.92 ± 4.03[ab]		31.92	51.91	-70.89
Fried	122.16 ± 37.87[b]		28.08	216.23	-15.17

Lettuce		0.002*			
Raw	139.92 ± 26.22 [a]		74.79	205.04	
Boiled	44.16 ± 7.54 [a b]		25.42	62.89	-68.44
Fried	118.40 ± 18.51 [b]		72.42	164.37	-15.38
Cucumber		0.001*			
Raw	133.68 ± 11.66 [a]		104.72	162.63	
Boiled	29.12 ± 4.02 [a b]		19.13	39.10	-78.22
Fried	94.16 ± 29.40 [b]		21.13	167.18	-29.56
Tomatoes		0.028*			
Raw	121.44 ± 25.58 [a]		57.89	184.98	
Boiled	37.84 ± 3.02 [a]		30.33	45.34	-68.84
Fried	105.60 ± 43.54		-2.56	213.76	-13.04
Carrot		0.014*			
Raw	119.36 ± 23.97 [a]		59.80	178.91	
Boiled	40.48 ± 8.38 [a]		19.65	61.30	-66.09
Fried	103.76 ± 32.21		23.75	183.76	-13.07
Onion		0.040*			
Raw	101.60 ± 30.41		26.05	177.14	
Boiled	47.92 ± 9.49		24.33	71.50	-52.83
Fried	101.20 ± 21.53		47.70	154.69	-0.39

Nitrate content of vegetable stew, soup and abom.

Vegetable stews, soups and abom had significantly lower nitrate contents compared to raw vegetables. Levels in stews were marginally higher than in soups for most vegetables. Only garden egg and tomato abom recorded higher nitrate levels compared to their stews.

Table 4: Nitrate content of vegetable stews, soup and *abom* compared to raw vegetables.

Composite vegetable food	Mean ± SD	P-Value	95% CI		% LOSS
			Lower boundary	Upper boundary	
Kontomire		P < 0.001*			
Raw	171.04 ± 13.37[abc]		137.82	204.26	
Stew	45.28 ± 5.28 [a]		32.16	58.40	73.52
Soup	45.28 ± 5.28 [b]		29.90	59.22	73.95
Abom	39.84 ± 3.93 [c]		30.07	49.60	76.71
Garden egg		P < 0.001*			
Raw	129.52 ± 13.88 [ac]		95.03	164.01	
Stew	40.24 ± 1.47 [a]		36.60	43.88	68.93
Abom	43.12 ± 3.85 [c]		33.56	52.68	66.71
Tomatoes		P < 0.001*			
Raw	121.44 ± 25.58 [abc]		57.90	184.98	
Stew	29.76 ± 1.92 [a]		24.99	34.53	75.49
Soup	29.68 ± 5.51 [b]		23.91	43.76	72.13
Abom	33.84 ± 3.99 [c]		16.00	43.76	75.56
Okro		P < 0.001*			
Raw	138.72 ± 10.68 [a b]		112.18	165.26	
Stew	37.60 ± 2.46 [a]		31.48	43.72	72.90
Soup	36.00 ± 3.69 [b]		26.82	45.18	74.05
Cabbage		P < 0.001*			
Raw	168.24 ± 14.65 [a]		131.84	204.64	
Stew	35.68 ± 1.32 [a]		32.40	38.96	78.79
Mixed vegetable		P = 0.001*			
Raw	121.44 ± 25.58 [a]		95.08	213.72	
Stew	35.52 ± 2.09 [a]		30.32	40.72	70.75

DISCUSSION

Nitrate content of vegetables in their raw state

The top six nitrate-rich vegetables (raw) determined in this study were green and mostly leafy, except for sweet pepper and green beans which are not leafy. Kontomire (cocoyam leaves) recorded the highest nitrate content followed by cabbage. Green leafy vegetables are exceptionally rich in nitrates [2, 6], partly because nitrates are mainly produced in the mesophilic cells of plants, which are found in plant leaves [1]. The findings in this work were similar to a study conducted in Tunisia [6] which reported higher nitrate contents in green leafy vegetables, cabbage and chard. Ayoyo and lettuce, both green leafy vegetables, also had high nitrate contents in this current study, although the nitrate content in lettuce (139 ± 26.22 mg/kg) was lower compared to the amount (1079 ± 240 mg/kg) reported in Tunisia [6]. This could be attributed to the low organic matter content of most Ghanaian farmlands due to excessive mineralization and continuous cropping [24]. Nitrates are formed in the soil from the oxidation of organic waste materials such as decomposing plants and manure through the activities of nitrogen-fixing bacteria [8]. The low organic matter content of most Ghanaian soils can thus affect the nitrate content of farm soils in Ghana and subsequently the vegetables cultivated.

Similarly, the nitrate contents in cucumber (133.68 ± 11.68 mg/kg) and garden eggs (129.52 ± 13.88 mg/kg) differed from the higher contents found in two closely related vegetable species grown in Tunisia: zucchini (875 ± 97 mg/kg) and eggplant (468 ± 71 mg/kg) respectively [3]. Nitrate contents vary significantly among vegetable plant species or vegetables belonging to different botanical families [25] and between different parts of plants in decreasing order from the petiole > leaf > stem > root > inflorescence > tuber > bulb > fruit > seed. Hence bulb and fruit vegetables such as onion and tomatoes have low nitrate contents [26]. This was evident in this current study where nitrate content in decreasing order was recorded for tomatoes, carrot and onions (121.44 ± 25, 119.36 ± 23.97 and 101.60 ± 30.41, respectively). Much lower nitrate contents have been reported in Iranian tomatoes (34.67 ± 0.67 mg/kg) and onions (68.03 ± 1.34 mg/kg) [27]. Other research works from China [28] and Poland [29] have documented similar trends. The nitrate content of the raw mixed vegetable salad was observed to be higher compared to that of the individual constituent raw vegetables (Table 2). The combination of a variety of vegetables with different nitrate contents may have resulted in this increase.

Effect of cooking methods on vegetable nitrate contents

Boiling resulted in a significant reduction of nitrate content in all vegetables investigated. The nitrate contents of boiled vegetables ranged from 29.12 ± 4.02 mg/kg in boiled cucumber to 52.96 ± 16.80 mg/kg in boiled vegetable salad which were significantly lower ($p < 0.001$) compared to nitrate contents in their raw states (133.68 ± 11 and 154.40 ± 23.88) respectively (Table 3). Percentage nitrate losses ranging from 52.83% (in boiled onions) to 78.22% (in boiled cucumber) were also observed. These losses were higher compared to losses ranging from 47% to 56% reported for green leafy vegetables (Chinese cabbage, celery, lettuce and English cabbage) from Fiji [8]. The possible difference in recipes followed in the two studies could in part explain these variations. Boiling vegetables at 100□ for two to three (2-3) minutes is an optimal cooking condition that preserves approximately 70% of vegetable nitrate contents [30]. However, in this study, boiling time ranged from 3-8 minutes at 100°C depending on the type of vegetable in accordance with Ghanaian cuisine and recipes.

Shallow frying likewise resulted in nitrate losses in all vegetables investigated though to a lesser extent compared to boiling. The nitrate contents of fried vegetables ranged from 92.64 ± 26.96 mg/kg in sweet pepper to 125.92 ± 40.75 mg/kg in cabbage, which were significantly lower compared to their raw content (147.20 ± 14.61 vs 168.24 ± 14.65 respectively; $p<0.001$) Table 3. For other vegetables such as onion, carrot and tomatoes, the differences were not significant ($p = 0.999$, $p = 0.279$ and $p = 0.440$) respectively. Percentage nitrate losses in fried vegetables ranged from 0.39% in onions to 37.07% in sweet pepper. These losses are significantly lower than loses observed in boiled vegetables ($p < 0.001$). The water-soluble nature of nitrates may explain this observation. Other studies which reported an increase in nitrate content in deep fried vegetables (between 158.75% to 307.06%) [1,8]. They attributed their results to high moisture loss from prolonged (12 minutes) deep frying of vegetables in a large volume of oil in their study. This contradicted the shallow frying for 2-4 minutes done in this current study, according to traditional Ghanaian recipes. Shallow frying (stir-frying) over a relatively shorter time may have retained relatively more moisture compared to deep-frying over longer periods leading to the relatively lower nitrate contents of fried vegetables in this current study.

Composite vegetable stews are peculiar to Ghanaian and other African cuisine. In the Ghanaian population, vegetables are used to prepare stews, soups and abom.

Nitrate levels in soups, stews and abom in general, were significantly lower compared to the raw state of the main vegetable ingredient but similar among themselves. In this current study, nitrate content of 45.28 ± 5.28 mg/kg, 44.56 ± 5.90 mg/kg and 39.84 ± 3.93 mg/kg were recorded for kontomire stew, kontomire soup and kontomire abom respectively, with the least levels found in kontomire abom. The preparation of abom requires boiling vegetables separately and discarding the cooking liquid. Discarding the cooking liquid causes a reduction in nitrate contents since nitrates leach into the cooking liquid. For tomatoes however, the least amount was found in tomato soups (29.68 ± 5.51 mg/kg) probably due to its relatively higher moisture content. The cooking methods, stew, soup abom thus affected vegetable nitrate levels to similar extents. The findings are contrary to what was expected. It was expected that the addition of other ingredients to the preparation of composite foods, such as nitrate-rich drinking water and other vegetables, would have increased the nitrate content of composite foods appreciably. Further studies will need to be carried out to affirm this finding and provide possible explanation. However, findings from the nitrate contents in Iranian vegetable stews; Ghormeh (herb) stew (105.45 mg/kg), celery stew (136.76 mg/kg) and eggplant stew showed high nitrate contents, possibly due to the nitrate content of the raw ingredients and the recipes used for their preparation [31].

Effect of cooking methods on vegetable nitrate content; implications for chronic disease management.

Dietary nitrate intake has been associated with cardiovascular health benefits including, maintenance of vascular homeostasis, vascular tone and integrity, and the consequent positive effects of lowering blood pressure, preventing blood lipid oxidation, and enhancing endothelial and platelet function [32, 33, 34, 35, 36]. The process is attributed to the nitric oxide (NO) formation from dietary nitrate through the entero-salivary nitrate-nitrite-nitric oxide pathway [36]. Among a cohort of older Australian women (70 -85 years) whose vegetable nitrate intake was 67.0 ± 29.2 mg/d, each SD higher vegetable nitrate intake was associated with a lower risk of atherosclerotic vascular disease (ASVD) and all-cause mortality[37]. The success of the DASH diet in the reduction of blood pressure has partly been attributed to the high nitrate intake from nitrate-rich green leafy vegetables and salads [38], as is the WHO recommendations for the intake of vegetables as a component of a balanced diet [39].

Evidence from this current study and other studies has expounded the effect of different cooking methods on vegetable nitrate content. The findings justifies the need to suggest appropriate cooking methods as part of recommendations for vegetable intake in the management for chronic diseases. Recommendations should thus encourage the intake of raw or shallow fried salads in the Ghanaian context. Composite vegetable foods equally recorded low nitrate contents irrespective of the method used in preparation.

Nitrate content was highest for raw vegetables, especially the green leafy ones. It was followed by shallow-fried and then boiled vegetables. Cooking in all its forms invariably resulted in the reduction of vegetable nitrate content. Composite vegetable foods equally recorded low nitrate contents irrespective of the method of preparation. The findings will inform dietetic counselling of patients with non-communicable diseases, on the best cooking methods that will retain the highest nitrate content for the highest cardioprotective benefit.

ETHICS

Ethics for this research with identification number CHS-Et/M.6-4.3/2020-2021 was obtained from the Ethical and Protocol Review Committee of the College of Health Sciences, University of Ghana.

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Author contributions statement

Conceptualization and design- RKSD, MA, ESA, RTO
Data curation and analysis- ESA, EAM, PNR, RKSD
Writing- original draft - ESA, EAM, PNR, AAM, RKSD
Writing- review and editing of manuscript- ESA, RKSD, GA, MA

Data availability

The datasets analysed during the current study are available

from the corresponding author on reasonable request.

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Abstract

Lockdowns imposed following the outbreak of the novel coronavirus (COVID-19) resulted in restricted movements and general distortion of eating habits which impacted on the health of the populace. In this study, a descriptive qualitative and phenomenological approach was employed to assess the impact of COVID-19 lockdown on the dietary choices and habits among patients with type-2 diabetes in Accra, Ghana. Twenty-six (26) Patients with T2DM were purposively sampled following the principle of data saturation at the diet therapy unit of the University of Ghana Hospital. Each interview session lasted an average of 45 minutes. Information elicited included food availability and accessibility, eating behavior, physical activity and adherence to medications during the lockdown. Data analysis and interpretation were aided by the NVivo12 software and Giorgi's method. The study participants largely accessed their regular foodstuff from what they stocked up prior to the lockdown, occasional trips to the market and online shopping companies. Hence, despite some change in their dietary patterns during the lockdown, this did not include their choice of food items. An increase in eating frequency and weight gain during the period was reported by some. As with their foodstuff, majority stocked their anti-diabetes drugs prior to the lockdown; and adherence to routine medication was better during the period. In conclusion, most participants managed to maintain healthy eating habits and better adherence to anti-diabetes medication during the lockdown. However, an increase in eating frequency, reduced physical activity and weight gain was also observed.

INTRODUCTION

Diabetes is a metabolic disorder of multiple etiology characterized by chronic hyperglycaemia and disturbances in macronutrient metabolism from defects in insulin secretion, insulin action or both (WHO, 2020b). The global prevalence of type 2 diabetes mellitus (T2DM), the commonest type of diabetes, was 8.8% in 2015 and is expected to increase to 10.4% by 2040 with a greater burden in developing countries. In Ghana, the prevalence is about 6.5% and it is also expected to increase by 2040 (Kretchy et al., 2020). A healthy diet and physically active lifestyle are universally recognized as fundamental for the prevention and management of T2DM. Unfortunately, total and partial lockdowns that were imposed in several countries to curb the spread of COVID-19 had some negative consequences on nutrition, health and lifestyle behaviours among the general population.

On one hand, the restriction of movement resulted in limited flow of food to markets causing food prices to rise, while availability, accessibility and choices reduced. However, there is also evidence that in some cases people ate more, both in terms of quantity and frequency. For instance, a study of dietary choices and habits during COVID-19 lockdown in Poland showed that about 43.0 % of participants ate more food and 52 % snacked more often (Sidor and Rzymski, 2020). The same study further reported increased intake of meat, dairy, fast-food and alcohol, while fruit and vegetable consumption decreased (Sidor and Rzymski, 2020). In Brazil, a study by Barone et al., (2020) on the impact of COVID-19 among 1701 patients with diabetes reported that majority of those who checked their blood glucose levels at home (91.5 %) during the pandemic had an increase or higher variability in glucose levels. Coupled with reduced opportunities for physical activity, the lockdown encouraged an obesogenic environment (Ansah et al., 2020). Such an environment is detrimental for T2DM patients as proper management of their condition requires adherence to healthy eating and lifestyle recommendations (Maiorino et al., 2017; Kretchy et al., 2020). Mandatory quarantine is also known to be associated with a high prevalence of psychological distress including emotional disturbance and exhaustion, insomnia, irritability, and depression (Sidor & Rzymski, 2020). In turn, such stressful conditions have been shown to cause deterioration in glycemic control among diabetic patients (Ahola et al., 2020).

As evidenced by various studies in different parts of the world (Carrol et al., 2020; Ruiz-Roso et al., 2020; Sidor and Rzymski, 2020), dietary choices and habits of diabetes patients were easily compromised during COVID-19 lockdown (Figure 1). Hence, knowledge of the specific challenges that people with diabetes face and their coping strategies during emergencies such as the COVID-19 pandemic and subsequent lockdown is needed. Studies on the impact of COVID-19 and the lockdown measures on various aspects of nutrition continue to emerge, but comparatively few have focused specifically on T2DM patients (Barone et al., 2020; Ruiz-Roso et al., (2020), or to the best of the authors' knowledge, on T2DM patients in Sub-Saharan Africa (Mekonnen et al., 2021). This current study therefore, investigated the experiences of T2DM patients concerning their dietary choices and habits during the COVID-19 lockdown in Accra. It also provides insightful information that can be used to formulate effective strategies to lessen the negative impact on the nutritional health of T2DM patients should a similar crisis occur in future.

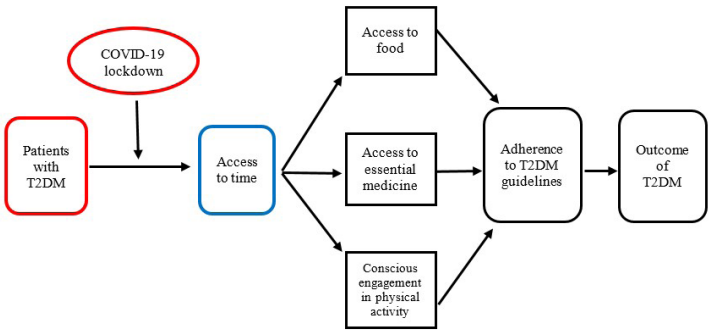

Figure 1: Conceptual framework of the impact of COVID-19 lockdown on the dietary choices and habits among patients with type-2 diabetes.

Source: Authors' construct.

STUDY SITE

The study was conducted at the University of Ghana Hospital, Legon in the Greater Accra Region. The hospital which has a bed capacity of six hundred and fifty (650), is located in the southern village of the University of Ghana and provides both in-patient and out-patient health care services to staff and students at the University as well as the general public. They include dental, maternity, eye, public health, surgery, obstetrics, and gynaecology services. Additionally, there are specialist consultancy services available for surgical procedures, obstetrics and gynaecology, paediatrics, internal medicine, diabetics, dermatology, ear, nose and throat and also orthopaedics. The diet therapy department of the hospital manages patients with hypertension, diabetes, cardiovascular diseases, obesity, dyslipidaemia among others. Apart from the general services provided, specialist dietetics consultation for patients with diabetes is offered on Fridays. The department also supports educational institutions to train nutrition and dietetics students.

STUDY POPULATION

The study population consisted of persons with T2DM who attended the Legon hospital for diabetes care during the study period and met the eligibility criteria. The participants were old cases of T2DM (diagnosed before the onset of covid-19) who were residents in Accra before and during the lockdown.

INCLUSION AND EXCLUSION CRITERIA
INCLUSION CRITERIA

Eligible participants recruited for the study were adults aged 18 years and above, diagnosed with T2DM before the onset of COVID-19 and who resided in Accra before and during the COVID-19 lockdown. They also visited the Legon hospital diabetes clinic at least once a month (regular attendees) before the outbreak of Covid-19. Each participant was capable of providing informed consent and did so prior to their enrolment into the study.

EXCLUSION CRITERIA

Patients who attended the Legon hospital diabetes clinic and were resident in Accra but did not spend the COVID-19 lockdown period in Accra were excluded.

SAMPLING
SAMPLE SIZE

The sample size for the study was determined following the principle of data saturation. Therefore, all consenting patients who met the selection criteria for the study were enrolled until the point where no new data and/or theme and/or dimension emerged in the interviews. A total of 26 was obtained.

SAMPLING TECHNIQUE

The study participants were purposively sampled.
DATA COLLECTION
DATA COLLECTION TOOL

A total of twenty-six (26) in-depth face-to-face interviews were conducted at the study site. The tool used in data collection was an interview guide which was designed with the use of relevant literature in similar studies, expert opinions

(Ruiz-Roso et al., 2020; Sankar et al., 2020) and the themes of the study objectives. The interview guide contained open-ended questions that explored the demographic characteristics, eating patterns, medication adherence and physical activity levels of participants, ways in which the pattern changed during the lockdown and if the changes persisted beyond the lockdown. Data collection covered six (6) weeks, from 5th July, 2021 to 17th September, 2021.

DATA COLLECTION PROCEDURE

Approval from the hospital administrator and the head of the dietherapy unit was obtained prior to data collection. Arrangements were also made to conduct forty-five (45) minutes of in-depth interviews in a separate and private space within the hospital to ensure participants' privacy. All interviews were conducted in English since all the study participants were literate. Direct observation and written notes were also taken during all interview sessions. The broad themes explored in the study included the number of meals consumed per day, meal timing, food acquisition, typical portion sizes, food choices, alcohol use as well as adherence to medication and engagement in physical activities. Eligible participants were furnished with an information sheet (Appendix I) and written informed consent was obtained from them to ensure voluntary participation. Additional consent was further obtained from participants to electronically record the interview sections. Written notes were also taken in the course of the interview, to capture any additional or vital information and non-verbal gestures. The audio recordings were later transcribed and the written notes interpreted with the help of a research data analyst. All data collected was checked at the completion of each interview to ensure that all questions had been asked, and all the answers had been recorded and/or written clearly. This process was repeated at the end of each day to check all the data collected that day. All COVID-19 safety protocols like hand washing, use of alcohol-based hand rub, wearing of a nose mask and social distancing were observed at all in-person sessions with the study participants.

VALIDITY AND RELIABILITY STRATEGIES

To achieve validity and reliability, data collection tools were pre-tested among five (5) T2DM patients at the National Diabetes Research Center in the Korle-bu Teaching Hospital. The responses obtained were compared to determine the consistency in the understanding of questions and address any disparities. The data collection tools were restructured around the responses derived from the pre-test. The sex of participants was included and questions that produced repeated answers were modified to improve clarity, accuracy and reduce interview duration.

The study was designed to satisfy the four main criteria proposed in the evaluation of the quality (reliability and validity) of qualitative research, namely credibility, dependability, conformability and transferability (Lincoln and Guba, 1985; Sohani and Fahmy, 2020). To ensure credibility, each study participant was engaged in a forty-five (45) minute face-to-face semi-structured interview, where non-verbal clues were observed and additional information obtained were written down. An audit trail (Merriam, 2019) and a code recode strategy was adopted. The transcribed text was read several times to make a general sense of the experiences of the study participants and to extract relevant information concerning the phenomenon under study. The meanings were categorized into major themes and subthemes per the study objectives. This process was repeated by another member of the study team to confirm the initial results before data analysis.
All the data obtained were presented as collected without any manipulations and verbatim analysis employed. The study processes, participant information, the purpose and aim of the study, the researcher's information and the relationship were clearly stated and participants were also furnished with the study purpose and aim prior to each interview.

DATA ANALYSIS AND PRESENTATION

The data were analyzed in six phases according to Giorgi's method (Giorgi, 1986). The six steps involved the reading and rereading of the transcribed interviews. This was done to ensure an accurate interpretation of the information gathered. In the second step, meaning units were identified and significant terms were coded. In stage three the meaning units were further regrouped in such a manner that each unit related to the objectives of the research. In step four, the units were then synthesized by transforming them into descriptive expressions. The fifth step involved analysis of the transformed units, focusing on intentionality. Then, finally, the descriptions were developed to reflect the experiences of the respondents. The organization of the quotes and units from the interviews that were significant to the study was aided by the use of NVivo 12 software.

ETHICAL ISSUES

Ethics approval was obtained from the Ethics and Protocol Review Committee of the College of Health Sciences, University of Ghana (CHS-Et-M.5/-4.12/2020-2021). The objectives of the study were explained to the participants

after which they were made to provide written informed consent. Confidentiality was ensured at all times and no data by which individual participants can be identified is published. All the necessary protocols and permissions at the study site were also obtained before the onset of the study.

RESULTS

BACKGROUND OF STUDY PARTICIPANTS

The background characteristics of the study participants is presented in Table 1. The majority of the participants were female (53.8%). All the participants had received some formal education with the majority having attained tertiary education (18; 69.2 %).

Table 1 Demographic distribution of study participants (n = 26).

Characteristic		n (%) or mean ± SD
Gender	Male	12 (46.2)
	Female	14 (53.8)
Age (years)		53 ± 7.2
	<40	8 (30.8)
	40-59	6 (23.1)
	60>	12 (46.2)
Level of education	Junior high school	4 (15.4)
	Senior high school	4 (15.4
	Tertiary	18 (69.2)
Religion	Christian	18 (69.2)
	Muslim	8 (30.8)
Marital status	Marriage	24 (92.3)
	Single	2 (7.7)
Occupation	Unemployed	2 (7.7)
	Housewife	4 (15.4)
	Teacher	2 (7.7)
	Health technicians	4 (15.4)
	Dental nurse	2 (7.7)
	Caterer	2 (7.7)
	Doctor	1 (3.8)
	Administrators	3 (11.5)
	Traders	6 (23.1)

THEMES EMERGING FROM INTERVIEWS/ DISCUSSION

The findings were summarized into four themes.

DIETARY CHOICES AND HABITS OF T2DM PATIENTS DURING THE COVID-19 LOCKDOWN

Almost all the participants asserted that their dietary choices and habits did not change substantially during the Covid-19 confinement. They had access to most of their usual foodstuff through stocking, occasional market visits, from food hawkers and online shopping companies. For this reason, all participants confirmed no deviation from their usual meal pattern and the type of foods they consumed prior to the lockdown. They had access to and ate as much vegetables, fruits, grains, dried and fresh fish as recommended by their dieticians prior to the lockdown. Some of the usual foodstuff participants reported access to are; vegetables (ademe, okro, garden-egg, tomatoes, green pepper, cucumber and onion), fruits (orange, apple, grapes and banana), grains (maize, rice, millet, wheat, oat, tombrown, brown bread), legumes, seeds and nuts (beans, groundnut, almond), fats and oil (sunflower oil, olive oil, vegetable oil), roots and tubers (yam, cocoyam, cassava), animal and animal products foods (low-fat milk, egg, fresh fish, dried fish, herrings). They prepared and ate their usual meals like oat and wheat porridges, 'tuo zafi', banku, kenkey, okro soup or stew and light soup, rice dishes, tomatoes, garden egg and kontomere stews, grilled/fresh fish, smoked/fresh meat. Some participants (particularly, trading) who bought cooked meals in the market or mostly ordered their lunch before the lockdown, indicated that they engaged in cooking at home and eating more homemade meals during the lockdown.

"As for the ingredients '. I just order from the food shopping company and they deliver them to me. Oh, I could buy anything from them. Food like tomatoes,pepper, okro, pawpaw etc…anything depending on the food I want to prepare. I had time to rest and I could cook for myself because I was always at home but first derr I was buying. It helped me r" (Participant 3)

"No ooh!, there was no difference in the way I used to eat duringthe period. I had access to all the foodstuff I used to eat.My daughter gets thefoodstuff from the same Madina market every market day since it was allowed to go to market… She buysthe usual food ingredients …. Like tomatoes, green pepper and my oranges" (Participant 10)."….ooh you could come to market and buy. They said you were allowed to go and buy things like foodstuff, so we only go to buy what we want during that time. I alwaysbuy the fruit small so that it will not spoil.I can buy banana, orange, fish,tomatoes"(Participant 11)"Me, I didn't have a problem at all. I eat everything I want because my children brought me a lot of food and I put them in the fridge. When it finishes I call and they buy me some again." (Participants16).

EFFECT OF THE LOCKDOWN ON PATIENTS' ADHERENCE TO THE DIETARY MANAGEMENT OF T2DM

It was observed that while some participants ceased the extra time opportunity presented by the lockdown to their advantage by improving on their dietary adherence for the management of their condition, others defaulted from it. All the participants reported that they ensured the consumption of vegetables, fruits, whole grains, low cholesterol oils and fish as part of their daily meals. They also reported being cautious about the quantity of fat they consumed because they knew it was unhealthy for their health. About three-quarters of the participants indicated that they ate the same amount of fruits, a few ate more carbohydrates and vegetables and almost all ate the same amount of fatty foods during the lockdown as they did before. Some participants particularly the female public workers between the ages of 40 - 59 reported that during the lockdown, they ate more frequently than usual, snacking on brown bread, soft drinks and biscuits. On the contrary, participants who worked in business or trading, reported that they were able to stick to consuming three main meals and one or two snacks as recommended by their dieticians.

Some participants, mostly the traders and a few public workers confirmed skipping mostly breakfast before the lockdown. They attributed the habit to the necessity of early set-off to work to dodge traffic and for this reason, they could not prepare breakfast and sometimes forget to eat after they arrive at work due to workload. However, they reported that during the lockdown, they were able to consume breakfast regularly, usually by 8:00 am. Similarly, a majority of the participants reported that they could have supper before 6:00 pm each day during the lockdown, where previously they hardly did so before 7:00 pm as recommended because they arrive home late from work due to heavy traffic . Some public workers reported skipping meals or eating late on their shift days.

"Oh, not really, I think the lockdown even offered me the greatest opportunity to stick to my diet because I was at home and so I eat when the time is due for me to eat. I eat morning food by 8:00 am, afternoon at 1:00 pm but sometimes 12:00 pm if I am hungry and evening derr by 6:00 pm. my fruits too sometimes one or two times before I eat the afternoon food. Erh! I will say it was helpful" (Participant 1).
"Because of the lockdown I was doing better. There was err! every food. What I was asked to eat by the dietician that is what I eat. I eat at the time on the paper they gave me. 7:30 in the morning I mostly eat oat, salad and brown bread, afternoon and evening… either rice or banku with okro. I use not to eat so much because of my condition so err! that helped my sugar level to reduce" (Participant 5).
"I was eating basa basa ……each time children complained of hunger I also eat with them which was not really what I use to do.
But it was mostly fruits and some drinks" (Participant 9).
"On my off days I eat more than three times. Any time I open the fridge I will cut bread or put any handy food into my mouth. The working days was better for me …… work will keep me occupy. But
I don't eat too much oil and I don't miss my fruits every day (Participant 18)
"Staying home hmm in between meals too will come.... sometimes you can see something and say let me taste some and before you know you have finished all. So sometimes you also end up eating certain things that you shouldn't have eaten like the children's cocacola or biscuits. Maybe if the lockdown was not there you wouldn't have had access to that food" (Participant 24).

ADHERENCE TO MEDICATION FOR THE MANAGEMENT OF T2DM DURING COVID-19 LOCKDOWN

The study participants were asked whether or not the COVID-19 lockdown had any bearing on their adherence to their medications during the period. The general response elicited from almost all the respondents was that it had very little or no effect on their adherence to the routine medications for their condition. Most of them had enough stock of their essential medicines before the lockdown. Having time at home also ensured they took the medications on time, without fail or interruptions. For patients who had stockouts, accessing the medications from the nearest pharmacy shops in their vicinities was not much of a challenge since there was some ease of movement, particularly for persons who needed to access essential medicines for their ailments and also to avoid contracting corona virus at the hospital.
"I was taking it without any problem. When I run out of drugs, I go to the chemist shop to buy some instead of coming to the hospital because it was closer and I didn't want to risk coming to the hospital" (Participant 9).
"Oh, I was getting them alright err you errm I was coming to the specialist hospital and this place one Doctor aaam. I bet you when this Doctor wants to give you medicine! this bag even is small. so likely when I came he give me for three months but before three months come the drugs will still be there then she will add another one. So likely for me the lockdown come I continue with the rest even up to this year even I can say some of the drugs are still with me ahaaa!"

(Participant 16).

Only one participant failed to stock his anti-diabetes drugs prior to the lockdown and failed to restock when he ran short during the lockdown. The participant was denied access to the hospital premises in an attempt to restock and for this reason, he stayed off the medication during the lockdown.

"Lockdown did not help me in particular because during that time, it came at the time my medication was finished and I remember I was coming down and I am at Akoti and the security personnel at the gate there will not allow me in despite all the explanations I gave. You see, they said I should go to and I said I work here so I attend hospital here and I am booked for everything here. So, it made me stop you know taking even the medication. So, for one year, I wasn't on any medication. So, it was until last month June 5th that I had the crisis" (Participant 3).

EFFECT OF COVID-19 ON PATIENTS' WEIGHT, EXERCISE, ALCOHOL INTAKE AND SMOKING.

A majority of the study participants notably those aged sixty years did not exercise at all either before or during the lockdown. A few participants, particularly the female public sector workers who exercised sporadically before the lockdown did not exercise at all during the lockdown. Some who said they engaged in physical activity before the lockdown reported that they reduced the frequency and duration during the lockdown.

"The exercise has been a problem.... not even during the lockdown but on normal days too. It is one area I have not been able to comply, it's been difficult for me he he he! That is one area I must try as much as possible to start doing something. Exercise has been a problem for me I haven't been able to do it at all. .... lockdown, I will say it made it worse because the nature of the work that I do will not allow me to sit around. So, I will say when I am work it helps me rather than when I am at home" (Participant 8).
"Before the lockdown, every morning I walk to the overhead bridge with my son and I use to go to the market to trade so I walk around but during the COVID-19 restrictions I stopped going to the market" (Participant 20).
Though the study participants were not entirely sure of their weight before and during the restriction, those who ceased the time on hand coupled with the leisure of availability of food and increased snacking frequency asserted to have put on a few kilograms of weight during the lockdown relative to the period preceding it.
"……..during the lockdown my weight increased a little bit, after the lockdown my weight started coming down rather" (Participant 11).
"I ate a little more during the COVID-19 lockdown..... well I have increased a little weight but I can't tell my weight" (Participant 22). All the participants admitted that alcohol intake has not been part of their lifestyles since they were diagnosed with T2DM and they had not taken alcohol in many years even before the COVID-19 restrictions. Smoking had never been part of the lifestyle of any of the participants.
"No oo I don't. It has been more than four to five years now I have not taken any alcohol" (Participant 11).
"No no no long before the lockdown I had stopped taking alcohol and I don't smoke at all" (Participant 13).

DISCUSSION

4.1 Dietary choices and habits of patients with diabetes during the Covid-19 lockdown
One of the objectives of this study was to find out how the COVID-19 lockdown affected the dietary choices and habits of the study participants. According to the findings of this study, the majority of the participants did not have problems with access to the foods they used to consume on a regular basis before the confinement experienced during the lockdown. As a result, though they experienced slight changes in their meal preparation and meal timing, they reported no change in the food items consumed.
This was because they had either stocked food or accessed their usual foodstuff from the market or food hawkers or online food shopping companies. Their usual food items such as vegetables, fruits, whole grains, meat, fish and even non-food essential items like drugs could be accessed from these outlets. Thus, they continued to prepare and consume their usual meals such as tea (decaffeinated) and whole-grain porridges (Oats, Tombrown, rice) with brown bread and low-fat milk for breakfast, rice dishes (Jollof, Wakye, rice balls), vegetable stews (Garden-egg, Kontomere stew) and soupy foods (Banku, T.Z, Fufu with light soup, okro or ademe soup and fish or chicken) for lunch or supper and vegetable salads (bell peppers, cucumber, carrot, lettuce) and fruits (apple, banana, grapes) for snack. This observation was not unexpected since markets, food vendors and other food service outlets were among the essential businesses allowed

to operate during the lockdown. Furthermore, immediately following the announcement of the impending lockdown, there were reports of panic buying, including overstocking of food among segments of the general public, in anticipation of a prolonged confinement period.

The major change in dietary pattern observed was a switch from eating away from home before the lockdown to eating home-prepared meals during the lockdown, especially among participants who were traders. The availability of time due to the confinement and relatively limited access to sold cooked meals increased the likelihood of eating home-cooked meals. Most participants particularly those in the business of trading improved on their meal timing. Cooking and consuming homemade dishes offers one the power to have control over what to eat and when to eat and thus a way to achieve healthy eating. Similarly, Altusseini and Alqahtani (2020), reported an increase in healthy food rating from 23.3% before the lockdown to 29.5% among study participants during the lockdown as well as an increase in the number of participants who eat from home during the lockdown. The improvement in the healthy eating pattern was associated with the increased shift to consuming homemade meals. They recommended interventions that motivate home cooking as a channel for incorporating healthy food items into meals.

ADHERENCE TO DIETARY GUIDELINES FOR THE MANAGEMENT OF T2DM DURING THE COVID-19 LOCKDOWN

Dietary management of diabetes is crucial for maintaining stable blood glucose levels within normal ranges. Diet management of T2DM should focus on the portion size of food, frequency of eating and quality of food components (Rolfes et al., 2020).

Although there is no particular diet recommended for the management of T2DM, following the DASH diet, Mediterranean diet, vegetarian diet or a combination have been shown to improve blood glucose levels (Maiorino et al., 2017). The similarities in these dietary patterns are the promotion of lots of fruits, whole grains, vegetables and a moderate amount of red meat and healthy fats consumption.

FOOD QUALITY AND FREQUENCY OF INTAKE

It was observed that participants generally made healthy food choices and almost all of them seemed cautious of what they consumed during the lockdown. An increase in vegetables and fruits and moderate fat consumption was observed among most participants. However, there was an increase in carbohydrate intake among a few participants through frequent snacking mainly because of their consistent exposure to food, which was further exacerbated by the constant request from children to eat between meals. The majority of the participants who increased snacking did so with either brown bread or fruits. Therefore, although the snacks increased their carbohydrate intake, so would their fibre intake. A few participants however snacked on refined carbohydrate foods such as soft drinks and biscuits. Most participants were careful about their fat intake and ate as little fat as possible, but a few others confirmed that they consumed more fried foods (fried egg and meat) on occasion during the lockdown. Overall, the study observed an increased intake of fruits, vegetables and whole grains as well as little fat consumption among the majority of the participants which can be linked to the increased shift to home meal preparations and consumption. The observed dietary pattern may be far from the Mediterranean or vegetarian dietary pattern. Nonetheless, it might have had a positive effect on their blood sugar levels especially if consumed in the right quantities. On the other hand, frequent snacking on carbohydrate-rich foods can negatively impact blood sugar levels which put one at risk of complications such as hyperglycemia (ADA, 2021a).

These observations somewhat contrast the findings of Ansah et al., (2020) who explored the dietary pattern and physical activity of 27 Ghanaians who lived between 7 to 21 days in Accra, Tema and Kumasi during the COVID-19 lockdown and found poor dietary habits with fewer participants reporting self-conscious eating behaviours while the majority ate more snacks. The trend in this current study however was similar to those of Ruiz-Roso et al., (2020) that examined the impact of the covid-19 on the nutritional habits, exercise habits and psychological effects in patients with T2DM in Spain. They observed an improvement in vegetable consumption (27.1 % to 40 %), a decline in the number of patients who avoided sugary foods (74.3 % to 67.1 %) and an increase in the frequency of snacking (2.9 % to 5.7 %) among study participants. The study concluded that there was a decline in healthy lifestyle among those who snacked frequently and anticipated the likelihood of participants maintaining the negative snacking habits after the lifting of the lockdown restrictions. Such behaviour can worsen their diabetes status as well as their general health. An unhealthy diet is associated with uncontrolled serum glucose, progression of the disease, and increased vulnerability to other cardiovascular diseases (Martín-Peláez et al., 2020).

MEAL TIMING

Meal timing and calorie distribution can influence blood glucose substantially (Ahola et al., 2019). Skipping meals especially breakfast is considered an unhealthy lifestyle that is associated with an increased risk of T2DM as well as hyperglycemia (Ahola et al., 2019). This study observed an improvement in meal timing among the majority of the study participants especially the traders. The main reason for skipping meals is lack of time as well as inability to cook, loss of appetite and feeling full (Santos et al., 2018). Most participants were able to eat their breakfast and supper on time during the lockdown because they spent more time at home and did not have to set off early to dodge traffic, catch up with business or take their children to school. Therefore, during lockdown most participants ate breakfast latest by 8:00 am and supper by 6:00 pm. Depending on the day, they either took one or two snacks between meals. The timing of lunch did not seem to be a problem for almost all the participants even before lockdown because they would have settled at their workplaces and had enough time to access food. Skipping of meals did not happen during the lockdown for most participants but a few (specifically health workers) either missed their breakfast or ate breakfast and supper late on days they had to report to work. Regular and timely consumption of meals especially breakfast is likely to lead to better blood glucose control and less risk of developing cardiac diseases, hypercholesterolemia and hypertension (St-Onge et al., 2017; Santos et al., 2018). On the other hand, skipping meals e.g. breakfast, is likely to result in eating more later in the day in addition to the risk of experiencing hypoglycaemia, hyperglycaemia, altered cardiac function, weight gain, nutrient deficiencies, central obesity, altered memory function and low-grade inflammation (Santos et al., 2018).

The findings of Ahola et al., (2019) confirmed an increased consumption of energy among study participants who skipped breakfast later in the day (lunch and supper) compared to those who ate breakfast. They however stated that even though an overload of calories at a meal is associated with poor glycemic control, no significant difference was found between the glycemic index of T1DM patients who skipped breakfast and those who did not. The study findings of Iglay et al., (2016) emphasise the risk of complications with poor glycemic control and the presence of comorbidities. The study reported the presence of one or more comorbidities in about 90 % of over 1.3 million T2DM study participants which included hypertension (82.1%), overweight/obesity (78.2 %), hyperlipidaemia (77.2 %), chronic kidney disease (24.1 %) and cardiovascular disease (21.6 %). The study also indicated an increased risk for skin, bone, eye, ear, gastrointestinal, urinary tract, and respiratory infections with a significant increase in hospitalization and mortality rates among DM patients with uncontrolled serum glucose levels. They as well associated poor glycemic control with impaired immune function and severe infections. A well spread-out calorie throughout the day with meals consumed at the right time is therefore essential for blood glucose control among patients with T2DM.

MEDICATION ADHERENCE EXPERIENCED BY PATIENTS WITH DIABETES DURING THE LOCKDOWN

Patients with diabetes need to adhere not only to their diet plans but also to their medications to reduce the chances of developing complications and thereby improve their health status and quality of life (Kretchy et al., 2020). In general, the COVID-19 restrictions limited patient visits to health facilities as well as access to medical care (Tao et al., 2020). Medication compliance can be influenced by age, family support, feeling worse and the fear of developing diabetes-related complications (Tao et al., 2020).

Almost all the participants stocked up enough anti-diabetes medications in anticipation of a long movement restriction prior to the lockdown. Some adopted to restocking their anti-diabetes drugs from various pharmacy shops in their localities since access to the health facility was challenging. Only one participant accessed drugs from the health facility and this was because she was a staff of the health facility under study. Most of these participants cited the fear of contracting the coronavirus as the reason for avoiding hospital visits during the Covid-19 lockdown. This trend confirms a general reduction in patient-health care provider contact and hospital visitation. The findings concur with the report by Tao et al., (2020) who found that fear of contracting the coronavirus by both health care providers and patients resulted in a general reduction in the frequency of hospital visits, reduction in health worker-patient contact and complete avoidance of hospital visitation by patients with diabetes. Participants confirmed that less engagement with work or businesses and the constant reminder from their wards and spouses during the lockdown ensured the timely intake of their medications as well as time for self-care. Availability of drugs and time facilitated the increased number of participants who adhered to the timing of medication intake. It is therefore essential for patients with T2DM to keep a reserve of their essential medications in

preparedness for reasons that may incapacitate them from accessing their medications from the health facility such as the Covid-19 lockdown. The support of family members should not be overlooked in the management of diabetes.
The only participant who skipped his medication due to the inability to access the health facility reported that he run into crisis after a year of staying off medication. This, therefore, confirms a high risk of relapse or developing other medical complications with total and or poor medication adherence among T2DM during restrictions such as Covid-19 lockdown

Although prior stocking of medication was appropriate for ensuring continuous adherence to the management of T2DM and to prevent relapse, patients who needed a change of medication in the course of the lockdown may be missed and this may negatively affect their health in time. Kretchy et al., (2020) emphasized that patients who needed a change or replacement of medication, as well as information on medication use, could be missed out due to movement restriction and fear of any pandemic. The consequences of this can be unsafe self-medication and increased use of over-the-counter medication due to the inability of patients to replenish their medications from the health facility. M Tourkmani et al., (2021) emphasized the benefits of telehealth on glycemic control among T2DM patients during the COVID-19 lockdown. Their study revealed a successful transition from face-to-face consultation to virtual consultation and a significant decrease in HbA1C of the study participants from pre-intervention to post-intervention among study participants. The study recommended the use of telehealth as an appropriate channel for such group of individuals to keep up-to-date information on medications from their physicians (M Tourkmani et al., 2021). Community strategy in the pharmacological management of diabetes during such confinement should also be considered to help prevent or reduce unsafe self-medication and the use of over-the-counter drugs during such times (Kretchy et al., 2020).

PHYSICAL ACTIVITY LEVEL AND WEIGHT CONTROL DURING THE LOCKDOWN

Physical activity is highly important in diabetes management (Ginszt et al., 2018). It improves insulin sensitivity, control weight, reduces mortality and boosts immune function thus reducing the risk of infections such as Covid-19 (ADA, 2021b). The American Diabetes Association recommend moderate exercise such as brisk walking for the management of diabetes. In this study, a reduction in physical activity was observed among a majority of the participants particularly those above sixty years and public workers. A few of the elderly (>60 years) participants did not exercise (even before the lockdown) because of constant knee and other body pains. More than half of the participants who habitually engaged in outdoor brisk walking and jogging before the lockdown encountered interruptions in their exercise routine for the fear of contracting Covid-19 or being assaulted by the state security personnel on patrol. While some in this group completely halted exercise, others reduced the frequency and duration of exercising from thirty minutes five times a week or twenty minutes every morning and evening to thirty minutes once or twice a week or twenty minutes either morning or evening respectively.

Physical inactivity increases the risk of glucose insensitivity, altered cardiac function and weight gain (Ginszt et al., 2018). Although participants had more time on their hands, much of it was spent in sedentary activities such as cooking, watching television and sleeping. These observations show that more than just time is needed for individuals to avoid a sedentary lifestyle and pursue a more physically active one. Resistance exercise (push-ups, sit-ups, squats and step-ups), aerobics (running, cycling, swimming and walking) or a combination of both for at least thirty minutes, five times a week improves insulin sensitivity, strengthen the muscles and improve cardiac function with an overall positive effect on glycemic control (ADA, 2021b; Ginszt et al., 2018). The type of physical activity, duration and intensity engaged in should be based on the individual's health status. Family walking around homes, engaging in dancing competitions with kids, playing football as a family are some ways through which study participants could have increased their activity levels without stepping out of their homes during the lockdown.

Weight control is a crucial component in the management of T2DM. A healthy weight and BMI have been associated with good glycemic control while overweight and obesity is associated with hyperglycemia, altered immunity among other complications (Sisodia and Chouhan, 2019). The risk of T2DM can be reduced by 58 % with 7% body weight loss and engaging in exercise thirty minutes a day, at least five times a week (ADA, 2021a). Weight gain was reported by a few participants who indicated an increase in snacking and less exercise, although they could not tell the exact number of kilograms (kg) gained. Most of those who frequently snacked were females, probably because they get more exposed to food when cooking and feeding their wards. Among persons with T2DM, weight gain increases the risk of insulin resistance, poor glycemic index and infections such as Covid-19 (Biamonte et al., 2021; Sankar et al.,

2020). On the other hand, regular exercise, losing modest weight (≥ 5 % but <10%) and keeping body weight within recommended limits can improve blood glucose control as well as minimize complications and resolve diseases (Apovian et al., 2019).

OTHER LIFESTYLE ISSUES (ALCOHOL CONSUMPTION AND SMOKING)

The American Diabetes Association guidelines recommend the cessation of smoking and alcohol consumption as one of the most important steps in the prevention of diabetes-related complications such as macrovascular and microvascular diseases, reduced inflammation processes and oxidative stress and lesser risk of damaging βcell function (Śliwińska-Mossoń and Milnerowicz, 2017). No smoking and alcohol drinking habits were noted among participants at the time of the study. About half of the study participants engaged in occasional intake of alcohol before their T2DM diagnosis but reported to have completely ceased alcohol consumption since then. Literature shows that the incidence of alcohol consumption among individuals with T2DM is low in comparison with the general population (Polsky and Akturk, 2017). This is likely due to a choice to abstain from alcohol altogether when patients become aware of the potential negative effect on their condition (T2DM). None of the study participants engaged in any form of smoking either before or after their medical diagnosis. This concurs with the findings by Sacre et al., (2021), who concluded similarly after comparing participants' smoking and alcohol habits before and during the COVID-19 lockdown in Australia. Literature shows a risk of developing T2DM and diabetes-related complications with smoking regardless of obesity and physical inactivity (Schipf et al., (2009).

The absence of smoking and alcohol intake among participants in this present study may be beneficial for them since it implies improved insulin sensitivity, a low risk of developing cardiovascular diseases, as well as other complications related to diabetes (Śliwińska-Mossoń and Milnerowicz, 2017; Zubizarreta et al., 2017). In cases where it is an issue, cognitive behavioural therapy, patient's motivation and pharmacotherapy are essential interventions that should be implemented to ensure smoking cessation among patients with T2DM (Zubizarreta et al., 2017).

CONCLUSION

The study generated valuable information on the experiences of T2DM patients during COVID-19 lockdown concerning their adherence to management. However, there are a few limitations that could be addressed in future research. First is the inability to generalize the research findings due to the small sample size. This study focused on patients with T2DM in the metropolitan city of Accra, limiting data to the influence of city settings. The experiences of T2DM rural dwellers during the COVID-9 lockdown is deficient in this present study. Future studies into the perspectives of rural T2DM patients with varied demographic characteristics may provide a better understanding of the impact of similar pandemic restrictions.. Also, although the Legon hospital is open to the general public, many who seek healthcare there have a high educational background (mostly tertiary), are gainfully employed and generally economically sound. This could account for the timely preparedness prior to the pronouncement of the COVID-19 lockdown and the adherence to dietary and medication management by most of the study participants. Due to the timing of the study, participants recalled their experiences fourteen months after the COVID-19 lockdown. This may have created room for personal influences and bias where relevant information could genuinely or intentionally overlooked. Nonetheless, the outcomes of this study could be utilized to guide future research into T2DM experiences leading to improved management in similar periods like the Covid-19 restriction.

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DIETARY DIVERSITY AND THE INTAKE OF IRON, FOLATE, AND VITAMIN B12 AMONG PREGNANT ADOLESCENTS

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Key words: dietary diversity, pregnant adolescent, iron, vitamin B12, folate

Abstract

Background: Adolescent pregnancy poses significant nutritional risks due to increased demands for growth and foetal development, yet adolescents often have poor dietary habits and inadequate nutrient intake.

Objective: This study determined specific micronutrient intakes and dietary diversity of pregnant adolescents.

Methodology: Three day 24-hour recall was performed on 223 pregnant adolescents to obtain dietary intakes and Minimum Dietary Diversity (MDD-W). Adequate intakes of iron, folate and vitamin B12 was observed in 39.1%, 21.3% and 73.2% respectively. Mean dietary diversity score was 3.85 ± 0.95. Poor dietary diversity was prevalent in 75.4%. The least consumption came from the dark green leafy group (9.4%), other vitamin A fruits and vegetables group (6.7%) and the other fruits group (3.1%). Mean micronutrient consumption of iron, folate and vitamin B12 were below recommendations

Conclusion: This study found that pregnant adolescents in the study had low intakes of iron, folate, and vitamin B12, and consumed diets lacking diversity, highlighting the need for nutrition education to promote dietary diversity and improve micronutrient intake.

INTRODUCTION

Adolescent pregnancy is a period of high nutritional risk, considering the nutritional demands of both pregnancy and the adolescent growth spurt. Additional nutrients are required for growth of the uterus and breasts, in preparation for lactation and for the development of the placenta as well as proper growth and development of the foetus. Studies have shown that dietary habits and the general nutrient intake of adolescents are poor (Rosi et al. 2019; Deka et al. 2015) 2015). They are also more prone to indulging in unhealthy dietary practices such as consumption of sugar sweetened beverages, low intake of fruits and vegetables and skipping of breakfast (Rodrigues et al. 2017; Popkin 2011; Moreno et al. 2010). Off-springs of adolescents tend to have poorer birth outcomes when compared to that of adult women (Marvin-Dowle et al., 2016). Outcome of studies examining the micronutrient status of both pregnant and non-pregnant adolescents have reported poor status, usually leading to low birth weight, small for gestational age births, still births and preterm deliveries (Baker et al. 2009; Shrimpton, 2012).

According to the Ghana Health Services Annual Family Health

report for 2016, about 12% of females seeking ante-natal services were adolescents (GHS 2017). This physiological age group is also characterized by high prevalence of anaemia (GHS, 2017). A Recent report from the World Bank indicated that anaemia in pregnancy is estimated at 54% in Ghana (WorldBank, 2016). Other studies have attributed this condition mainly to poor dietary intakes of micronutrients specifically iron, folate and vitamin B12 (Finkelstein et al. 2019; Shipala et al. 2012; Peña et al. 2003).

The roles of these nutrients especially in pregnancy cannot be overemphasized since iron deficiency alone is responsible for about half of all anaemias in pregnancy with resultant decreased oxygen carrying capacity and various complications (Sifakis & Pharmakides, 2000). Folate deficiency is regarded as the second most common cause of anaemia in pregnancy (Darnton□Hill, 2013). Its deficiency leads to megaloblastic anaemia. Deficiency of folate particularly around the period of conception has been linked to the development of neural tube defects. Vitamin B12 on the other hand is an important cofactor in the metabolism of folate and therefore its deficiency may result in an impairment in folate metabolism and its consequences (Htet et al. 2016).

There is enough evidence to support the link between poor maternal nutrient intakes and adverse pregnancy outcomes (Lee et al. 2013). The diversity of a diet provides indication of its micronutrient quality. High dietary diversity scores have been linked to high intakes of micronutrients (Nguyen et al. 2018). An earlier study had reported inadequate micronutrient intakes and largely plant-sourced foods as common feature of the diet of women who are pregnant in developing countries (Lee et al., 2013). There is a dearth of information regarding dietary intakes and the diversity of the diet among pregnant adolescents particularly in the sub-Saharan Africa. The findings of this study sought to bridge the gap in knowledge and provide some insight into the nutritional situation of pregnant adolescents. The aim of this study was to determine the nutrient intakes and dietary diversity of pregnant adolescent in some selected communities in Accra, the capital city of Ghana.

METHODS

Study design, study site and study population

A cross sectional study design approach was employed. A hospital-based study was carried out at the ante-natal units of three government health institutions all located in the Accra Metropolis of the Greater Accra Region of Ghana. Adolescent girls between the ages of 15-19 years in the metropolis form about 10% of the total population in Greater Accra (GSS, 2014). The hospitals where the study was conducted are located in three different municipalities in the Accra Metropolis. They were selected based on their geographic locations in the Metropolis; Ablekuma South (South-West), Ga South (South-Central) and La Dade-Kotopon (South-East).

Pregnant adolescents between the ages of 15-19 years attending antenatal care were recruited consecutively. A total of 223 pregnant adolescents were interviewed. The pregnant girls were eligible for inclusion if they were reporting for the first time to the ante-natal clinic for that particular pregnancy irrespective of any previous pregnancy. All those who were coming to the clinic for reasons other than antenatal care were excluded.

Ethical approval was obtained from the Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences, University of Ghana. Permission was sought from the management of the various hospitals where the studies were carried out. Informed consent was also obtained from the pregnant adolescents.

DATA COLLECTION

Dietary intake information was obtained using a three day 24-dietary recall. The first day's recall was taken on the first day of attendance at the clinic. Subsequent recalls were done via telephone calls, one on a week day and the other on a weekend. The information on each participant was obtained within a 2-week period. The expectant girls were asked to recall and estimate quantities of foods they had eaten over the past 24-hours. Familiar household measures such as spoons and ladles were used to estimate portions of foods eaten. To quantitatively estimate the amount of nutrients consumed, the estimated food portions were converted to grams. These were then inputted into the dietary analysis software Microdiet version 3.3 (Downlee, UK) to obtain the nutrient totals.

Determination of diversity of the diet was based on the recall of the first day. The FAO/FHI360 protocol for determination of minimum dietary diversity in women of reproductive ages was used (FAO & FHI360, 2016). Foods were classified into 10 main groups namely, Grains, tubers and white roots and plantains, Pulses (lentils, peas and beans), Nuts and seeds, Dairy,

Poultry, fish and meat, Eggs, Dark green leafy vegetables, Other Vitamin A-rich fruits and vegetables, Other vegetables and Other fruits. A score of one was awarded if a participant consumed food from a food group. If no food was consumed from a particular food group, a score of zero was awarded. The average of the scores were then computed. A food was deemed to be consumed if at least 15g was consumed in a day. The highest possible score one could obtain was ten and the lowest was zero. A score greater or equal to five was considered good and a score less than five was considered poor.

STATISTICAL ANALYSIS

Data was analysed using the IBM SPSS Statistics 25.0. Means, median and standard deviations were used to describe distribution of the data. T-tests and ANOVA (Post-hoc, Bonferroni) were used to test for differences between means of nutrients across trimesters and within variables. Statistical significance was set at $P<0.05$. Z-test for proportions were used to test for differences between proportions.

RESULTS

Characteristics of participants are presented in Table 1. The mean age was 17.87±1.06 years. About 28% of the girls had not received any formal education. The majority were single and the rate of unemployment was high (46.2%). All but one of the girls were not on nutritional supplement.

Table 1: Background characteristics of pregnant adolescents (N=223)

Variable	Total N (%)
Age (years) *Mean ± SD*	
17.87 ± 1.06	
Educational level	
No formal education	63 (28.3)
Primary	75 (33.6)
Junior High School	79 (35.4)
Senior High School	6 (2.7)
Marital status	
Married	9 (4.0)
Single	214 (96.0)
Occupation	
Unemployed	103 (46.2)
Artisan	40 (17.9)
Trader	80 (35.9)
Lives with	
Parents	85 (38.1)
Husband/partner	77 (34.5)
Alone	13 (5.8)
Other relative/friend	48 (21.5)
Previous pregnancy	
Yes	23 (10.3)
No	200 (89.7)
Supplement use	
Yes	1 (0.4)
No	222 (99.6)

Nutrient intakes are reported in tables 2 and 3. Mean caloric intake was 1622 (551) kcal. Protein, carbohydrates and fat intakes were 40.3 (13.7) g, 276.4 (111.1) g and 46.7 (23.1) g respectively. An ANOVA test performed showed no statistical difference between intakes within the trimesters of pregnancy (table 2). Intakes of vitamin B12 ($P=0.008$) and iodine ($P=0.043$) were significantly different between the trimesters of pregnancy (Table 3).

Table 2: Macronutrient intakes of pregnant adolescent girls (N=223)

utrient	1ST Trimester (n=65)	2ND Trimester (n=142)	3RD Trimester (n=16)	TOTAL	Percentage contribution to energy (%)	*p*-Value
nergy (Kcal)						
Mean ± SD	1630 ± 517	1627 ± 573	1540 ± 504	1622 ± 551	-	0.828
C.I	1502 - 1759	1532 –1722	1271 – 1809	1549 - 1694		
rotein (g)						
Mean ± SD	41.4 ±11.4	40.0±15.0	37.9 ± 9.4	40.3 ±13.7	9.9	0.620
C.I	38.55 –44.2	37.51 – 42.5	32.9 - 42.9	38.4 – 42.6		
arbohydrate g)						
Mean ± SD	273.6 ± 105.8)	279.5 ± 114. 6	259.6 ± 104.2	276.4 ±111.1	68.2	0.772
C.I	247.4 – 299.9	260.5 – 298. 6	204.04 – 315.1	261.74 – 291.0		
ats (g)						
Mean ± SD	47.9 ± 23	45.8 ± 23.2)	45.7 ± 22.9	46.4 ± 23.1	25.7	0.828
C.I	42.2 -53.6	41.9 – 49. 6	33.5 - 57.9	43.3 – 49.4		

ANOVA test for significant differences in means set at $p < 0.05$

Table 3 micronutrient intakes of pregnant adolescent girls

Nutrient	1ST Trimester (n=65)	2ND Trimester (n=142)	3RD Trimester (n=16)	Total	P-Value
Iron (mg)					
Mean ± SD	9.09 ± 4.3	9.17 ± 4.4	8.5 ± 2.9	9.1 ± 4.3	0.849
C.I	8.0– 10.2	8.4– 9.9	6.9 – 10.1	8.54 – 9.7	
Folate (µg)					
Mean ± SD	115.9 ± 52.6	110.6 ± 59.5	93.3 ± 38.7	110.9 ± 56.4	0.358
C.I	102.84 – 128.9	100.7 – 120.5	72.7 – 114.0	103.5 – 118.3	
Vitamin B_{12} (µg)					
Mean ± SD	2.0 ± 1.8[a]	1.44 ± 0.9[b]	1.48 ± 0.9[b]	1.6 ± 1.3	0.008*
C.I	1.6 – 2.5	1.3 – 1.6	1.0 – 1.9	1.4 – 1.8	
Selenium (µg)					
Mean ± SD	31.7 (16.6)	34.5 (19.4)	26.4 ± 14.6	33.1 ± 18.3	0.199
C.I	27.6– 35.8	31.2 – 37.7	18.6 – 34.2	30.7 – 35.5	
Iodine (µg)					
Mean ± SD	58.0 ± 42.1[a]	57.9 ± 38.6[a]	31.9 ± 37.4[b]	56.1 ± 39.9	0.043*
C.I	47.6 – 68.4	51.5 – 64.3	12.0 – 51.9	50.8 – 61.3	
Vitamin C (mg)					
Mean ± SD	28.3 ± 17.6	30.5 ± 9.4	37.8 ± 27.9	30.4 ± 26.41	0.441
C.I	2.4 – 32.7	25.7– 35.5	22.9 – 52.6	27.0 – 33.9	
Calcium (mg)					
Mean ± SD	434 ± 313	426 ± 313	403 ± 359	427 ± 315.1	0.935
C.I	354 – 512	374 – 477	211 – 594	385– 468	

*ANOVA (Post hoc-Bonferroni) significant difference set at $p < 0.05$. [a] and [b] Significantly different from each other

On table 4, a description of how the nutrient intakes of the girls compare with the Estimated Average Requirements (EAR) or Recommended Daily Allowance (RDA) and the percentage contribution to the EAR/RDA is shown. Mean intakes for all the nutrients were below the dietary recommendations. Iron, contributed to only about 31% in meeting the EAR recommendations. Similarly, dietary folate contributed 21.3% of EAR. Intakes of vitamin B12 were however high in terms of its contribution to meeting the EAR. A one sample t-test performed showed significant statistical difference between micronutrient intakes and dietary recommendation values (Table 4).

Table 4: Comparison of nutrient intakes with EAR/RDA comparison of nutrient intakes with EAR/RDA

Nutrient	EAR	Mean intakes	[a] Percentage of intakes Met (%)	*p*-Value
Iron (mg)	23	9.1	39.1	<0.001*
Folate (µg)	520	110.9	21.3	<0.001*
Vitamin B_{12} (µg)	2.2	1.61	73.2	<0.001*
Selenium (µg)	60	33.1	55.1	<0.001*
Iodine (µg)	220	56.1	25.5	<0.001*
Vitamin C (mg)	80	30.4	38.1	<0.001*
Calcium (mg)	1300	426.8	32.8	<0.001*

*One-sample t-test significant at $p < 0.05$. [a]Mean intakes/EAR or RDA x 100

The Percentage of girls with adequate energy and nutrient intakes is shown in table 5. With the exception of carbohydrates where about 94% were able to meet their recommended intakes, the other nutrients showed low percentages between 1.3-28.3% of those who met the dietary requirement recommendations of these nutrients.

Table 5: Percentage of girls with adequate energy and nutrient intakes

Nutrient	1st Trimester (n=65) n (%)	2nd Trimester (n=142) n (%)	3rd Trimester (n=16) n (%)	Total (N=223) n (%)	*p*-value
[1]Energy	7 (10.7)	7 (4.9)	0 (0.0)	14 (6.3)	<0.001*
Protein	20 (30.8)	41 (28.9)	2 (12.5)	63 (28.3)	<0.001*
Carbohydrates	64 (98.5)	131 (92.3)	15 (93.8)	210 (94.2)	<0.001*
Calcium	6 (9.2)	13 (9.2)	2 (12.5)	21(9.4)	<0.001*
Iron	**1 (1.5)**	**2 (1.4)**	**0 (0.0)**	**3 (1.3)**	**<0.001***
Zinc	1 (1.5)	3 (2.1)	0 (0.0)	4 (1.8)	<0.001*
Selenium	10 (15.4)	26 (18.3)	1 (6.3)	37 (16.6)	<0.001*
Iodine	3 (4.6)	3 (2.1)	0 (0.0)	6 (2.7)	<0.001*
Vitamin B_{12}	**20 (31.3)**	**27 (19.0)**	**3 (18.8)**	**50 (22.5)**	**<0.001***
Vitamin C	2 (3.1)	9 (6.3)	1 (6.3)	12 (5.4)	<0.001*
Folate	**Not determined**	**Not determined**	**Not determined**	**Not determined**	-

Table 6 describes the impact of socioeconomic variables on nutrient intakes. Education did not have significant influence on nutrient intakes. Those who had had previous pregnancies had significantly higher intakes of iron (11µg verses 8.9µg; p = 0.041) and iodine (72 µg versus 54 µg; p = 0.042) when compared to those who had not. Vitamin B12 (2.11 µg versus 1.56 µg; p = 0.003) and vitamin C (46 mg versus 29 mg; p = 0.027) intakes were significantly higher in girls who practiced pica compared to those who did not.

Table. 6 Mean nutrient intakes according to socioeconomic variables (N=223) – Between subgroup comparisons

Characteristic	Energy (kcal)	Protein (g)	Carbohydrate (g)	Fat (g)	Calcium (mg)	Iron (mg)	Zinc (mg)
Educational level							
No formal education (n=63)	1478 (507)	39.6 (14.5)	247.2 (96.2)	42.9 (19.2)	416 (313)	8.4 (4.7)	4.8 (2.0)
Formal Education (n=160)	1678 (559)	40.5 (13.4)	287.9 (114.7)	47.7 (24.4)	431 (317)	9.4 (4.1)	4.8 (2.0)
p-value	*0.848*	*0.918*	*0.393*	*0.131*	*0.999*	*0.566*	*0.899*
Marital status							
Married (n=9)	1369 (584)	36.1(12.9)	234.3 (100.3)	37.7 (23.9)	260 (216)	8.1 (6.2)	4.5 (2.1)
Single (n=214)	1632 (549)	40.4 (13.7)	278.2 (111.4)	46.7 (23.1)	434 (317)	9.1 (4.1)	5.0 (1.9)
p-value	*0.547*	*0.716*	*0.735*	*0.564*	*0.229*	*0.237*	*0.793*
Religion							
Christian (n=165)	1610 (529)	36.8 (12.7)	276.1 (111.6)	45.4 (21.7)	418 (303)	9.0 (4.2)	4.9 (1.8)
Islam (n=56)	1642 (594)	41.4 (16.5)	274.1 (104.8)	48.9 (26.9)	452 (354)	9.2 (4.4)	4.9 (2.4)
p -value	*0.357*	*0.064*	*0.871*	*0.478*	*0.210*	*0.754*	*0.127*
Previous pregnancy							
Yes (n=23)	1770 (581)	41.3 (13.2)	296.2 (116.1)	54.2 (28.7)	411 (296)	11.0 (5.6)	5.2 (1.7)
No (n=200)	1605 (546)	40.1 (13.8)	274.1 (110.6)	45.5 (22.3)	429 (319)	8.9 (4.0)	4.9 (2.0)
p -value	*0.475*	*0.947*	*0.521*	*0.504*	*0.482*	*0.041**	*0.630*
Living with							
Parents (n=85)	1591 (412)	39.7 (10.5)	268.0 (80.9)[a]	46.7 (22.4)	466 (330)	8.7 (3.5)	4.9 (1.6)
Husband/partner (n=77)	1637 (574)	41.1 (15.1)	281.2 (116.6)[a]	45.5 (21.1)	423 (328)	9.1 (3.4)	5.0 (2.1)
Alone (n=13)	1347 (459)	36.2 (15.4)	202.4 (71.1)[a]	48.7 (20.7)	308 (187)	8.6 (5.6)	4.5 (2.2)
Other relative/friend (n=48)	1725 (714)	41.0 (15.0)	303.6 (144.4)[b]	46.5 (28.2)	393 (289)	9.9 (5.6)	5.1 (2.1)
p -value	*0.155*	*0.647*	*0.025**	*0.969*	*0.286*	*0.428*	*0.849*
Pica practice							
Yes (n=24)	1765 (463)	40.5 (9.9)	305.0 (102.2)	50.3 (20.8)	409 (258)	10.4 (4.0)	4.9 (1.2)
No (n=241)	1609 (557)	40.2 (14.0)	273.9 (111.7)	46.0 (23.3)	428 (320)	9.0 (4.3)	5.0 (2.0)
p -value	*0.898*	*0.128*	*0.777*	*0.745*	*0.149*	*0.987*	*0.132*
Educational level							
No formal education (n=63)	1.02 (0.44)	32 (20)	55 (36)	1.56 (0.89)	28 (21)	108.15 (45.37)	
Formal education (n=160)	1.13 (0.56)	33 (18)	56(41)	1.63 (1.40)	31 (28)	111.99 (60.24)	
p-value	*0.105*	*0.905*	*0.264*	*0.293*	*0.233*	*0.158*	
Marital status							
Married (n=9)	0.97 (0.37)	26 (9)	51 (55)	1.54 (0.97)	26 (17)	93.71 (41.47)	
Single (n=214)	1.11 (0.53)	33 (18)	56 (39)	1.61 (1.29)	31 (27)	111.62 (56.86)	
p -value	*0.185*	*0.172*	*0.048**	*0.921*	*0.739*	*0.286*	
Religion							
Christian (n=165)	1.10 (0.50)	32 (16)	57 (40)	1.65 (1.34)	31 (27)	108.22 (52.83)	
Islam (n=56)	1.07 (0.56)	34 (23)	54 (40)	1.49 (1.06)	30 (24)	116.37 (64.45)	
p -value	*0.997*	*0.008**	*0.713*	*0.866*	*0.845*	*0.319*	
Previous pregnancy							
Yes (n=23)	1.29 (0.53)	30 (20)	72 (50)	1.61 (0.94)	38 (35)	111.36 (52.50)	
No (n=200)	1.07 (0.52)	33 (18)	54 (38)	1.60 (1.31)	30 (25)	110.85 (56.91)	
p -value	*0.962*	*0.864*	*0.042**	*0.805*	*0.129*	*0.938*	
Living with							
Parents (n=85)	1.10 (0.52)	31(15)	60 (40)	1.66 (1.57)	29 (23)	102.49 (46.01)	
Husband/partner (n=77)	1.90(0.50)	34 (21)	58 (39)	1.56 (1.06)	28 (22)	113.77 (62.38)	
Alone (n=13)	0.80 (0.34)	27 (16)	36 (44)	1.32 (1.00)	26 (16)	96.91 (41.68)	
Other relative/friend (n=48)	1.20 (0.60)	37 (20)	51 (39)	1.68 (1.08)	39 (37)	124.90 (63.83)	
p -value	*0.145*	*0.237*	*0.184*	*0.779*	*0.078*	*0.117*	
Pica Practice							
Yes (n=24)	1.05 (0.34)	29 (15)	34 (27)	2.11 (2.93)	46 (38)	90.85 (41.95)	
No (n=241)	1.10 (0.54)	33 (18)	58 (40)	1.56 (1.01)	29 (25)	112.66 (57.00)	
p -value	*0.083*	*0.424*	*0.085*	*0.003**	*0.027**	*0.123*	

*ANOVA and T-test. Significant differences set at $p < 0.05$. Data is presented as means (SD)
Values with superscripts a and b significantly different from each other

Figure 1. shows the consumption from the various food groups. All participants consumed from the grains, cereals and roots group. However, less than 10% consumed from the dark green leafy group (9.4%), other vitamin A fruits and vegetables group (6.7%) and the other fruits group (3.1%). Overall, out of a score of 10, mean dietary diversity score obtained was 3.85 (0.95). (Table 7) Overall, good dietary diversity was seen in 24.6% of the study population. (Figure 2)

Figure 1. Consumption from food groups

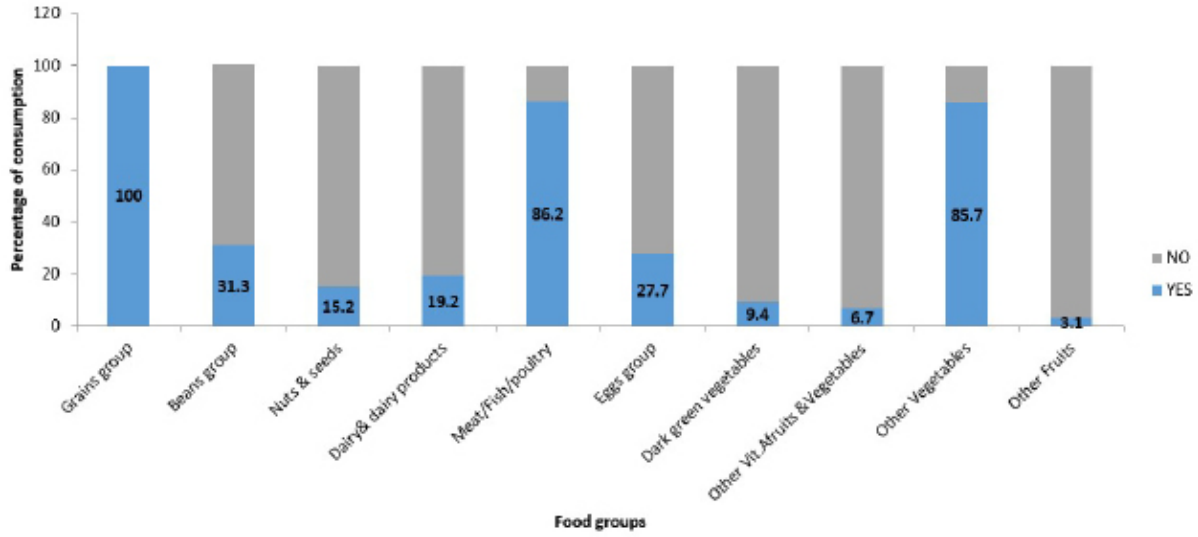

Table 7: Mean Women's Minimum Dietary Diversity Score (MDD-W) according to socio- economic characteristics

Characteristic	Mean (SD)	*p*-value
Total	3.85 ± 0.95	-
Educational level		
No formal education (n=63)	3.76 (0.86)	0.748
Formal education (161)	3.88 (0.98)	
Marital status		
Married (n=8)	3.13 (0.99)	0.728
Single (n=216)	3.88 (0.94)	
Religion		
Christian (n=166)	3.76 (0.97)	0.169
Islam (n=56)	4.09 (0.84)	
Previous pregnancy		
Yes (n=23)	4.13 (0.97)	0.767
No (n=201)	3.82 (0.94)	
Living with		
Parents (n=86)	3.84 (0.94)	0.637
Husband/partner (n=77)	3.89 (0.94)	
Alone (n=13)	3.54 (1.19)	
Other [relative/friend] (n=48)	3.89 (0.90)	
Pica practice		
Yes (18)	4.00 (0.91)	0.577
No (206)	3.94 (0.95)	
Occupation		
Unemployed (100)	3.84 (0.96)	0.189
Artisan (36)	3.64 (0.93)	
Trader (72)	3.97 (0.94)	

T-test significant at $p < 0.05$
ANOVA significant at $p < 0.05$

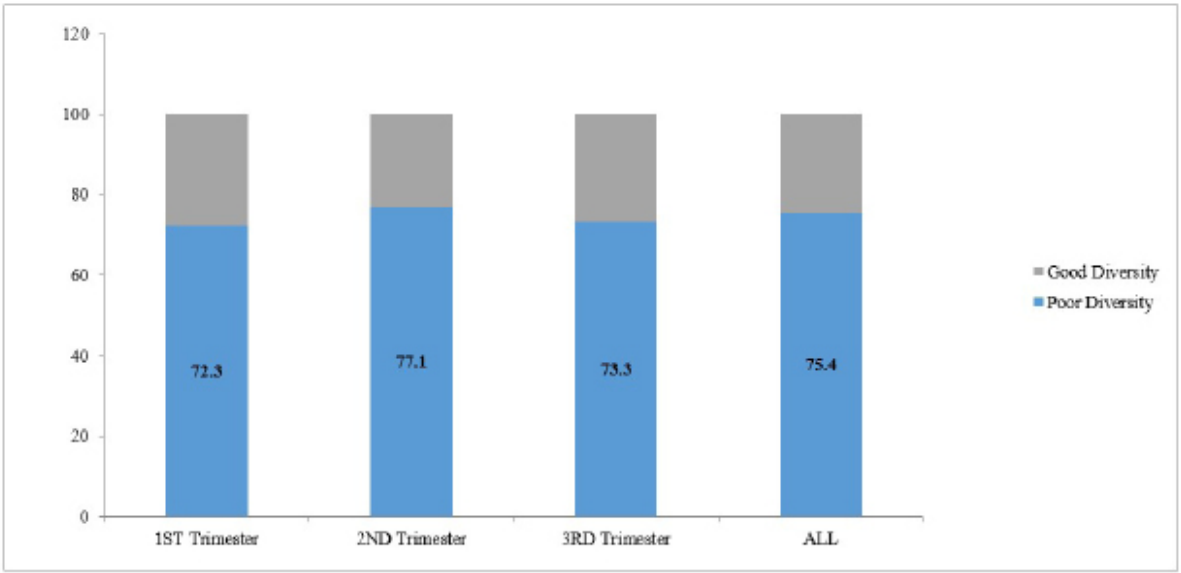

Figure 2: Percentage of pregnant girls with poor dietary diversity and good dietary diversity

Z- test showed significant differences between poor diversity and good diversity ($p = 0.001$)

DISCUSSIONS

Analysis of the macronutrient intakes showed that mean energy and protein intakes were low compared with Institute of Medicine recommendations of 2400 kcal and 71 g respectively (DRI 2020). Studies in the US, UK, Bangladesh and among Latina pregnant adolescents have reported low energy intakes between 2273 kcal and 2387 kcal (Nguyen et al. 2018; Singh et al. 2017; S. Lee et al. 2014). Likewise, protein intakes were reportedly low in the present study in comparison with earlier studies conducted among pregnant adolescents in the US, UK, Bangladesh and North America (Nguyen et al, 2018; Singh et al., 2017; Lee et al., 2014; Derbyshire, 2009). The findings of the present study could be attributed to various interconnected factors that influenced their food choices and hence their dietary intakes. One of these probable factors is the socioeconomic status, which have been reported to affect dietary intakes in a similar study (Berglund et al. 1997). For instance, many of the girls in this study were either unemployed or engaged in low income jobs and therefore could not afford to buy some foods. Among Egyptian pregnant adolescents, (Yassin, Sobhy, and Ebrahim 2004)., reported that close to half of the girls (48.3%) had low incomes and 48% were illiterate and therefore these affected their purchasing power and subsequent dietary intakes.

The Ghanaian diet is built essentially around carbohydrate based staples (Eli□Cophie, Agbenorhevi, and Annan 2017), hence it was not unexpected that mean carbohydrate intakes largely exceeded recommendations with as high as 94.2% attaining adequate intakes. An earlier study in Ghana among expectant mothers reported similar findings (Nti, Larweh, and Gyemfua□Yeboah 2002). This finding calls for improved public health education on the dietary choices of Ghanaians in general, stressing on the need for balanced inclusion of other dietary sources to ensure optimum nutrition.

Physiological changes in adolescence and pregnancy increases the demands for iron. Almost all (99%) the girls did not meet recommended intakes of iron. Meeting dietary iron requirements is largely a global challenge even in developed countries. About 80% of pregnant women (18 to 45 years) in the UK, were reported to have had intakes below recommendations (Alwan et al. 2011) while in the US, among African American women (18-36 years), 89% had dietary iron intakes below the EAR (Groth et al. 2017). In a systematic review, average dietary iron intakes over the duration of pregnancy in adolescents in developed countries were between 11.2 mg to 20 mg (Marvin-Dowle, Burley, and Soltani 2016). In Africa, intakes below recommendations were reported among South Africa and Kenyan pregnant adolescents (Bopape, Mbhenyane, and Alberts 2008; Shipala et al. 2012). Contrary to present findings, adequate dietary iron intake was found in 73% of non-pregnant adolescents in a Benin study (Alaofe, Zee, and O'Brien 2007). Nevertheless, the authors expressed concern over bioavailability because about 97% of the dietary iron consumed was in the non-heme form. A reason that can be attributed to the low dietary intakes of iron is the low intakes of animal source foods. A major source of dietary

iron is from animal source foods. Because animal source foods are expensive it could hinder its affordability seeing that the girls are largely of low socioeconomic background. This agrees with findings from Herrador et al. (2015) where higher socioeconomic status was associated with increased odds of consuming animal source foods. There are dire consequences of low iron intakes in pregnancy such as low birth weight, perinatal mortality and premature birth, therefore public health measures such as supplementation and more importantly education and improvement in the living standards of the girls so they can afford to buy high iron containing foods. This will improve upon the dietary intakes of iron thereby ameliorating the problem of iron deficiency and possible effect on the pregnancy outcomes.

The findings of the present study agree with some studies in South Africa and Bangladesh where low dietary folate intakes were found (Bopape, Mbhenyane, and Alberts 2008; Nguyen et al. 2018). Among Latina pregnant adolescents about 72% were unable to meet folate requirements (Singh et al. 2017). Correspondingly, dietary folate intakes among adult pregnant women in Accra, Ghana was inadequate (Koryo-Dabrah, Nti, and Adanu 2012). Contrarily, intake of folate among a cohort of girls from the UK was about three times higher than the intake of participants of this current study (Baker, et al., 2009). The discrepancy may be explained by the addition of supplemental folate to the dietary intakes of the UK girls which was not the case for these Ghanaian girls. Fortification of foods with folate in the Ghanaian context will be essential to minimize the effect of poor dietary intakes as has been done in Tanzania and Brazil (Barnabé et al. 2015; Noor et al. 2017). To this end, there is currently an ongoing mandatory food fortification programme in Ghana however most manufacturing companies are not complying with regulations to fortify (Nyumuah et al. 2012). Additionally, promotion of folate containing foods could be a key to mitigating the problem.

This study demonstrates that vitamin B12 intakes were better when compared with intakes of iron and folate even though intakes were below recommendations. There is dearth of published information on vitamin B12 intake among pregnant adolescent girls in Ghana, nevertheless in an unpublished work cited by Akwetea (2015), average intake of 2.2 µg was seen among non-pregnant adult females. The present study bridges the knowledge gap of up-to-date information on the vitamin B12 intakes of pregnant adolescent girls in Ghana.

Vegetarianism was not reported in the current study and because of the reported frequent consumption of animal source foods which are the main source of vitamin B12, it would have been expected that the adequacy level of the vitamin would be high. However, it seemed that the outcome of frequent intakes of animal source foods was blunted by low amounts consumed. Similarly, Nti et al., (2002) recounted frequent but rather low intake of animal source foods in pregnant women in some parts of Ghana. The low consumption levels can be explained by poor socioeconomic status and inadequate knowledge, as seen in this study, and/or cultural beliefs surrounding consumption of some animal source foods in Ghana (Arzoaquoi et al. 2015; Colecraft et al. 2006).

The role of vitamin C in enhancing non-heme iron absorption is essential in blood formation. Vitamin C consumption was 30.45 mg on the average throughout the pregnancies, meeting 38.1% of the EAR and falling short of the recommended minimum intakes of 50 mg required for achieving optimum absorption effect in a meal (Hallberg, Brune, and Rossander 1986). Contrary to the present findings, Venezuelan pregnant adolescents had adequate vitamin C intakes (Peña et al. 2003). Underlying the low level of vitamin C intake is the poor consumption of fruits found in this study. Encouraging increased fruit intake among this physiological group should be paramount in facilitating optimal non-heme iron absorption and also to prevent the risk of other reported complications of iron deficiency in pregnancy such as preterm delivery and low birth weight (Ochoa-Brust et al. 2007; Siega-Riz et al. 2003).

The MDD-W is a dichotomous indicator useful for categorizing women of reproductive ages into having good dietary diversity or poor dietary diversity. Similar to what pertains in most developing countries, the starchy staples (the grains, white roots, tubers and plantain group) were the most consumed. Other similar reports have been seen in a cohort of Kenyan expectant women (99%) (Kiboi, Kimiywe, and Chege 2017). Contrarily, in the findings of another study, starchy staples were found to be the least consumed among Iranian non-pregnant adolescent (Mirmiran et al. 2004). Authors, ascribed their findings to cultural influences. Nevertheless, in the Ghanaian context, starchy staples act as the main component of the diet and therefore it was not surprising to find all the girls consuming from this food group. The second most consumed food group was the meat/fish/poultry (86.2%). This is similar to consumption pattern (85.9%) in adult Bangladeshi pregnant women (Shamim et al. 2016). On the other hand, only 24% of pregnant women in Kenya consumed from the meat/fish/poultry group probably due to high cost of animal source foods (Kiboi et al., 2017). Despite the high percentage (86.2%) of consumption from the meat/fish/poultry group in the current study, this was

not reflected in their mean protein intakes as the amounts consumed did not meet recommendations. Moreover, the percentage of girls who obtained adequate intakes was low (28.3%). This would suggest that the girls knew the value of adding proteins to the diet, however, they were probably discouraged from doing so adequately because of the typically high cost of animal proteins, although it is also likely that they lacked knowledge of the importance of eating from this group. This study was conducted in the southern part of the country, along the coast, where fish abounds and the expectation would be that fish consumption would be high. However, fishing is commercialised and the fish caught are not for consumption but sold to generate income. The cost of fish is therefore quite high and beyond the means of these girls with low socioeconomic backgrounds. This low consumption of foods from this group may perhaps be a reason why there was relatively high intakes of the much cheaper starchy staples to compensate for energy requirements and to "fill the belly" to curtail and satisfy hunger. Reasons identified among pre-schoolers in Ghana, by researchers as constraints to consumption of animal source, foods included low income, poor nutrition knowledge and food beliefs (Colecraft et al., 2006).

The most poorly consumed foods were reported in the vitamin A dark green vegetables (9.4%) group, other fruit (3.1%) group and other vitamin A fruits and vegetables (6.7%) group. This contradicts findings from the Northern region of Ghana where 72%, 46.5% and 7.8% consumed from the vitamin A dark green leafy vegetables group, other vitamin A fruits and vegetables group and other fruits group respectively (Saaka et al. 2017). This study was conducted in the Southern part of Ghana where green leafy vegetables are not readily part of the diet of people unlike the Northern part where green leafy vegetables form a major part of the diet. In Kenya, reports showed 58%, 32% and 51% of pregnant women consuming from vitamin A dark green leafy vegetables group, other vitamin A fruits group and vegetables and other fruits group respectively (Kiboi et al., 2017). It is worrying as consumption from these three food groups among the pregnant adolescents of the present study were extremely low. The implication is that many of them would not meet the recommended requirements for a wide-range of micronutrients. A reason that could justify for the low intakes from these food groups would be the poor dietary practices associated with the adolescent physiological age group (Banfield et al. 2016). Actually, some adolescents resort to bad dietary choices and are inclined to go for flavoured sugar drinks and sodas instead of going for healthier choices such as vegetables and fruits. Barros et al. (2004), collaborates the findings of the present study of low vegetable and fruit intake among pregnant adolescents in Brazil. The increase of fast food eateries in the cities prohibits many from consuming local foods that may contain more fruits and vegetables.

Rasmussen et al. (2006) reported of individual preferences, socio-economic status, parental intakes, and availability/ accessibility of home as issues that were positively associated with vegetable and fruit consumption among children and adolescents (8-18 years). This observation could be true of the adolescents in this current study. Most of the girls in the present study were not living with their parents and so could not have been influenced either positively or otherwise. Additionally, they may not be socio-economically sound to afford fruits and vegetables daily, mainly because majority were either unemployed or engaged in low income activities that would not be able to support their upkeep.

Overall, MDD-W was reported to be 3.85, a figure indicative of poor dietary diversity with a significant proportion of girls (75.4%) characterised as having poor diversity. Likewise, low dietary diversity score was reported among adolescent girls in South-Western Nigeria which predisposed them to iron deficiency anaemia (Olumakaiye, 2013). Poor formal education as well as nutrition knowledge deficit could account for the poor dietary diversity obtained. In Bangladesh (Na et al. 2016) and Shamim et al., (2016) both reported high dietary diversity scores among more educated women. Also, frequent ante-natal visits was found to predict high dietary diversity scores in Northern Ghana (Saaka et al., 2017). So, in the current study, because the girls were interviewed on the first day of ante-natal care it can be assumed that they might not have acquired enough education on good nutrition in pregnancy.

CONCLUSIONS

This study has shown that intakes of iron, folate and vitamin B12 were low among the pregnant adolescents studied. Additionally, their diets lacked diversity with a significant proportion having meals mainly from the grains, white roots, tubers and plantain group. Consumption of foods in the vitamin A dark green vegetables and fruits and vegetables group was very poor. In the light of these findings, dietitians and nutritionists should include nutrition education during the antenatal care attendance to improve their knowledge on nutrition related behavioural factors associated with obtaining diversity in their diet as this can help improve upon their iron, folate and vitamin B12 intakes. Additionally, they should collaborate with healthcare providers, community leaders and other stakeholders to ensure access to nutrient-dense foods and integrate nutrition counselling into prenatal care.

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Declaration of Interest

Authors have no conflict of interest to declare.

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KNOWLEDGE AND AWARENESS OF TYPE II DIABETES MELLITUS AMONG UNDERGRADUATE STUDENTS IN HEALTH-RELATED COURSES AT THE UNIVERSITY OF GHANA.

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Key words: Knowledge, Awareness, Undergraduate students, Diabetes mellitus, Attitude

Abstract

Introduction: Diabetes mellitus (DM) is one of the significant non-communicable diseases (NCDs) that are on the rise and are a threat to the general public's health. The rate at which diabetes mellitus (DM) is becoming more common in Ghana is alarming, and the majority of research shows that many individuals with diabetes typically lack the knowledge necessary to manage their condition.

Methodology: This study assessed undergraduate health-related course students' knowledge and awareness of diabetes of the University of Ghana campus. On the campus of the University of Ghana, a survey with 130 students (from College of Health Sciences and other departments such as Nutrition and Food Science, under the College of Basic and Applied Sciences) was conducted. A questionnaire was used to assess the socio-demographic (age, gender, tribe, level of education, religion), knowledge, awareness, attitude and self-reported anthropometry (weight and height) of study participants.

Results: 46.2% of the 130 respondents were female, and 53.8% were male. Most respondents had good knowledge and positive awareness on type II diabetes mellitus with majority of them knowing answers to the questions relating to definition of the disease (86.2%), risk factors (93.1%), signs and symptoms (93.8%), best ways to diagnose the disease (24.6%) and how to control and manage the disease (99.2%). The average composite score for overall diabetes knowledge was good 92.3%. A P-value (0.003) was obtained, indicating a significant association between department of study and knowledge of type II diabetes mellitus.

Conclusion: The study reveals that participants possess good knowledge and positive awareness towards type II diabetes mellitus. Nevertheless, a systematic education curriculum for diabetes education is paramount for all levels of educational system in Ghana.

INTRODUCTION

Background

Diabetes mellitus (DM) is a chronic metabolic condition characterized by hyperglycemia due to insufficient insulin, resistance, or both. Approximately 200 million people currently have diabetes, a number expected to rise to 333 million by 2025, predominantly affecting developing countries. Diabetes causes 3.2 million deaths annually worldwide. As the prevalence of diabetes increases, so do complications such as foot problems, which significantly contribute to hospitalization, amputation, and mortality among diabetic patients. Diabetes education is essential for effective management. In 2015, Ghada El-Khawaga et al. found that only one-third of diabetics had a thorough understanding of diabetes causes. In the Gambia, Foma et al. reported that one-third of diabetics were aware of the hereditary nature of the disease, and 80% had a family member with diabetes. Despite frequent hospital visits for various diabetes complications, Wee et al. (1999) found that Singaporeans were well-informed about diabetes. Shooka Mohammadi et al. demonstrated a significant correlation between low education levels and poor knowledge, attitude, and practice (KAP) scores regarding diabetes, questioning the effectiveness of diabetes education among less educated individuals.

The study aims to identify knowledge gaps between diabetes

subjects and their practices. Globally, mean BMI, overweight, and obesity rates are rising due to dietary changes and increased physical inactivity. In 2015, an estimated 1.5 billion people were overweight, with rates predicted to rise in almost all nations. Overweight and obesity contribute to 44% of the diabetes burden, 23% of ischemic heart disease, and 7%-41% of certain cancers. In Southeast Asia and Africa, 41% of deaths from high BMI occur under the age of 60, compared to 18% in high-income nations (WHO, 2009). Approximately 10% of people in Western Africa are obese. Proper nutrition is essential for a higher quality of life (WHO, 2007). People with healthy diets in middle age have better metabolisms to combat diet and physical activity-related diseases. Without adequate nutrition, people's lives and livelihoods are unstable (WHO, 2014). A well-planned diet should be diverse, balanced, and moderate in energy and unwanted constituents. However, under strong visceral influences such as hunger, thirst, or addiction, individuals may make unhealthy decisions (Loewenstein, 1996). A better food system can promote diverse, balanced, and nutritious diets, while education, information, regulation, and other interventions help consumers make better-informed dietary decisions (Sundaram et al., 2015).

Unhealthy eating practices have significantly impacted individual nutrition and health, contributing to coronary heart disease, cancer, stroke, and diabetes mellitus—four of the top ten causes of death in the US linked to nutrition (Abood et al., 2003). Economic status positively correlates with diet quality, but even high-income consumers may have low consumption of nutrient-dense foods and dietary imbalances. Many people consume energy-dense foods high in fat and sugar to make food more appealing, leading to increased consumption and resistance to substituting healthier options, despite awareness and availability (Drewnowski et al., 2005; Sundaram et al., 2015).

Main objective

To determine the level of knowledge and awareness of type II diabetes mellitus among undergraduate health related course students on the University of Ghana campus.

Significance of study

The study on type II diabetes mellitus knowledge and awareness is significant as it promotes health literacy and helps with diabetes prevention, early identification, effective management, and health equity. We can improve health outcomes and reduce the impact of diabetes on individuals and communities by identifying knowledge gaps and addressing them with concentrated interventions.

METHODOLOGY

Study design

A cross-sectional study was conducted among University of Ghana undergraduate students offering health related course to assess their knowledge and awareness of the symptoms, management, risk factors and best ways to diagnose type II diabetes mellitus and how demographic and lifestyle variables affect their knowledge and awareness.

Study site

This study was conducted at the University of Ghana, Legon. The university is located in Accra, which is the capital of Ghana and the capital of the Greater Accra Region. The University of Ghana's academic structure is made up of four colleges (Health Science, Basic and Applied Sciences, Humanities and Education), with each college comprising schools and each school comprising departments. The University of Ghana is not made up solely of students in the health sciences. It is a comprehensive university with a diverse range of academic programs and students from various disciplines, including arts, sciences, business, social sciences, and more.

Study population

Participants were University of Ghana undergraduate health related course students who were recruited from College of Health Sciences and other departments such as Nutrition and Food Science, under the College of Basic and Applied Sciences.

Sampling technique

Students from College of Health Sciences and other departments such as Nutrition and food Science, under the College of Basic and Applied Sciences were selected to participate in the research. These departments were selected because they are in the best position to treat and manage diabetic patients.

Data collection and measurement

Data on nutrition knowledge was collected using the modified nutrition knowledge questionnaire (Parameter & Wardle, 1999). A 43-item questionnaire comprising seven subscales: (a) definition of diabetes (4 items), (b) risk factors of diabetes (4 items), (c) signs and symptoms of diabetes (8 items), (d) control and management of diabetes (4 items), (e) best ways to diagnose diabetes (2 items), (f) awareness of diabetes (15 items) and (g) attitude towards diabetes (6 items) were administered to participants using Google forms via online. The questionnaire was administered to participants online via Google Forms. Participants provided basic background information such as age, tribe, gender, religion, and level of education. They were informed of the study's purpose, assured of voluntary participation and anonymity, and offered some incentives. Participants answered "yes" or "no" to the questions. Additionally, participants were asked to provide their anthropometric data (height and weight) through the online questionnaire.

Pre-testing of Questionnaires

Five percent (5%) of the questionnaire was pre-tested on other undergraduate students on the University of Ghana campus to ascertain its validity and reliability before it was administered. Incorrect wording and other shortfalls made during pretesting were corrected and modified to suit the context of the research.

Data analysis

The study's data were imported into Microsoft Excel for accuracy verification, and analyses were conducted using SPSS version 27. Continuous variables were reported as means and standard deviations, while categorical variables were presented as frequencies and percentages. The independent variables investigated were (a) demographic variables, including age, sex, level of education, tribe and religion, and (b) lifestyle variables, including assessing eating habits. The outcome variables measured were attitude towards diabetes, general knowledge and awareness of type II diabetes, diabetes symptoms, diabetes managements, risk factors and diabetes diagnosis. Responses were coded with "one" for correct answers and "zero" for incorrect ones. The raw score from the sum of correct responses was converted to a final score between 0 and 100 Zhang et al., (2009), with a higher score indicating better knowledge, attitude, and awareness of diabetes. Participants' BMIs were calculated using their heights and weights, and they were categorized as "underweight," "normal," "overweight," or "obese" based on WHO standards. The comparison between demographic characteristics and diabetes knowledge was analyzed using chi-square tests.

Ethics Statement

Permission was soughed from the department (Nutrition and Food Science) and also students signed a concern form before partaking in the study.

RESULTS

Socio-demographic characteristics of study participants.

The results are based on the interviews of one hundred and thirty (130) participants. Table 1 provide an overview of the socio-demographic characteristics of the study participants. The table includes elements like age, gender, tribe, and religious affiliation. The highest percentage of participants were from Level 400 (30.8%), followed by Level 200 (30%), Level 300 (23.8%), Level 100 (11.5%), and Level 500 (3.8%). Nursing and Midwifery had the most students (30.8%), followed by Nutrition and Food Science (27.7%), and Medical Laboratory (12.3%). The student population was predominantly male (53.8%) with females making up 46.2%. The majority belonged to the Akan tribe (64.6%), followed by Ewe (15.4%), Ga/Adangbe (11.5%), and Northern Ethnicity (8.5%). Most students were Christians (96.2%), with Muslims (3.1%) and traditionalists (0.8%) being minorities. The average age was 21.35 years (±2.557). Most students were aged 18-21 (64.6%), followed by 22-25 (30.8%), 26-29 (3.1%), and above 30 (1.5%).

Variables	Frequency (N)	Percentage (%)
Which level are you?		
Level 100	15	11.5
Level 200	39	30
Level 300	31	23.8
Level 400	40	30.8
Level 500	5	3.8
Which department are you enrolled in?		
Biochemistry cell and Molecular Biology	6	4.6
Biomedical engineering	3	2.3
Family and Consumer Science	8	6.2
Medical Laboratory	16	12.3
Nursing and Midwifery	40	30.8
Nutrition and Food Science	36	27.7
School of Medicine	14	10.8
School of Pharmacy	7	5.4
Gender		
Male	70	53.8
Female	60	46.2
Tribe		
Akan	84	64.6
Ga/Adangbe	15	11.5
Ewe	20	15.4
Northern Ethnicity	11	8.5
Religion		
Christian	125	96.2
Muslim	4	3.1
Traditional	1	0.8
Age (years)	21.35 ± 2.557	
18-21	84	64.6
22-25	40	30.8
26-29	4	3.1
Above 30	2	1.5

Knowledge level on diabetes mellitus.

The results show the knowledge of 130 students about diabetes mellitus (DM). Important details regarding Diabetes Mellitus (DM) and its many elements are presented in Table 2. It provides information on how the respondents understand DM, its risk factors, symptoms and symptoms, control and management methods, and diagnostic approaches.

Table 2 presents the average percentage scores for various questions related to Diabetes Mellitus (DM). For the question about understanding what DM is, respondents answered correctly 86.2% of the time and incorrectly 13.8% of the time. This indicates a generally strong understanding of foundational concepts. Exploring signs and symptoms, 93.8% of respondents provided accurate answers, while 6.2% were incorrect. When it comes to controlling and managing DM, a significant 99.2% of respondents answered correctly, leaving only 0.8% with incorrect responses. Lastly, only 24.6% exhibit a good understanding of the optimal diagnostic methods for DM, highlighting a significant gap in knowledge compared to other aspects.

Table 2: Respondents' average score on each question under the knowledge level on diabetes mellitus.

Variables	Good (%)	Poor (%)
Average	92.3	7.7
Definition	86.2	13.8
Risk Factors	93.1	6.9
Signs and Symptoms	93.8	6.2
Control and Management	99.2	0.8
Best ways to diagnose	24.6	75.4

Respondents' awareness on diabetes mellitus.

The results show the responses of participants on the awareness of diabetes. The results capture respondents' understanding of the causes, effects, management, and misconceptions associated with diabetes. Figure 1 displays the awareness percentages of two categories, "Good" and "Poor." 92.3% of the dataset's have "good" awareness, whereas 7.7% have "poor" awareness levels.

Figure 1 General awareness level.

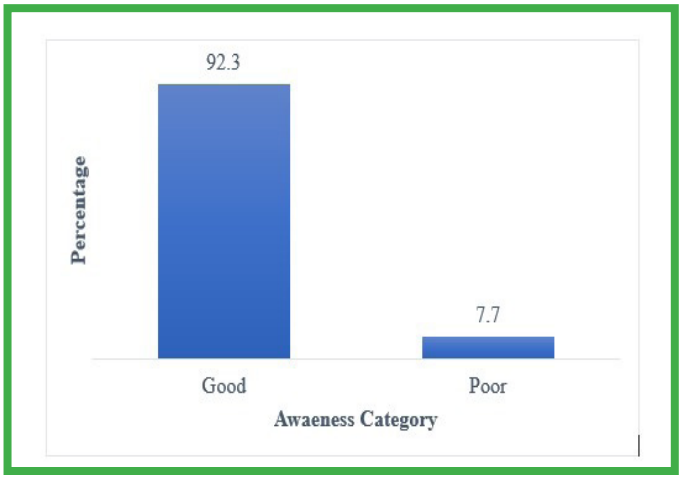
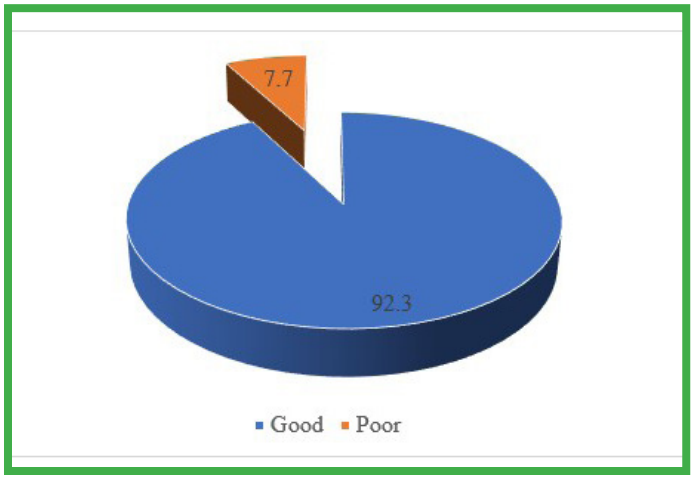


Figure 2 Attitudes of respondents towards diabetes mellitus.



Respondents' attitudes towards diabetes mellitus.

According to Figure 2, 92.3% of respondents demonstrated a positive or "good" attitude, while 7.7% exhibited a negative or "poor" attitude.

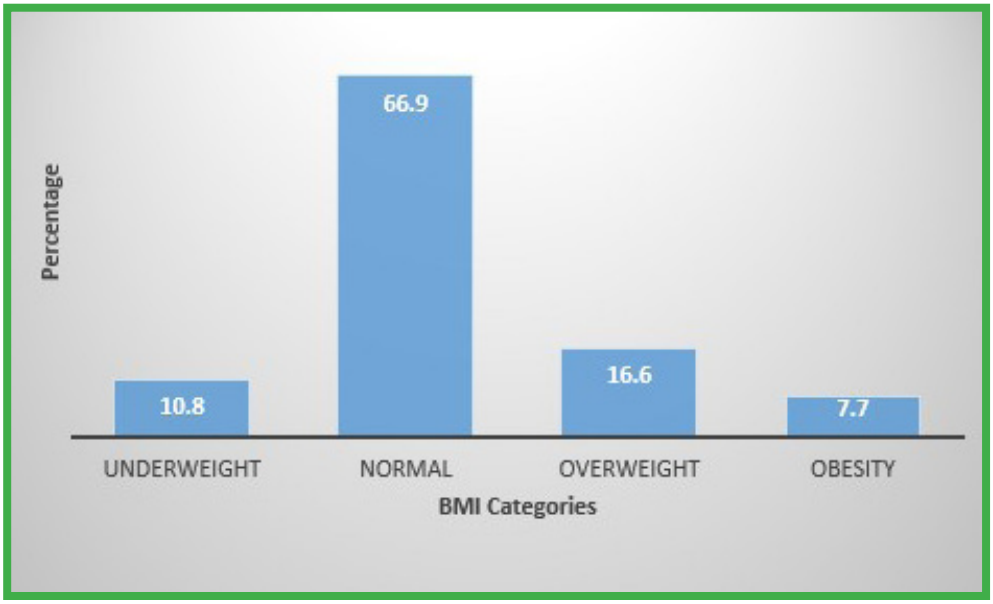
Anthropometric parameters of study participants.

The anthropometric measurements of the individuals are shown in Table 3 below. The table compares the average sample group (N=130), the males (N=70), and the females (N=60) in terms of weight, height, and BMI. The sample group's overall mean weight is 61.70 kg, and its standard deviation is 15.14. The mean weight of men is larger at 65.27 kg, while the mean weight of women is somewhat lower at 57.54 kg. A statistically no significant difference in weight between both genders is shown by the p-value of 0.19. The sample as a whole has a mean height of 1.67 meters and a standard deviation of 0.14 meters. Males have a mean height of 1.69 meters, which is marginally higher than that of girls, who stand at 1.54 meters. The p-value of 0.00 indicates a significant gender difference in height. For the entire group, the mean BMI is 23.07 kg/m2, and the standard deviation is 5.82. Females have a mean BMI of 23.31 kg/m2, which is somewhat higher than that of males, who have a mean BMI of 22.86kg/m2. There is no statistically significant difference in BMI across genders, according to the p-value of 0.44.

The distribution of body mass index (BMI) categories among 130 respondents is shown in Figure 3 below. Four BMI classifications are shown in the graph: underweight, normal, overweight, and obesity. The majority are "Normal" or within that range. Furthermore, a sizable chunk is labeled as "Underweight," and a sizable portion is labeled as "Overweight." The category "Obesity" is applied to a smaller fraction.

Table 3 Anthropometric parameters of study participants.

Variable	Total (N=130) Mean ± SD	Male (N=70) Mean ± SD	Female (N=60) Mean ± SD	P-Value
Weight (kg)	61.70 ± 15.14	65.27 ± 16.92	57.54 ± 11.57	0.19
Height (m)	1.67 ± 0.14	1.69 ± 0.14	1.54 ± 0.10	**0.00**
BMI (kg/m^2)	23.07 ± 5.82	22.86 ± 6.63	23.31 ± 4.77	0.44



Demographic variables associated with participants' level of knowledge of type II diabetes mellitus.

The table displays information on the percentages of participants who have "Good" and "Poor" knowledge of diabetes mellitus across a range of demographic characteristics, along with the corresponding p-values. A total of 95% of females and 95.7% of males displayed strong knowledge and a p-value of 0.286 showed no statistically significant gender-based difference, which means gender does not appear to significantly influence knowledge levels. Department of enrolment has a major impact on knowledge levels, with family and consumer science (50% good knowledge) and school of medicine (100% good knowledge) participants having very different knowledge levels. The p-value of 0.003 indicates that detailed health education at all health-related course departments may lead to an improvement in knowledge. With percentages ranging from 89.3% to 100%, knowledge levels are largely uniform across age groups. The p-value of 0.322 suggests that age does not significantly affect the variation in knowledge.

Muslims and Traditional have slightly greater knowledge levels than Christians (100% good knowledge, 100% good knowledge and 92% good knowledge respectively), however, the difference is not statistically significant (p-value = 0.805). Tribe does not affect knowledge levels because all groups have some degree of good knowledge, and the p-value of 0.218 indicates that there is no noticeable tribal variation.

Table 4 Demographic variables associated with participants' level of knowledge of type II diabetes mellitus.

Demographic characteristics	Knowledge		P Value
	Good (%)	Poor (%)	(N)
Gender			
Female	95	5.0	0.286
Male	95.7	4.3	
Which department are you enrolled in?			
Biochemistry cell and Molecular Biology	100	0	
Biomedical engineering	100	0	
Family and Consumer Science	50	50	
Medical Laboratory	100	0	**0.003**
Nursing and Midwifery	92.5	7.5	
Nutrition and Food Science	91.7	8.3	
School of Medicine	100	0	
School of Pharmacy	100	0	
Which level are you?			
Level 100	80	20	
Level 200	89.7	10.3	0.239
Level 300	96.7	3.3	
Level 400	95	5.0	
Level 500	100	0	
Tribe			
Akan	89.3	10.7	
Ga/Adangbe	100	0	0.218
Ewe	100	0	
Northern Ethnicity	90.9	9.1	
Religion			
Christian	92	8	
Muslim	100	0	0.805
Traditional	100	0	
Age (years)			
18-21	89.3	10.7	
22-25	97.5	2.5	0.322
26-29	100	0	
Above 30	100	0	

Demographic variables associated with participants' level of awareness of type II diabetes mellitus.

The table presents demographic characteristics alongside awareness levels within a sample population. It contains six demographic factors: Gender, Level of education, Department, Age (years), Religion, and Tribe, along with corresponding percentages of individuals categorized as having good or poor awareness. The table indicates that females (91.7%) and males (92.9%) exhibit relatively high percentages of good awareness, with no statistically significant gender-based difference (p=0.800). Awareness increases with the academic level, ranging from 86.7% in Level 100 to 100% in Level 500. However, this difference is not statistically significant (p=0.678). Awareness varies across departments. For example, 100% good awareness is reported in Biochemistry, Biomedical Engineering, Medical Laboratory, and School of Pharmacy, while Nursing and Midwifery shows 92.5%, and School of Medicine shows 71.4%. The p-value here is 0.106. Awareness is highest in the age group above 30 at 100%, whereas it is lowest among those aged 26-29 at 75%, with a p-value of 0.565. Christians show 92% good awareness, while both Muslims and Traditionalists show 100%, but the difference is not statistically significant (p=0.805). Awareness levels vary among different tribes (Akan, Ga/Adangbe, Ewe, Northern ethnicity). Ga/Adangbe shows 100% good awareness, while Akan shows 90.5%. The difference is statistically significant (p=0.642).

Table 4 Demographic variables associated with participants' level of knowledge of type II diabetes mellitus.

Demographic characteristics	Knowledge		P Value (N)
	Good (%)	Poor (%)	
Gender			
Female	95	5.0	0.286
Male	95.7	4.3	
Which department are you enrolled in?			
Biochemistry cell and Molecular Biology	100	0	
Biomedical engineering	100	0	
Family and Consumer Science	50	50	
Medical Laboratory	100	0	**0.003**
Nursing and Midwifery	92.5	7.5	
Nutrition and Food Science	91.7	8.3	
School of Medicine	100	0	
School of Pharmacy	100	0	
Which level are you?			
Level 100	80	20	
Level 200	89.7	10.3	0.239
Level 300	96.7	3.3	
Level 400	95	5.0	
Level 500	100	0	
Tribe			
Akan	89.3	10.7	
Ga/Adangbe	100	0	0.218
Ewe	100	0	
Northern Ethnicity	90.9	9.1	
Religion			
Christian	92	8	
Muslim	100	0	0.805
Traditional	100	0	
Age (years)			
18-21	89.3	10.7	
22-25	97.5	2.5	0.322
26-29	100	0	
Above 30	100	0	

Demographic variables associated with participants' level of attitude towards type II diabetes mellitus.

The table presents demographic characteristics and their association with attitude levels within a sample population. It comprises six demographic factors: Gender, Level of education, Department, Age (years), Religion, and Tribe, with corresponding percentages of individuals categorized as having good or poor attitudes. Both females (78.3%) and males (80%) exhibit relatively similar percentages of good attitudes, with no statistically significant gender-based difference (p=0.815). Good awareness ranges from 70% in Level 400 to 84.6% in Level 200, with a p-value of 0.530, suggesting no significant variation by academic level.

Awareness varies by department. Biochemistry and Biomedical Engineering both show 66.7% good awareness, while Family and Consumer Science shows 100%. Medical Laboratory has 75%, Nursing and Midwifery has 82.5%, Nutrition and Food Science has 72.2%, School of Medicine has 78.6%, and School of Pharmacy has 100%. The p-value of 0.504 indicates that there is no significant difference by department of study. Awareness by age group is as follows: 18-21 years at 79.8%, 22-25 years at 82.5%, 26-29 years at 50%, and above 30 years at 50%. The p-value of 0.275 indicates attitude levels do not significantly differ across age groups. Christians show 79.2% good awareness, Muslims 75%, and Traditionalists 100%. Comparing the awareness of Christians and Muslims to that of the Traditionalist, there is a noticeable difference, although it's not statistically significant (p=0.858). Attitude levels vary among different tribes (Akan, Ga/Adangbe, Ewe, Northern ethnicity). Ga/Adangbe individuals have a relatively high percentage of good attitudes (86.7%), while Ewe (70%) and, Northern ethnicity (72.7%) have lower percentages. The differences are not statistically significant, though there is a trend towards significance (p=0.578).

Table 6 Demographic variables associated with participants' level of attitude towards type II diabetes mellitus.

Demographic characteristics	Awareness		P Value (N)
	Good (%)	Poor (%)	
Gender			
Female	78.3	21.7	0.815
Male	80	20	
Which department are you enrolled in?			
Biochemistry cell and Molecular Biology	66.7	33.3	
Biomedical engineering	66.7	33.3	
Family and Consumer Science	100	0	
Medical Laboratory	75	25	0.504
Nursing and Midwifery	82.5	17.5	
Nutrition and Food Science	72.2	27.8	
School of Medicine	78.6	21.4	
School of Pharmacy	100	0	
Which level are you?			
Level 100	80	20	
Level 200	84.6	15.4	0.530
Level 300	83.9	16.1	
Level 400	70	30	
Level 500	80	20	
Tribe			
Akan	81	19	
Ga/Adangbe	86.7	13.3	0.578
Ewe	70	30	
Northern Ethnicity	72.7	27.3	
Religion			
Christian	79.2	20.8	
Muslim	75	25	0.858
Traditional	100	0	
Age (years)			
18-21	79.8	20.2	
22-25	82.5	17.5	0.275
26-29	50	50	
Above 30	50	50	

DISCUSSION

The study explored demographic and lifestyle factors influencing students' knowledge and awareness of type II diabetes, finding that males were slightly more aware than females. This contrasts with many studies that show females generally have higher diabetes knowledge due to their roles in health fields and caregiving (Al-Mahrooqi et al., 2013; Fukuoka et al., 2014; Lemes dos Santos et al., 2014; Majumder et al., 2013; Manierre, 2015; Bloom et al., 2001; Family Caregiver Alliance, 2016). However, the study supports other research indicating males' greater awareness (Deepa et al., 2014; Fezeu et al., 2010; Gillani et al., 2018).

No significant differences in diabetes knowledge were observed across different study disciplines or levels, though students from the Family and Consumer Science department had less knowledge, possibly due to curriculum differences. No significant differences were observed in diabetes knowledge across different study levels (100 to 500), though a slight difference was noted between levels 500 and 100. According to Al-Sarayra and Khalidi (2012), significant differences should be expected between lower and higher levels of study if the length of study impacted knowledge. Overall, the duration of study did not significantly influence diabetes knowledge. Raising diabetes awareness through educational programs is essential for preventing the disease and its complications (Johnston, 2017; Swanson & Maltinsky, 2019). Effective diabetes education benefits society and supports diabetes prevention efforts (Powers et al., 2016; Xu et al., 2016). The International Diabetes Federation (2017) and Johnston (2017) recommend programs focusing on diabetes education for management and prevention. University students, as future leaders, play a key role in spreading health knowledge, making it crucial to include diabetes education in their curricula. A lack of diabetes knowledge can lead to poor health decisions, worsening health, and higher mortality rates (Centers for Disease Control and Prevention, 2020; Gunasekeran et al., 2020; U.S. National Library of Medicine, 2020).

The study targeted undergraduate health-related students, who are expected to disseminate relevant health information within their families. The findings indicate that respondents possess good knowledge of type II diabetes mellitus, accurately answering questions about its definition, risk factors, symptoms, control, and diagnosis methods. Most participants demonstrated understanding in control and management (99.2%), symptoms (93.8%), risk factors (93.1%), definition (86.2%), and diagnosis methods. This contrasts with Al Shafaee et al. (2008), who found that many participants were unaware of basic diabetes symptoms.

Additionally, the results differ from Gillani et al. (2018), who reported limited knowledge of diabetes treatment among the Pakistani population. Overall, 92.3% of participants showed good understanding of diabetes, aligning with studies indicating above-average diabetes knowledge among Iraqi students (Mohammed et al., 2018) and Nigerian civil officials (Agu et al., 2014). These findings are consistent with other research demonstrating that students generally have high levels of diabetes knowledge (Kharono et al., 2017; Li et al., 2013).

Contrasting with some studies that report limited diabetes knowledge. For example, Omani adults (Al Shafaee et al., 2008) and Jordanian students (Al-Sarayra & Khalidi, 2012) showed limited knowledge. Additionally, other studies found that health field students, such as nurses, physician assistants, and medical students, lack diabetes-related knowledge (Edwards et al., 2014; Henry, 2015; Rushforth et al., 2016; Yacoub et al., 2014). Haroon et al. (2016) also reported that novice preclinical Pakistani medical and dental students had little understanding of diabetes. A possible explanation for the high knowledge levels could be that participants made educated guesses, particularly on risk factors and symptoms. However, the lowest scores were on questions about the best ways to diagnose diabetes, with many participants mistakenly thinking urine sugar measurement was the best method.

The study also assessed participants' awareness of type II diabetes in terms of causality, treatment, symptoms, and complications. The item with the highest percentage of correct answers (95.4%) was regarding the increase in blood sugar levels in untreated diabetes, differing from the findings of Hu et al. (2013) on a Chinese population. The statement about the need for special care when cutting toenails had the fourth-highest correct response rate at 87.7%. Other statements, such as the impact of regular exercise on the need for insulin or diabetic medication (50% correct), signs of low blood sugar (49.2% correct), and urine testing as the best way to check diabetes (37.7% correct), received fewer correct responses.

In contrast, Bastos (2004) found fewer correct responses for statements about diabetes causality related to sugar intake and kidney function. Similarly, Hu et al. (2013) reported low correct response rates for the statement on kidneys' difficulty in keeping urine without sugar. Participants demonstrated good awareness of diabetes symptoms, with 91.5% correctly responding to the question on fasting blood sugar levels. Overall, 92.3% of participants answered the questions correctly, which is likely due to information from friends, relatives, and mass media, consistent with Mohieldein et al.'s (2011) findings.

The study evaluated participants' attitudes towards diabetes mellitus (DM) using six questions on dietary changes, consequences, and treatment and control of the illness. The participants exhibited a positive attitude towards DM, which is crucial for reducing the prevalence and improving the management of the disease. This positive attitude contrasts with Shanthirani et al.'s (2005) findings of low attitudes and knowledge about diabetes. The positive attitudes in the current study are attributed to the participants' high level of awareness and fair to good knowledge about diabetes, supporting the notion that knowledge and attitude are correlated. This finding is consistent with Ambigapathy et al. (2003), who also reported a positive correlation between knowledge and a good attitude towards diabetes.

In the study by Gregg and Bracco (2019), BMI was used to evaluate the nutritional status of participants. Most participants had a normal BMI, but males exhibited higher BMI levels compared to females. A BMI above the normal range (18.5-24.9 kg/m^2) indicates overweight or obesity, which are significant risk factors for type II diabetes mellitus and cardiovascular diseases (NIH, 2004; Edelstein et al., 2009). Overweight and obese individuals have an increased risk of diabetic macrovascular and microvascular complications (ADA, 2014; CDC, 2014). Obesity is a major risk factor, with approximately 75% of type II diabetes cases attributed to it (Manson & Spelsberg, 2012).

Research on gender differences in diabetes knowledge yields mixed results. Some studies indicate that females have better knowledge (Al-Mahrooqi et al., 2013; Fukuoka et al., 2014; Lemes dos Santos et al., 2014; Majumder et al., 2013; Manierre, 2015), while others find no difference or greater male knowledge (Bani, 2015; Mohieldein et al., 2011). In this study, males (95.7%) had slightly better diabetes knowledge than females (95%), but the difference was not statistically significant ($p = 0.286$), consistent with Hassanein et al. (2018). Education level significantly impacts diabetes knowledge, with higher education correlating with better understanding. Level 500 students showed 100% "good" knowledge compared to 80% in Level 100 students (Smith & Andrews, 2019; Al-Sarayra & Khalidi, 2012; Johnson et al., 2018). Age did not significantly affect knowledge levels, aligning with previous research (Jones & Smith, 2020). Religious affiliation showed minor differences, with Muslims (100% "good" knowledge) slightly ahead of Christians (92%), but the difference was not statistically significant ($p = 0.805$), in line with Brown & Green (2017). Knowledge levels were consistent across tribes, supporting findings that tribal identity is not a strong predictor of

diabetes knowledge (Wilson & Johnson, 2016).

Both females (91.7%) and males (92.9%) demonstrate high levels of good awareness about diabetes, aligning with research indicating no significant gender-based disparities (Smith et al., 2018). Level 500 students have the highest awareness (100%), while Level 200 (89.7%) and Level 100 (86.7%) students show lower percentages, though these differences are not statistically significant ($p = 0.678$), supporting the notion that advanced education enhances awareness (Johnson & Miller, 2019). The 26-29 age group has notably lower awareness (75%) compared to younger groups, consistent with studies showing age-related variations in awareness (Brown et al., 2020), though this difference is not statistically significant ($p = 0.565$). Muslims have slightly higher awareness (100%) than Christians (92%), with no significant difference ($p = 0.805$), in line with research on religious influence on awareness (Rahman & Ali, 2017). Ethnic differences in awareness are present but not statistically significant ($p = 0.642$), with Ga/Adangbe individuals showing the highest awareness (100%) compared to other ethnic groups. Further investigation with a larger, diverse sample is recommended to explore the role of ethnicity in awareness levels (Kwame et al., 2021).

CONCLUSION

In conclusion, the study provides valuable insights into participants' anthropometric measurements, attitudes, and understanding of diabetes. The findings show that participants have good knowledge and positive awareness of type II diabetes mellitus, which suggests they may be able to avoid risk factors and take preventive measures. They can also benefit their communities by supporting those with diabetes and helping reduce its prevalence. Despite the overall strong knowledge and awareness, some areas of misunderstanding need further research and education. Implementing a systematic diabetes education curriculum at all educational levels in Ghana is crucial to prevent the predicted high diabetes prevalence by 2030.

RECOMMENDATION

Evaluate the existing curriculum for health science students to ensure comprehensive coverage of type II diabetes and identify any gaps for enhancement. Examine the correlation between education level and diabetes knowledge, assessing if advanced education improves understanding. Investigate the impact of clinical exposure and practical training on diabetes knowledge, determining if hands-on experience enhances awareness. Explore the benefits of interdisciplinary education, assessing if collaborative learning among various health science disciplines improves diabetes understanding.

LIMITATIONS

The study's sample is limited to University of Ghana undergraduate health-related course students, who may have higher knowledge levels than the general public. As the research is conducted at a single university, the findings may not fully represent the broader population of Ghana or health science students in other countries.

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PROCEEDINGS OF AN AFRICAN NUTRITION SOCIETY PRE-CONFERENCE CONSULTATIVE WORKSHOP ON SCHOOL HEALTH AND NUTRITION 5-6 OCTOBER 2024 UNIVERSITY OF CAPE COAST GHANA

Preface

This document is based upon contemporaneous notes taken by two attendees, Drs Landman and Owolabi, during the pre-conference consultative workshop. Their notes were supplemented with all the abstracts, presentations and responses to questionnaires submitted by speakers and panellists. In an attempt to provide a document that could be of use and value to readers who had not attended the workshop, as well as to attendees, the editors sought to verify facts and information by consulting several sources: for Catholic Relief Service (CRS) experiences, by reference to a publication circulated at the workshop entitled 'Advancing Integrated Health and Nutrition in Africa – CRS Multi-Stakeholder Approaches and Promising Practices' (no date), by Jessie Bennett and Mawuli Sablah, with review support from Anne Sellers and Timothy Boom, CRS, Baltimore, USA. Information about projects and programmes other than those supported by CRS was checked by searching the websites of relevant country, donor or agency programmes. Wherever possible, we have included these and other sources of reference supplied by speakers. Chairs and co-chairs of some of the sessions kindly supplied summaries of key lessons learned, questions to be answered or issues to be resolved that emerged from the panel and plenary discussions they had chaired. These summaries have been incorporated into the document that follows.

The document was peer-reviewed by members of the African Nutrition Society's (ANS) ad hoc Group and by senior figures who attended the workshop to ensure that it is readable, accurate and a useful account of the consultative workshop. We thank Mrs Jennifer Overton, Ms Kwadzani Nyanungo, Dr Frank Hayford and Mrs Julia Tagwireyi for their invaluable assistance. We are also grateful to Professor Ann Ashworth-Hill of IMTF who also reviewed this document.

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Programme of the Consultative Workshop

Session 1: National Experiences: positive lessons learned and challenges in Catholic Relief Services (CRS) and Non-CRS supported School Feeding Programmes (SFP) chaired by Mrs Jennifer Overton (CRS) and Dr Victor Owino (International Atomic Energy Agency).

Session 1a: CRS Championship: Showcasing Consolidated CRS Experience on School Nutrition in Africa: Overview[1] , followed by a Panel of 5 Chiefs of Parties.

Overview: Édouard Nonguierma, Chief of Party, focussed on CRS's work in Benin, Mali and Burkina Faso, 3 of the 10 countries where CRS works, also including Burundi, Guinea Bissau, Lesotho, Madagascar, Sierra Leone, The Gambia and Togo. School Feeding Programmes (SFP) extend CRS's work on the First 1,000 days. CRS is the largest implementer of USDA McGovern Dole Food for Education (FFE) Nutrition Programmes, providing a nutritious school meal daily to ~ 950,00 students. Its goals are to address longstanding inequalities, applying learning from partnerships with locals in remote and fragile areas. CRS integrated programmes that focus on primary school-aged children include school gardens and use market-based approaches to promote food security in WASH-friendly schools in which there is emphasis on washing hands (with soap), provision of gender-specific latrines, and promoting good menstrual hygiene management (MHM)]. Five areas of experience to note are social behaviour change, multisectoral integrated programming, school meals, nutrition governance standards and using learning and adaptive management for improvement. CRS spends > US$350 million for the benefit of > 950x103 children. It trains canteen workers and for beneficiaries, deworming, micronutrient supplements, health and nutrition education using pedagogy designed to mainstream the use of fortified foods on menus. It encourages school gardens and clean school environments. CRS also runs clean school competitions and clubs to support its activities and goals. SFP Management Committees work with Parent-Teachers' Associations, Community Health Workers, School Management Committees and mothers' support groups to effect community empowerment. CRS introduces savings and loan groups and promotes awareness of good nutrition and WASH. CRS is looking forward to more partner research in order to integrate locally sourced foods into better recipes for school meal programmes which will in turn help build local economies and sustainability through more multisectoral programming.

1 See 'Advancing Integrated Health and Nutrition in Africa – CRS Multi-Stakeholder Approaches and Promising Practices' n.d, by Jessie Bennett and Mawuli Sablah, with review support from Anne Sellers and Timothy Boom, CRS, Baltimore, USA.

Gambia: Halimatou Bah spoke about a new project arising from the McGovern Dole (USDA) Food for Education Programme awarded US$28.5 million for 5 years. SFP offer more meals that use fortified foods selected to address local problems, such as Vitamin A deficiency. School meals are based on local rice and other products. Recipes are developed in consultation with local stakeholders so that they are culturally appropriate. The project advocates about school education to the Ministry of Education. SFPs commenced with training for mothers and support for food markets to secure good food safety and nutritional quality. SFPs revitalised regional committees. Memos of Agreement are signed Village Development Committees, Parent-Teacher Associations and School Management Committees to secure community support for SFPs through contributions in cash or kind. SFPs are multi-sectoral and multi-stakeholder. Quarterly gatherings of stakeholders from 310 schools meet in clusters to provide comprehensive updates on all components. They are action-oriented to address challenges, set benchmarks and establish committees for follow-up actions. Therefore, there is regular feedforward and feedback. A Peer Health Programme is being introduced for children in grades 4-6. Produce from school gardens diversify school meals. As part of WASH, SFPs test water quality.

Madagascar: Andrianjafitrimo Nasoavina Veromanitra spoke about a new SFP known as Mianatra ("Learn") that served 12,277 school meals in 18 schools in the first week of February 2023. USDA awarded the first McGovern-Dole project in Madagascar in 2021, to Global Communities with implementing partners CRS and FHI 360, to support the Government of Madagascar to improve literacy among school-age children and provide nutritious daily school meals in the chronically food insecure southern Androy region. Mianatra aims to supply >64,000 preschool and primary school students with daily meals in 130 targeted schools over 5 years. CRS engages focal point teachers in each school whom they train in collaboration with local health centres. Mainstreaming nutrition in teacher-training curricula together with systematic primary and secondary education will contribute to nutrition education sustained across the education system. Fresh produce from school gardens enriches simple school meals. Communities provide firewood and water for school canteens while parents help pay cooks and buy condiments, thereby signifying their dedication to their children's well-being. WASH clubs, set up with 238 members, promote peer health and hygiene while locally-made handwashing stations allow multiple students to wash their hands at the same time, reducing waste.

Benin: Edouard Nonguierma said this SFP adapts to local circumstances. Outreach extends school-based teaching and learning for reinforcement at home. There are tiers of engagement among national, regional and mayoral or town hall levels. Community members, supported by CRS and Ministry of Agriculture, manage 96 school gardens that supply produce for nutritious school meals. Local farmers receive training in climate-smart agriculture. Local community farms supply school canteens. Sale of surplus produce funds medical visits, school supplies and WASH activities. Implementing low-cost solutions such as Tippy Tap handwashing stations with support from strong Parent-Teacher Association, led to an increase from 13% to 93% pupils' washing their hands before meals. Benin is a CRS programme country that has advanced towards transition most, with government covering 54% of the cost of national school meals and moving towards full coverage with locally-bought meals.

Burkina Faso: Abdoulaye Bikienga said their SFP operates in a context of food insecurity due to war in Sahel 3-7 years ago. The SFP reaches 2 million displaced, equivalent to some 10% of the population and 1 million schoolchildren. They try to locate displaced people in secure areas by using local partners to enable outreach food distribution in insecure areas, by making extensive use of technology for data capture and information exchange. Cooperation with government is instrumental as the latter invests in commodity transport and legal support (in the form of decrees) that create a framework for programme sustainability. Parent-Teacher Associations are trained in hygiene and are involved in implementing low-cost solutions such as Tippy Tap handwashing stations, and vitamin A and Iron nutrition practices. Trained women volunteers mentor girls. This, together with offering MHM support by offering reusable menstrual pads, helps girls to stay in school. Community health workers have supported MHM awareness-raising sessions for >17,000 students that help to reduce stigma and enable girls stay in school.

Chad: Mr Sansan Dimanche, Sahel Health, Nutrition and Resilience (SHNR) spoke about a Home-Grown School Feeding (HGSF) project in Mailao village, Madiogo Canton that uses a hybrid system in which a centralised system manages and supplies dry goods while a decentralised system puts perishable items on menus. HGSF is at the heart of agricultural policies in various Sahel countries since the African Union (AU) integrated and formalised the concept within its Agricultural Development Program (ADP) and recommended HGSFPs for all sub-Saharan African states. However, implementing HGSFPs requires the participation of institutions at national, regional, district and local levels. Although the objectives of HGSFPs focus on nutrition, agriculture, and reducing poverty among vulnerable groups, their implementation falls under the ministry responsible for education. HGSFPs help to keep children in school, in environments conducive to nutritional education and with access to WASH facilities, thereby reducing the challenges all pupils, but particularly girls, face. They provide nutritious school meals and are based on parents' contributions. Since about 2022, Sahel SHNR has supported local production of food in gardens that supply school canteens in all 5 primary schools in Madiogo Canton, mainly by capacity-building to empower education and human development institutions. Building on its expertise in food security and school feeding, SHNR collaborates with governments to implement HGSFPs in all its intervention areas.

Sierra Leone: Finah Koroma said it was difficult to work in hard-to-reach remote areas, especially in the COVID era when schools were closed. Take-Home rations that parents prepared at home replaced school meals. These were accompanied by memory cards to enable learning in smaller groups (<25) for social distancing. After engagement with communities, Savings and Loans groups in Communities (SILIC) were set-up in 310 schools. The communities decided on who holds the money, how to manage interest and how to disburse funds which occur after collecting for up to 8months.

PLENARY DISCUSSION

Gender: The benefit for girls is evident from their increased enrolment and attendance. In Gambia, both enrolment and attendance are now better for girls and for boys. In MHM, girls are taught how to use reusable pads. There is a programme to build gender-specific toilets. The situation in Burkina Faso is improving with a programme of mentoring by older women, grandma figures partnered with girls and their families who act as role models, supporting reading groups and advocating to parents for girls to complete their schooling, a point that they promote as both a right and beneficial in order to prevent girls being removed before completing primary school to become servants.

Evaluation and identifying lessons: CRS is evaluating mentoring. Qualitative studies showed mentors lacked competence to promote literacy, leading to a change in criteria for recruitment or finding ways to raise competency

in mentors. IT methods are an issue. In Benin, SFP have had less impact on literacy than on hygiene. While a focus on gender has improved attendance, research is needed to identify whether this change is directly attributable to CRS SFP.

Access to fruit and vegetables: Because barriers to fruit and vegetable consumption are cultural, sensitising communities must occur along with ensuring an adequate supply from school and home gardens. Madagascar recognised the need to undertake baseline research to identify local fruits and vegetables rich in micro-nutrients to complement staple foods

Documenting practice: Attendees were invited to use the Nutrition Community of Practice (CoP) of the Research Consortium for academics and practitioners, co-chaired by Robert Akparibo and Bimbola Adesanmi, to capture the practical know-how presented by School Meals Coalition (SMC) countries and CRS. CRS is interested in collaborating on research and on documentation.

Governance and sustainability: Technical support is needed to form School Food Policy that builds sufficient capacity for sustainability. While it is important to identify alternative sources of funding if governments cannot step in, Uganda's experience showed that it was essential for the Ministry of Education to undertake coordination. All non-government organisations (NGOs) in CRS countries engage in joint monitoring and evaluation with governments. They have a ratio of I supervisor per 15-16 schools. In Benin, a national nutrition coordination committee is responsible for the oversight of all activity. In the Gambia, government is increasing its financial contribution and is taking over in 2 regions. In the Gambia, CARITAS is phasing out of its local partnership as government provides 30% less funding. The Government of Ghana took over responsibility for SFP from CRS in 2005. SFPs extend CRS's work on nutrition and health in the first 1,000 days. Jennifer Overton highlighted

a. the value of a holistic approaches based on good collaboration with multiple stakeholders.
b. a need for research for development and for a focus on sustainability.

CRS looks forward to more partner research that integrates locally sourced foods into better recipes for school meal programmes, which will in turn help build local economies, sustainability and more multisectoral programming.

Session 1b: Panel of non-CRS countries: Dr Bimbola Adesanmi (Nigeria), Mr Mufaro Chiriga (Ethiopia), Professor Habiba Hassan-Wassef (Egypt), Ms Beatrice Nakholi, (Kenya), Mr Richard Quashigah (Ghana) and Ms Kwadzanai Nyanungo (Zimbabwe).

Ethiopia: Mr Mufaro Chiriga, World Food Programme (WFP) Ethiopia, reported that over 30 years, the scope, strategic focus and Government ownership of Ethiopia's School Feeding Programmes (SFP) have grown, with universal coverage by 2030 envisioned. The Ministry of Health's National Policy and Strategy includes school feeding. A National School Feeding Policy Framework and Strategy were endorsed in 2021. Complementary policies form a facilitatory policy environment. Ethiopia's programme follows a HGSGF modality. School meals are provided by the WFP together with development partners and the Government which supplies the highest share. School meals reached >7.5 million children this year in almost all regions. WFP delivers both in-kind and HGSF modalities, with the HGSF proportion increasing steadily over the years to 55% of WFP school meals in 2024. WFP is Ethiopia's major partner in a McGovern-Dole Food for Education Programme that began with undertaking a baseline survey and scoping review. The aim of the SFP is to provide school meals for primary schools (Grades 1–8) and pre-school children on the same sites. Its initial targets were to feed 200,000 children in 450 schools in Year 1, tapering to 134,500 children from 348 schools in Year 5. Take-home rations (THR) will be provided for girls in grades 5 and 6 and boys in Grade 6 in Afar. Support activities will promote literacy, health, nutrition, and capacity strengthening. Flexibility in the SF menu and ad hoc use of THR were sensible adaptations that avoided waste but also – on the evidence of the baseline survey and situation analysis – can be judged to have substantially benefitted food-insecure households experiencing the added stress of the pandemic. Baseline evaluation found correlations between food consumption scores and various indicators of child performance that strongly support the potential of school feeding to strengthen educational performance by alleviating hunger. The baseline survey identified educational and nutritional outcomes and helped to identify barriers and opportunities for better design and implementation.

There is a need for food diversification to provide more than a cereal-based meal. HGSF is seen as a potential game changer, with benefits not only for school children receiving meals, but also for local communities and local economy, with an estimated Return on Investment (ROI) of U$7.20 for each U$1 invested, compared with U$3.10 ROI from the traditional in-kind modality. HGSF also creates opportunities to increase the dietary diversity of school meals, including nutrient-dense foods, while delivering locally acceptable foods. An example of the role of nutrition experts is within WFP's ongoing pilot project to enable existing nutrition-sensitive social protection projects, SFP and a Productive Safety Net Programme (PSNP) to meet their nutrition goals. To do so, the project assesses the nutrition-sensitivity of both projects, identifies gaps and priority areas to be strengthened and pilots an intervention package, generating evidence. Consideration of opportunities for leverage while meeting challenges the programme faces identified the extent of government's commitment of resources, and the creation of an environment conducive to strengthening SFP in order to achieve universal coverage by 2030. Areas for improvement identified include innovative financing, the quality of the school meals, infrastructure for school meals, cross-sectoral collaboration, among others.

Nigeria: Bimbola Adesanmi reported that WFP considers Nigeria's the best National Home-Grown School Feeding Programme (NHGSFP) in Africa, one that is feeding 10 million children. Menus vary according to state. State nutrition committees run integrated programmes comprising nutrition education, food safety and hygiene. Foods are locally sourced and prepared by >120k cooks who receive nutrition education. WFP supplied tablets loaded with the Schools Menus Planner PLUS app that converts portions into standard, commonly used units e.g. bowls.

The SFP is spreading competency in food safety. This HGSFP has achieved a great deal in successfully feeding millions of children and boosting local agriculture. Hurdles that impede HGSFP's achieving its full potential include inadequate funding constrains meal quality and reach; reducing the effects of some cooks' corruption requires stricter monitoring. Management inefficiency, including too few regular reviews, leads to unmet demand and the risk of mismanagement. Furthermore, there are discrepancies between successes reported and experience in some areas.

Egypt: Some 13 million primary school children get meals while 25 million students get a WFP dry snack made from concentrated fortified date paste. These meals or snacks supply 30% of daily nutritional needs. While the economic crisis led to emphasis on increasing exports, government tried to strengthen social protection with a multi-pronged multi-action programme costing Egyptian £ >1 billion, with support from WFP that left a shortfall . Government consulted nutritionists to devise menus. As little is decentralised, the national programme largely bypasses the 29 provincial governors. However, two governors have invented their own local approaches. Logistical problems arise because there are two teaching sessions daily in each school. Independent Food Banks involve mother's organisations, not nutritionists, to produce cooked meals every day. Conditional cash transfers are subject to weight and height monitoring.

Plenary Discussion:
The roles of local communities
Nigeria: Location of the programme in the presidency evidences the governments strong political will. As a humanitarian programme, it must involve communities. There must be demonstrable buy-in before government disburses direct payments to women. Communities monitor workers and procurement contracts that entail bartering and are responsible for vetting and approvals. Community involvement is state policy. HGSFP aims to provide social protection that entails monitoring and evaluation (M&E) issues,

Ethiopia: SFP has 8.5 million beneficiaries. Government provides 80% support. Some communities provide food, especially home-grown. SFPs build on traditional community social protection practices where they exist or persist. Shocks affect sustainability especially for smallholder farmers. Volunteers act as cooks and manage supplies.

Egypt: The community is involved indirectly, through partners who are active in government-recognised organisations. It is important to consider the environment around schools (a.k.a. "fringe") where vendors, from the community, sell snacks. Trials are underway into the feasibility of replacing usual snacks with standardised, improved snack foods to be supplied in school canteens.

Cross-sectoral Linkages

Ethiopia: Challenges, especially around wholly home-based SFP, require that all involved appreciate their own and others' contributions towards fulfilling their shared goal. Efforts need to be systematic and sustained. Beyond documentation, engagement and a push for collaboration,

setting targets and goals are also needed in order to "achieve what we measure."

Egypt: SFP face difficulties because each sector is ignorant about what other sectors (can) do. There is a need for motivation and commitment, exchange of information and education. Joint planning at every stage from concept to implementation is vital, including decisions about the distribution of roles, who will hold budgets and how to allocate and disburse funds. Since the Millenium Development Goals (MDGs), institutional reform to facilitate intersectoral working has not occurred.

Nigeria: Started its programme in 2004, having prepared for 2 years in order to secure multisectoral coordination. It has a defined budget and undertakes joint M&E in which evaluators are trained to look at all key performance indicators (KPIs), nutritional, educational, and financial, within the value chain. Government ministries Budget and Planning, Agriculture, Education and Health agreed a holistic approach for which the Ministry of Justice formulated memoranda of understanding and drew up standardised contracts for local multisectoral use. The HGSFP is committed to using measures that would enable attribution of changes in outcomes to the programme.

Use and Management of Data

Nigeria: HGSFP defines needs e.g. amounts of commodities and looks for changes in anthropometric indices that cannot confidently be attributed to the HGSFP (versus home feeding). Women befriend other women to mentor about cooking nutritious meals. HGSFP that alleviates hunger encourages learning. Nigeria is committed to spending 100 billion Naira to feed 10 million more children per day. Developing technology to create a dashboard that is easily accessible at every level would help improve data management.

Ethiopia: Choice of outcome measure to be used is under active discussion. Process indicators are easier. Ethiopia is moving towards digitised technological approaches that can be shared between the Ministry of Education and WFP.

Egypt: The Ministry of Education monitors school attendance, for example; these data are in the public domain. School Health Services are weak, inefficient and focus on crises. About ~ 1 year ago, the President ordered 13 million primary school children to be assessed for wasting, stunting, obesity and anaemia. To date, 8 million have been covered. Healthy Living and Family Centres [Family Clubs] were ordered to reverse the stunting observed in early childhood.

Experiences in Kenya, Zimbabwe and Ghana

Kenya: Beatrice Nakholi Education Officer, Busia, Kenya reported that the Government of Kenya started school meals in 1980, in collaboration with development partners, primarily to incentivise the enrolment and retention of rural children, particularly in the deprived northern areas of the country, in order to help realise a goal of universal primary education, to bridge the north–south divide, and minimise rural-urban migration. School meals have remained a core development intervention to support the country's achievements in education. The policy framework for SFP includes the National Pre-Primary Education Policy, Section 1.2.3 of which highlights how vital the health and nutrition of Early Childhood Development Education (ECDE) learners are for better and healthy futures. The Food and Nutrition Security Policy (2011) includes 14 priority nutrition areas, such as reducing the prevalence of micro-nutrient deficiencies, improving nutrition in schools (explicitly mentioned within institutional feeding), data collection and cross-sectoral food and nutrition data analyses. The National Nutrition Action Plan (2012–2017) further commits to "promote appropriate nutrition for school children and adolescents" highlighting improvement of nutrition and feeding in both public and private school institutions amongst its strategic objectives.

Since the inception of SFP, Kenya has been one of 59 governments that uses the World Bank's Systems Approach for Better Education Results (SABER) Policy tool to design their National School-Based Health and Nutrition Program. This tool guides National and County Governments to evaluate their education system's policies against international benchmarks and identify actionable priorities to strengthen their programmes. Kenya collaborates with counties, World Bank, UNICEF and other development partners that focus on varied educational domains, recognising that a sound policy framework lays the foundation for implementing policy effectively, for monitoring implementation fidelity and for strengthening learning outcomes. The instruments used focus on the

well-being of children associated with provision of school meals and include a multisectoral framework that plays a vital role in all aspects of design and delivery of school health and nutrition interventions to improve the health, development and education of school children. In 2023, committed to expanding SFPs, the government signed a 1.7 billion K Shilling Intergovernmental Partnership Agreement, to enable it to achieve universal coverage for >1.9 million learners in public schools . Kenya's SFP that has been hailed as the largest in Africa, devolved to counties, for example, Food4Education feeds 170k children in 5 counties, including Nairobi.

Busia is one of 13 counties in the Kenya Lake Region Economic Block with 7 strategic intervention areas that are designed to foster the social and economic growth and development needed to improve shared value from which education and health will benefit. Busia County's Department of Education and Industrial Skills Development (EISD) established sustainable, reliable and predictable financing of its Early Childhood Development Education-Multi Annual Indicative Funding Programme (ECDE-MNIP) to secure sufficient budgetary allocation for the SFP programme. EISD is in the process of establishing a special purpose ECDE-MNIP fund and SFP accounts dedicated to funds from the county, development partners and donors. Busia DEISD partners with Nutrition in City Ecosystems (NICE, that also works in Rwanda and Bangladesh) with oversight from national and county level multi-sectoral cabinets. NICE, that is supported by the Swiss Development Agency, opted to use locally grown organic foods in the project's HGSFP. Their current focus is on all 426 public ECDE centres. Locally procured and grown milled rice and oil are used together with the 2kg beans each parent provides as their stake and contribution to prepare nutritious hot meals for 47,375 learners. Recommended portions for each learner are 50g rice, 3g oil and 3g salt. Rice is grown in cooperatives. The project promotes vegetables and actively seeks other locally available produce e.g. cassava, fish, etc. A Public Health Officer certifies the safety of produce. Nutritionists devise nutrition and meal plans, supervise food deliveries, conduct inspections to ensure ECDE learners are well-fed, healthy and able to learn. They counsel learners and education stakeholders about nutrition issues and healthy eating habits. Nutritionists are included in secretariats of sub-county and ward coordination committees. School Boards of Management include representatives of departments of education, trade unions and others from civil society. The project fosters 4K Clubs to benefit school and kitchen gardens by enabling children to help their parents to grow their families' contributions.

Because they are key aspects of public policy implementation, monitoring, evaluation, accountability and learning (MEAL) are conducted using processes, methods and tools structured in line with national and county legal documents and guidelines that include: the Kenyan Constitution of 2010 section 232, National M&E Policy, Kenya's norms and standards for M&E, Kenya's evaluation guidelines, Busia County's monitoring and evaluation policy and the County Integrated Monitoring and Evaluation System (CIMES) guidelines. The county government helped to develop and implement a MEAL guideline and evaluation plan for ECDE-MNIP. It devised indicators for new priority areas in nutrition and in capacity enhancement and stakeholder involvement; and promoted partnership and collaboration with relevant stakeholders to provide multi-perspective insights in effective MEAL. It also developed tools for data collection, analysis, reporting and dissemination and established mechanisms for feedback from the beneficiaries, while providing a framework for learning from and adoption of good practices. Within this, there are quarterly monitoring reports that include implementation status; food standard compliance reports; stock cards with issue and requisition reports; a supervision checklist and an outcome evaluation report. For learners there are health and nutrition assessment records; daily meal registers and monthly school feeding summaries, as well an evaluation report on scholastic achievement. Challenges faced include effective joint planning; maintaining goodwill; securing county governmental guarantees for budget lines for all 5 million child beneficiaries.

Zimbabwe: Kwadzanai Nyanungo, a School Health and Nutrition Consultant, explained that, in compliance with the AU Heads of State Summit's decision in 2016, prioritisation of the HGSFP has been tied to Zimbabwe's National Development Strategy, the AU Continental Education Strategy for Africa and the Sustainable Development Goals (SDG), including SDG 4, all of which includes school meals indicators.

The school meals programme was further boosted by the 2022 UN Transforming Education recommendations on post-COVID-19 system recovery and resilience measures.

The implementation of the HGSF programme in Zimbabwe is guided by the AU Continental Education Strategy and the Comprehensive Africa Agriculture Development Programme, with local adaptation of the AUDA-ANEPAD Guidelines on the Implementation of the HGSFP. The

UNICEF Nutrition Guidelines and the Regional School Nutrition Guidelines for SADC Member States, which have been adapted under the Zimbabwe School Nutrition Guidelines.

Since the AU declared an Africa Day of School Feeding (ADSF) in 2016, it has been a key calendar event. In line with the annual theme from the AU, all the 72 districts in Zimbabwe hold annual ADSF commemorations which draw significant attendance, with local, multisectoral stakeholder participation. Such nation-wide advocacy, led by local leadership, including traditional chiefs and School-Parent Assemblies, has effectively mobilised community participation and ownership of the HGSFP.

Zimbabwe adopted a phased approach to a government-led HGSFP, beginning with Infants (pupils in the first 4 years of primary school in 8 rural provinces out of the 10 in the country). From 2018, coverage has expanded to cover all primary school grades, thereafter, all secondary schools.

At the practical implementation level, in 2016, a baseline survey conducted to establish the state of implementation readiness for the HGSFP identified the infrastructural gaps, shortage of cooking and serving utensils, lack of cooking facilities, over-reliance on firewood, WASH gaps, as well as training support needs of different implementation levels. Informed by the survey, operational guidelines for the implementation of the phased HGSFP were spelt out in the Secretary's Circular Number 5 of 2019, in which the Ministry of Health and Child Care is responsible for providing nutritional expertise on dietary rations and meal planning and the different roles of multisectoral players in decentralised School Feeding Committees are elaborated.

Since 2018, the government of Zimbabwe has been allocating a budget for the SFP, which has in turn translated into Parliamentary oversight and accountability checks by the legislature. For example, questions have been asked on evidence of programme coverage, expenditure and evidence of service delivery, concerns expressed over perceived unpaid reproductive work through using volunteers, mostly women, rather than paying for catering services, because it exacerbates gendered social imbalances.

While the HGSFP has been scaled-up to cover all day scholars at primary and secondary levels, on the ground there have been mixed implementation results depending on resource availability and leadership capacity per school. To address local operational costs, every school is expected to have an income-generating business unit to fund its own development and ensure the sustainability of key programmes like the HGSFP. Notably, some primary and secondary schools have been able to provide one hot balanced school meal to all their pupils, all year round while more schools require capacity strengthening at leadership level.

Several UN agencies, particularly WFP, UNICEF, FAO and UNESCO, have provided mostly technical expertise and limited, targeted financial support, such as the School Improvement Grant to a very limited number schools in 10 out of the 72 districts, guided by strict selection set criteria.

The technical support received from the WFP includes two capacity assessment surveys that were conducted using the World Bank SABER methodology in 2017 and 2022. This identified that for the food procurement framework and procedure addressing the capacity gap was a priority. Subsequently, work began on the customisation of HGSFP food procurement system in order to accommodate a hybrid of centralised and decentralised modalities that accommodate smallholder farmers, school-parent governance structures as well as the desired livelihood enhancement and job creation for women and youth. In 2023/4 a digital meal planning application was introduced to Zimbabwe by the World Food Programme and a training of trainers workshop held for the dissemination of the School Menu Planner Plus App, SMP+.

UNESCO's technical support enabled the harmonised monitoring, evaluation and reporting of national, continental, regional and SDG progress indicators. UNICEF has added the HGSFP to the ongoing School Improvement Grant as a model of targeted capacity strengthening for equitable, sustainable resource distribution.

Currently efforts are underway to accelerate full HGSFP implementation, ensure the success of complementary initiatives such as WASH, school health, menstrual health management, immunisation, physical education and capacity-building for implementers. Several challenges yet to be fully addressed include compliance enforcement, strengthening of multisectoral linkages among education, health agriculture, social welfare, women affairs, youth WASH, finance sectors, civil society, the private sector and communities, the public health certification for food handlers, and strategies to counter climate change-induced food and nutrition insecurity.

Ghana: Richard Quashigah, Ghana School Feeding Programme, explained that Ghana's SFP , in existence since

2005, takes a "whole of government" approach , with the Ministry of Local Government and Rural Development the programme's designated oversight body. SFP management and implementation structure incorporates multiple stakeholders. It is associated with increasing school attendance and retention by ~ 1/5th. Since its introduction, the prevalence of stunting has fallen among boys from 29.7% in 2006 to 19.5% in 2017 and among girls from 26% to 15.6%. In adolescents, wasting fell among boys from 12.1% to 9% and from 4.4% to 3.2% between 2006 – 2017 . School meals meet 30% of nutritional needs daily but there are concerns about dietary diversity, in light of iron-deficiency anaemia found for example, in Northern and Western states among 23.5 % of girls and 13.1 % of boys aged 10-19 years . Where feasible, bottom-up home-grown food and school-based programmes are supported by state and district level implementation committees.

Plenary Discussion:
Food Safety and cooking

Kenya: Due to a food-borne disease outbreak, Kenya's SFP uses dry rations and checks the nutrient and energy composition of ingredients. In the absence of canteens, there is no cooking at schools. Food is cooked at home and brought to school. Local industry can produce simple foods e.g. porridge or composites using probiotics. The community devised criteria for recruiting cooks, who must have a child at the school they cook for. They are screened first before (re)training is provided. Eligible women recruited to cook must be able to walk to the school. This ensures high levels of (in)formal scrutiny by neighbours who keenly verify that dry rations supplied are actually cooked. Kenya learned how to standardise serving sizes from Ghana, by using a uniform covered metal bowl with standard gauges. They also cook for the teachers and, crucially, for their own children. All cooks are paid. Profits are made from procurement. Work with WFP is underway.

Egypt: Independent Food Banks have mobile kitchens. In relation to capacity to perform scientific testing for food safety 17 countries in the AU have Food Science and Agricultural Science Parks.
Ethiopia: WFP's resilience team explored the feasibility of laboratory testing with local producers, manufacturers and universities.
Zimbabwe: The government pays for laboratory testing.

Food and recipes:

Nigeria: Women can adapt soybean recipes and set up small and medium-sized enterprises (SMEs) in the private sector to scale-up porridge production at state level. The SFP porridge recipe was adapted from one used to manage moderate malnutrition in the community. Children who leave school at noon get biscuits instead of porridge.
School or home gardens:

Ghana: Asked whether large-scale SFP in Ghana incorporate school or home (kitchen) gardens, a speaker replied that school gardening was impracticable because Ghanaian schools had too little space for gardens, usually lack boundary walls and form community resources. If there were gardens, produce could not be protected from animals or theft. WFP is piloting the use of parboiled rice in 6 schools in the countryside. A question about African parents helping to feed children in school went unanswered.
Zimbabwe: School gardens are not designed for and cannot feed all the school children for even 1 day. They form demonstration plots or sources of vegetables or herbs that enhance the palatability of food, complemented by school orchards. These provide practical life skills and promote children's interest and expertise in horticulture. In places where conditions are unfavourable for growing crops, food production projects in fisheries, raising poultry or rabbits, bee-keeping, mushroom growing, or rearing small and large livestock are also part of the practical skills curriculum. However, there are schools with large tracks of arable land, and those can employ adults for large scale production, beyond the capacity of school gardens.

Egypt: Urban schools lack the space for gardens. The potential of hydroponics and community gardens, where feasible, could be explored. Gardening is important for developing school-age children's taste for locally-grown culturally-appropriate foods.

Key Lessons Learned in Session 1:

HGSFPs have gained momentum in Africa since AU's resolution to promote them. Workshop presentations indicated wide variation in the extent of implementation to date. Most of the funding for HGSFPs comes from external donors and NGOs. Some countries like Kenya, have budget lines, from county not national government.

In many countries, e.g. The Gambia and Sierra Leone governments have begun to support some districts and are investing in HGSFP and SMP like Burkina Faso and Mali. In CRS-supported countries like The Gambia, Madagascar, etc, governments have begun to take ownership of the SFPs.

a. There is an urgent need for *better linkages* and for *budget allocation* at all levels of government – national, district/county, local.
b. *Multisectoral and multidisciplinary collaboration* are crucial as school feeding cuts across many sectors and disciplines. Kenya and Nigeria show how different players including nutritionists (who design meal guidelines), public health officers (who ensure food safety) and local government (for overall coordination) and other players can contribute to make more impact.
c. *Integrated Service Delivery*: Complementary services that together with nutritious school meals are more effective than SFPs alone, include training of school canteen workers and teachers in nutrition, nutrition education for children and parents, providing such health services as deworming, iron and folic acid supplementation, fortifying local food (oil, rice, etc), menstrual hygiene (MHM) and WASH i.e. handwashing, improved toilets, water supply. Other multi-sectorial services that benefit socio-economic and community development include improving food production, income generation and savings for parents (etc).
d. *Research* to identify what works was underscored, e.g. value for money studies, randomised controlled trials and qualitative research. It would also be useful to improve *documenting* and *sharing good practice*.
e. There is a *need for more data*. Evidence dashboards are used at all levels, from local to national. However, there are still questions about what to measure and how to measure it. For example, is measuring height a good indicator of the impact of a providing school meal for a short while?
f. There are gaps in the *digitalisation* of data and *application* in strategy and policy.
g. *Political will* is the key to everything. Without government ownership, programmes will not work.
h. *Leveraging* important national and international days like the *Africa Day for School Feeding* for advocacy and education can help raise awareness among and beyond stakeholders.
i. Concern was expressed that a *life cycle approach* may be missing on the basis that children eat vegetables if they were exposed to them early.

Session 2a: Nutrition in Context, chaired by Dr Mawuli Sablah (CRS) and Professor Amos Laar (ANS, University of Ghana) who provided a summary.

Adolescence: experiences, engagement, evidence for policy. Dr Deda Ogum-Alangea (Africa Research, Implementation Science and Education, (ARISE) Network & University of Ghana (UG)

ARISE is an international collaboration of partners established in 2014 as a dynamic platform for groundbreaking research, transformative education and sustainable partnerships across the region. It was initiated and supported by the Harvard T.H. Chan School of Public Health and co-convened by the Africa Academy for Public Health (AAPH). The network has thrived in advancing implementation science that prioritises adolescents in the following priority research areas: nutrition & physical activity, mental health, sexual and reproductive health, food systems, and to a lesser extent, climate change. The network currently consists of 10 sub-Saharan African countries and 22 institutions in Burkina Faso; Ghana; Nigeria; South Africa (3 institutions); Tanzania (5 institutions); Uganda (2 Institutions); Botswana; Rwanda (2 institutions); Senegal; Ethiopia (2 institutions); and Heidelberg Institute of Global Health, Germany. Partners who meet annually have produced more than 200 publications. The Network's first study was an exploratory community-based nutrition survey of 8,075 adolescents aged 10-19y. Subsequent studies were conducted in different member countries in priority research areas, one of which sought to harness longitudinal data and digital technologies to improve adolescent health in 8 African and 2 Asian countries. The current phase of the Network's activities involves two related studies with a public health capacity development component, on reducing nutrition-related noncommunicable diseases in adolescence and youth and interventions and policies to boost nutrition fluency and diet quality in Africa (NUTRINT); a Research Network for Design and Evaluation of Adolescent Health Interventions and Policies in sub-Saharan Africa (DASH); and an initiative on the Future of Health and Economic Resiliency in Africa (FHERA). FHERA meetings have substantially advanced towards establishing graduate public health training in Africa. The ARISE network places a high priority on capacity development and comprises multi-disciplinary teams of researchers, post-doctoral fellows, graduate students and interns.

Dr Ogum outlined a MEGA randomised control trial (RCT) of school meals, education, gardens and scaling-up high-impact micronutrient supplementation. A DASH study in 5 countries entailed interviews conducted with 79 school administrators, 765 food vendors, and 4,999 10–15 years of age in 79 schools. Environmental assessment revealed there were no school kitchens, 30 (38%) had school gardens and seriously inadequate WASH facilities. A cluster RCT study in Tanzania (for 1 year) and Burkina Faso (for 12 weeks) involved 84 schools in which 4,500 10–17-year-olds were assigned to one of three groups: one got daily micronutrient supplements, another weekly iron supplements, and a third were controls . A cross-sectional study piggy-backed on HDSSs of 8,075 10-19 years of age in 9 communities, 3 urban, 6 rural. It found a small majority of 10–19-year-olds ate fruit (53-57%), a minority ate vegetables (21-31%). There were low levels of physical activity and some alcohol use and substance abuse and gender differences in handwashing and physical activity. In Ethiopia, stunting increased with age in both rural and urban areas. HAZ was associated with handwashing in rural areas. Asked about body image, most young people said they wanted to be heavier, while wanting to be thinner was associated with higher exposure to the media. Dr Ogum highlighted quantitative evidence from selected early studies that found gender differences in nutritional status, physical activity and hygiene behaviours among adolescents in sub-Saharan Africa. The pooled prevalence of anaemia recorded was 41.8% (95% CI: 40.8 – 42.8) with 3.7% having severe anaemia. Ethiopia recorded the least (4.9%) while Ghana recorded the highest (73.6%) prevalences. Dr Ogum saw a need for health promotion interventions and pointed out the potential of community approaches over school setting approaches to intervention. ARISE– NUTRINT (under EU) seeks to increase nutrition fluency. In 6 countries DASH uses surveillance of context-specific interventions in nutrition and physical activity, sexual health.

Benefits of Fortified Whole Grain Foods in School Feeding Programs, Johnes Davids, Fortified Whole Grains Alliance (FWGA) and Rockefeller Foundation.

The Fortified Whole Grains Alliance (FWGA) is a 2.5-year-old coalition of stakeholders that spans the food system, including nonprofit and private sector members. The purpose of the Alliance is to sustainably improve the diets of school children, vulnerable populations and eventually, whole populations, by increasing consumption of fortified whole grain (FWG) foods. In the short term, the Alliance specifically aims to reach more than 10 million people through FWG by 2025, across 5+ countries. Work on FWG maize is ongoing in East Africa (Kenya, Rwanda, and Burundi). Grains account for approx. 50% of energy and

> 40% of protein intakes in LMICs. In the long term, the Alliance intends to convert at least 50% of grain foods for consumption in institutional markets and 25% in consumer markets to FWG in LMICs by 2032. That only 20-30% of grains consumed are whole contributes to the double burden of malnutrition. Use of FWG confers significant environmental benefits because they require less fertiliser and less water, improving land use by 20%. Therefore, they can be supplied more sustainably, with implications for mitigating climate change. FWG use maximises nutrition, by reducing diversion of germ and bran layers into animal feed. FWG could help to reduce NCDs and Type II DMM (2018). Incorporating FWG foods into school menus would enable learners to benefit from nutrient-dense diets at no additional cost, broaden menu diversity and encourage resilience in food systems. Mr Davids reported on a pilot study with FWG maize meal in Rwanda that showed the feasibility of a large-scale shift towards FWG foods in school feeding. The project started with >13,000 learners in 18 schools then expanded to 74,000 learners in 81 schools. Implementation of universal coverage is now being explored. To date, FWG maize meal has reached 500,000 and more learners in E. Africa. After 18months, 73% students were found to know the benefits of whole grains and to have accepted the food, despite its unfamiliar darker colour. The Alliance recently started a FWG wheat flour initiative in school feeding in Egypt. In the medium to long-term, FWGA expects to create blends of the "Big3" grains (wheat, rice and maize) with at first, sorghum, millet legumes and pulses, adding neglected grains and other nutrient-dense foods later. Mr Davids noted that a shift to whole grains from polished grains would be cost neutral. FWGA expects to spend U$ 250 million on the three components of their work: firstly, building awareness and promoting the acceptability and value of using FWG, secondly investing in R&D to increase supply and devise FWG products, and thirdly in increasing distribution of FWG at scale.

Social considerations: poverty, gender, Dr Rosemary Anderson Akolaa, University of Environment and Sustainable Development, Ghana

HGSFP form a way to achieve nine SDGs: 1, 2, 3, 4, 5, 8, 10, 12 and 16. Since Ghana's SFP started in 2005 it has served 3.8 million 4–12-year-olds in 11,000 schools, meeting key educational, agricultural and nutritional objectives. According to WFP, about 19% of under-five year olds suffer from chronic malnutrition. Poverty is a barrier to education in Ghana, where 23% lived below the poverty line in 2021 and children from low-income households are more likely to drop out of school (GSS, 2021). SFP provide an incentive to attend school, improving girls' enrolment by 16% in low-income countries (LICs) (WFP & UNICEF, 2021). Ghana's SFP addresses nutrient deficiencies thereby improving both physical and cognitive development, which are critical to academic performance and long-term productivity. UNESCO (2020) says that for girls, a 10% increase in SFP coverage reduces the gender gap by 9%. Gender equality is enhanced as catering provides employment for > 30,000 women, and with that, some financial independence and a measure of equality in their communities. Challenges remain. While the SFP has made progress, there are ongoing concerns about the nutritional quality and consistency of meals. It is crucial to ensure that the food provided meets the dietary and nutritional quality standards consistently. Funding limitations often affect the programme's reach and quality. Quality is a collective responsibility, shared by local and national governments with international partners. Addressing these issues requires stronger indigenous, governmental and international support, with a focus on partnerships for sustainable implementation. Policies that explicitly target gender disparities in education and nutrition should be prioritised. Increasing awareness among families and providing incentives for education will promote gender equity. Ghana's SFP is a lifeline for many children, especially from poor and marginalised communities. By addressing the intertwined challenges of poverty and gender, SFP can become even more effective, improving the children's and the country's development (World Bank 2019, UNESCO, 2020).

Providing nutritious school meals in Ghana: key considerations *Ms Patience Asiedu, World Food Programme (WFP)*

WFP, in partnership with the Rockefeller Foundation and others, has been exploring cost-effective ways of enhancing the quality of the school meals, while strengthening government capacity. Food insecurity in the June-August lean season rose from 401,822 affected in 2017, increasing most years to reach a peak of 1.293 million in 2023. In 2024, the numbers affected fell somewhat to 1.053 million. Between 2020-22, food prices rose by 50% to >58% for energy-rich foods in north Ghana, where most households (58-81%) are unable to afford nutritious diets. Using WFP PLUS modelling reveals that the school meal budget allocation for ingredients alone should be raised from 1 to at least 1.2 cedi per day to meet at least 30% of nutritional targets in all regions, excluding the total costs of meal preparation (transport, cooking fuel, cooks' wages and seasoning). Currently 1.5 cedis/ day are spent on

meals in public schools, compared with the 10 cedis/day spent on meals in private schools. Meeting the nutritional needs of school-aged children in Ghana requires a combination of approaches, including growing nutrient-dense crops, promoting wholegrains and food fortification. Biofortification is necessary because diversity alone cannot meet all nutrient requirements, with calcium being a particular problem. Ms Asiedu presented an example of a food system pathway applied to SFP (Josep & Jordi, 2024) that graphically illustrated the complexity of the system. It depicted 6 challenges: cost of production, engagement with food processors, test kits for micronutrient analyses, school meal planner, payment delays for caterers and NAFCO (National Food Buffer Stock Company), adding complexity to the production process. It identified 5 gaps - access to finance, lack of inputs and water quality, market development, industry capacity development, conducive policy environment and 4 leverage points - sustainable funding, expanding the new NAFCO model to new institutional markets, empowering the National Food Fortification Alliance (NFFA) and strengthening the food system perspective in the project. Ms Asiedu noted that free school meals (FSM) are provided in some senior schools but not in junior high or basic schools. SFP is centralised with devolution to schools. SFP forms a key safety net but there are quality shortcomings. She highlighted as key considerations, firstly, delays in disbursement and a use of credit that are unsustainable: there must be sustainable access to finance. Secondly, a conducive policy environment that reduces the cost of doing business, provides input subsidies for farmers; exempts taxes on food fortificants or premixes and fosters local premix production. Thirdly, opportunities for the private sector to invest could leverage the contribution of small-scale producers with for example tax exemptions; supporting the capacity of (local) food industry to innovate in food production, such as local millers being able to fortify flours, as well as market development. There is an increasing need to mitigate climate change, requiring a move towards clean cooking, using model kitchens and reducing the carbon footprint of food processing.

Plenary Discussion

Poverty: Countries need to undertake poverty surveys in order to align social protection with education and health considerations. Higher levels of malnutrition result from higher poverty levels in Ghana.

Money and funds: One participant queried the adequacy of funding from government and parents. Another was worried about the adverse effects of corruption that he suspected of being ignored. The speaker also posed questions about the scale of free school meals in secondary schools, their cost-benefits.

Sustainability: A participant queried whether sustainability had received the attention it needed and advocated for all options and models to be explored, calling for more emphasis to be placed on food-based approaches that promote and harness culinary skills instead of using imported fortificants. They commented that ecology also contributed to disparities in nutrition: because of less rainfall, northern Ghana gets one crop per year not two as in the south. In all public high schools scholars get 3 meals per day though their quality is unclear.

Quality: After advocating a focus on changing menus for quick wins, a participant questioned how quality is defined and by whom. A speaker explained that quality is defined as meeting at least 30% of micronutrient requirements as well as meeting food safety and diversity standards, Food-Based Dietary Guidelines. She also said that the private sector is motivated by corporate social responsibility (CSR) to contribute to SFP. She mentioned that parents supply packed school lunches that include snacks that might be unhealthy.

Aesthetics and acceptability: In response to a question about the aesthetic acceptability of FWG, speakers commented. One said that indigenous ancient grains are opportunity crops. Another emphasised the importance of sensitisation, recounting experience of people's perceptions of the status of indigenous foods. The speaker had become aware of a perception that in the capital, Accra, citizens eat 'fast' or western foods with higher status than local foods. To counter this, they had videoed food cooked at home to show that they ate local foods cooked using traditional recipes and to demonstrate preservation of vegetables. A one-year post-evaluation showed the target group had used more diverse local foods, associated with a decrease in hospital attendance for treatment of childhood malnutrition. A similar approach could be used to promote the use of red millet (Panicum miliaceum), nutritious but of low status at home, though not abroad. Before their project began in Rwanda, FWGA undertook market research in schools and used the slogan 'grains of greatness' in their sensitisation campaign. Surveys showed that 76% of young people acknowledged that FWG were nutritious and 97% totally accepted eating FWG. Tests showed the FWG products had good keeping quality, with a shelf life of 5 months. FWGA studied the effects of heat, antioxidants, types of packaging and effects of methods of storage in their R&D on FWG maize meal and measure the levels of phytates and vitamin

B2 in flours. Organic methods maximise metal contents. Fortification is required to compensate for losses incurred during food handling, food preparation and cooking, for example, to ensure that flours retain enough iodine to be efficacious despite the use of iodised salt bought in bulk and kept in poor storage conditions.

S***ampling and statistical power***: ARISE research includes 10 to 24-year-olds recruited using quota sampling for power. It uses age-appropriate standards for comparisons.

Key Lessons Learned in Session 2a:

1. Dr Deda Alangea – Adolescence: Experiences, Engagement, and Evidence for Policy

Dr Alangea highlighted the work of the ARISE Network, a collaborative initiative focused on generating knowledge around school nutrition through global partnerships. The Network has produced over 200 publications, contributing significantly to evidence-based policy development. Dr Alangea emphasised the need for nutrition-specific, nutrition-sensitive, and nutrition-friendly interventions, noting that many African schools do not provide healthy diets. The unhealthy school environment remains a major barrier to students' well-being, and addressing these gaps through policy and practice is essential.

2. Johnes Davids – Benefits of Fortified Whole Grain Foods in School Feeding Programs

Johnes Davids spoke on the importance of fortifying whole grains in school feeding programmes, showcasing the nutritional benefits of this cost-effective and sustainable intervention. He focused on the "big three" cereals—maize, rice, and wheat—which are prevalent in East, West, and North Africa, respectively. He highlighted that fortification of these cereals can enhance students' nutritional intake without increasing costs, making it a budget-neutral intervention. He urged policymakers to consider scaling up such initiatives to improve the nutritional quality of school meals across Africa.

3. Dr Rosemary Anderson Akolaa – Social Considerations: Poverty, Gender, and School Feeding

Dr Akolaa introduced the critical role of social factors, particularly gender and poverty, in shaping school feeding programmes. She stressed that school feeding is directly or indirectly linked to all the Sustainable Development Goals (SDGs) and plays a crucial role in advancing gender equality. In some contexts, school feeding programmes have challenged traditional gender norms, increasing school attendance for girls. However, challenges related to the quality of meals and the sustainability of programmes remain significant. Akolaa urged stakeholders to consider the social dimensions of school feeding when designing policies.

4. Ms Patience Asiedu – Providing Nutritious Meals in Ghana: Key Considerations

Patience Asiedu underscored the potential of the WFP's "Fill the Nutrient Gap" exercise, in improving the implementation of the school meals programme. The initiative supports countries in identifying gaps in nutrition and devising solutions. She emphasised the need for a multi-faceted approach to addressing nutritional challenges in schools. She outlined the financial implications of providing nutritious meals to Ghana's students, estimating a minimum requirement of GHS10.00 per student per day. Moreover, she stressed the importance of using both fortification and dietary diversification in school feeding programmes, rather than focusing solely on one approach. The discussions following all the presentations focused on the challenges and opportunities for improving school nutrition in Ghana.

Conclusions:

The workshop underscored the vital role of school health and nutrition in promoting educational outcomes and achieving broader development goals. Presenters and participants highlighted both the challenges and opportunities in scaling up school nutrition programmes across Africa. While fortification, dietary diversification, and addressing social factors such as gender and poverty were central themes, it was clear that a coordinated, multi-sectoral approach is needed to drive meaningful progress. Moving forward, stakeholders must continue to collaborate and innovate to ensure that all children have access to nutritious meals that support their health and academic success.

Session 2b: Importance of nutrition for school-age children and adolescents, chaired by Barbara Bray (Nutrition Society, UK), who provided a summary.

Why invest in nutrition for school-age children and adolescents? *Professor Donald Bundy, London School of Hygiene and Tropical Medicine (LSHTM) and the Global Research Consortium for School Health and Nutrition (GRCSHN).*

Professor Bundy provided an overview of the current situation in child health and nutrition before introducing the key elements of his talk. He said the importance of nutrition after the first 1,000 days was being recognised increasingly, citing how an environment that promotes consumption of an unhealthy diet and low physical activity increased the risk of obesity and harmed health as children age. He next highlighted the financial and human capital cases for investment in school-aged children. Finally, he described how the School Meal Coalition (SMC) is addressing the shift in focus to include adolescents. By bringing together 103 countries, the SMC is leveraging the work of four initiatives: a) the Research Consortium, b) the Sustainable Financing Initiative, c) the Data and Monitoring Initiative and d) the Cities Feeding the Future Initiative, to gather evidence and provide solutions to improve nutritional status in the first 8,000 days.

The role of the Global Research Consortium Communities of Practice, and the School Health and Nutrition Special interest group. *Associate Professor Robert Akparibo, University of Sheffield, GRCSHN, Nutrition Society's School Health and Nutrition Special Interest Group (SHN-SIG)*

Dr Akparibo said that the purpose of the GRCSHN is to generate evidence of the effectiveness of school health and nutrition programmes and to provide policymakers with policy and programmatic guidance. He highlighted two of the consortium's seven Communities of Practice (CoP). Firstly, the Good Examples CoP which is developing national case studies for every SMC member state, and secondly, the Nutrition CoP which is assembling evidence on the "next 7,000 days" and indicators of the nutritional status of school-aged children. Dr Akparibo said that the Nutrition Society (UK) had established a Special Interest Group (SIG) on School Health that collaborated with its international partners. Finally, he introduced the global database led by the Data and Monitoring Initiative of the SMC, hosted by WFP. Newly launched, it uses a core set of nutrition indicators and methodologies for universal adoption.

The Contribution of Non-governmental Organizations: experiences and lessons learned (I): *Swiss Health Foundation, Ms Elizabeth Imbo, Nutrition in City Ecosystems (NICE) and Sustainable Agriculture Foundation (SAF-Africa)*

Ms Imbo said that providing nutritious school meals presents a significant challenge to local governments of Busia and Bungoma Counties in Kenya that provide school meals within the devolved government system whereby the state Department of Early Learning and Basic Education supports ECDE. The school meals comprise rice and beans procured through an integrated mechanism for public procurement and home-grown school meals programmes (HGSM). The NICE pilot project aims to integrate the Nutrition-Sensitive Value Chains (NSVC) that it promotes into nutritious and diversified meals for school menus, including African leafy vegetables (ALVs) and eggs. The primary objective of the pilot is to generate insights into effective pathways for incorporating nutrition into school meal programmes. Specifically, the pilot intends to a) develop ways to involve local farmers in public procurement systems for school meals; b) enhance school health and nutrition by incorporating fresh, locally sourced vegetables and c) secure access to safe, nutritious meals for school children. The NICE project engaged with local farmers organised into hubs that are responsible for producing the NSVC. NICE provides agricultural advisory services, aggregating produce and adding value to agricultural products. The project helps schools to establish gardens to enable sustainable production of fresh vegetables for school kitchens. Through Multi-Stakeholder Platforms (MSPs) and in collaboration with local school procurement teams, the pilot aims to secure supportive interventions that strengthen capacity to deliver good nutrition, that foster local sourcing, and that enable local farmers to benefit from governmental procurement opportunities, as well as promote sustainable local production, and facilitate access to food by the most vulnerable in urban and peri-urban schools. County nutritionists will design menus that focus on affordable and nutritious options and enable teachers and support staff to encourage pupils to eat healthy, diverse diets. The project also involves the parents. Another approach will be to support farmer hubs in business development, fiscal capacity, public procurement processes and food quality standards for school delivery. One outcome the project anticipates is the development of an inclusive procurement system that facilitates the participation of groups of smaller farmers and of farmer hubs in local procurement initiatives and opportunities.

The Contribution of Non-governmental Organizations:

experience and lessons learned (II): *Bayer Foundation USAID. Associate Professor Juan Andrade, University of Florida*

Professor Andrade posed the question 'Can we balance economics and nutrition in an effective and sustainable manner?' He presented evidence from the soybean innovation laboratory project in Northern Ghana. This showed that substituting a spoonful of rice with one of soy flour is financially achievable within the preparation cost of 1 cedi per school meal, is environmentally prudent and increases the protein content of the food. The presentation concluded that school meals need to be nutrient dense which can be achieved by using soy products, while cautioning that not all soy ingredients are cost-effective. Other challenges in this area are the last mile of delivery. For example, payment of suppliers and caterers needs to be timely to ensure success, and the onus is on the development community to design evidence-based solutions to mitigate these issues.

Plenary Discussion

There was time for speakers to answer two questions:
First 1000 vs first 8,000 days: A speaker emphasised the importance of continuing to focus on nutrition during as well as after the first 1,000 days to establish good health in young adults. The purpose of the SMC was reiterated as one of the tools to influence governments to focus on supporting school meal initiatives including access to finance for the private sector.

Parents' contributions: Presentations explicitly acknowledged that parent-led involvement in SFP is worthwhile and had outlined approaches to meeting the challenge that stem from parents 'being at the tail-end of the poverty structure.' In answer to the question about how to resolve this, a speaker explained that in Kenya, county governments lead their school meals programmes. Parents are asked to contribute a tin of beans every three months to the school meals. There are plans to support parents´ capacity to cultivate beans so that they can supply them to schools, directly, within the HGSF model. Meanwhile, the primary focus is upon establishing an enabling framework that secures an adequate supply of safe food.

Unanswered questions included 'What does health mean to you?' 'What efforts are being made to speak to governments in middle-income countries?' 'How can governments be influenced?' and 'What creative ways exist to bring the private sector into school feeding and to provide innovative finance to kick-start the entry of SMEs?'

Key lessons learned in Session 2b:

1. Why invest in nutrition for school-age children and adolescents?

Professor Bundy gave an overview of the current situation in child health and nutrition before introducing the key elements of his talk. Stating in part 1 the increasing recognition of the importance of nutrition after the first 1,000 days, he used the example of an environment that promotes an unhealthy diet and low physical activity, further increases their risk of obesity and harmful health effects as children age. In part 2 he highlighted the financial and human capital case for changing policy for investing in school-age children, and in part 3 he discussed how the SMC is addressing this shift in focus to include adolescents. Bringing 103 countries together the coalition is leveraging the work of four initiatives: the Research Consortium, the Sustainable Financing Initiative, the Data and Monitoring Initiative and the Cities Feeding the Future to gather evidence and provide solutions to improve nutritional status in the first 8,000 days.

2. The role of the Global Research Consortium communities of practice, and the School Health and Nutrition Special interest group.

Dr Akparibo (U Sheffield) shared the purpose of the Global Research Consortium which is to generate evidence on the effectiveness of school health and nutrition programmes, and to provide policymakers with policy and programmatic guidance. The talk focused on two of the consortium's seven Communities of Practice; the Good Examples CoP which is developing national case studies for every SMC member state, and the Nutrition CoP which is assembling evidence on the "next 7,000 days" and indicators for school-age children and has established a special interest group within the Nutrition Society in the UK, as well as collaborating with other international partners. Finally, he introduced the global database led by the Data and monitoring initiative of the SMC, hosted by WFP. Newly launched, it uses a core set of nutrition indicators and methodologies for universal adoption.

3. The contribution of non-governmental organizations: experiences and lessons learned

(I): Swiss health foundation. Sustainable and local nutritious school meals programmes

Ms Imbo reported on The Nutrition in City Ecosystems pilot project (NICE) taking place across four schools in the cities of Busia and Bungoma. The aim is to develop Nutrition Sensitive Value Chains that support schools to diversify their meals to include more nutritious foods, for example, African green leafy vegetables and eggs. Local farmers have been recruited through hubs which facilitate the provision of agronomic advice, collating of produce and accessing the public procurement system. The pilot includes provision of nutritionists to design menus with the schools and training on food and nutrition for the teachers and support staff. Elizabeth shared some of the observations coming out of the pilot study, particularly the benefits of a multi-stakeholder approach that includes parents.

The contribution of non-governmental organizations: experience and lessons learned (II):

Can we balance economics and nutrition in an effective and sustainable manner? Associate Professor Juan Andrade, University of Florida reported evidence from the soybean innovation lab project in Northern Ghana that showed how substituting a spoonful of rice with one of soy flour is not only financially achievable within the preparation cost of 1 cedi per school meal, it also it environmentally prudent and increases the protein content of the food. The presentation concluded that school meals need to be nutrient dense, and can be enhanced with soy products, however, not all soy ingredients are cost effective. Other challenges in this area are the last mile of delivery. For example, payment of suppliers and caterers needs to be timely to ensure success, and the onus is on the development community to design evidence-based solutions to mitigate these issues.

Questions from the floor included 'What does health mean to you?'; 'What efforts are being made to speak to governments in MIC countries and how can governments be influenced?'; 'Are the first 1,000 more important than the next 7,000 days in a child's development?'; What creative ways exist to bring the private sector into school feeding and to provide innovative finance to kick-start the entry of SMEs?'; 'Parent-led activity in school-feeding programmes is worthwhile but is a challenge because parents are at the tail-end of the poverty structure. How can we resolve this?'

A speaker stressed the importance of continuing to focus on nutrition after the first 1,000 days to establish good health in young adults. The purpose of the SMC was re-iterated as one of the tools to influence governments to focus on supporting school meal initiatives including access to finance for the private sector. The speaker clarified that the school meals initiative is being led by the county government, with parents being asked to contribute a tin of beans every three months for use in the school meals programme. Additionally, there are plans to build parental capacity to cultivate beans and supply them directly to the school as part of the Home-Grown School Feeding model. The key focus, however, is to establish an enabling framework that ensures the safe production of food for the initiative.

Session 3: International Agencies: experiences, support and data informed policy chaired by Julia Tagwireyi (ANS & AfriCAN) and Professor Alan Jackson, CBE (IMTF & ICONIC).

Summary of Experiences from School Health Initiatives to date: data support, informed policies and challenges . Ms Millie Alustapha spoke on behalf of Mphumuzi Sukarti, Senior Nutrition and Food Systems Officer, Food and Agriculture Organisation (FAO).

FAO's key mission and actions are designed to promote food security and good nutrition in partnership with other international agencies and national governments. Ms Alustapha mentioned FAO's food system framework and nutrition strategy, drawing attention to FAO's data services, starting with its open access Global Indicator Food Consumption Data (GIFT), that contains 52 disaggregated datasets from 30 countries; FAOSTAT, comprising food balance sheet data on food supply for more than 245 countries and a compilation of Food-based Dietary Guidelines (FBDG) from 100 countries, including 11 in Africa; INFOODs, concerned with food composition; Codex Alimentarius; and the Inter-Agency Social Protection Tool (ISPA), a food security and nutrition e-learning tool. Ms Alustapha referred to HGSF projects in Cameroon, Congo, Gabon and similar scaled-up programmes, including one in Ghana. She emphasised that Integrated HGSF programmes require food, health and environmental standards linked with food and nutrition education about food choices, the content of which should be technically sound and translated into lay language for pupils and their parents.

School Nutrition in South Africa, Professor Rina Swart, *University of Western Cape, Centre of Excellence in Food Security (video).*

President Nelson Mandela started the National School Nutrition Programme (NSNP) in 1994 to alleviate poverty. In 2002 NSNP was transferred from the Ministry of Health to the Department for Basic Education (DBE). In 2009-11, NSFP was extended to some secondary schools. At first, NSNP offered a 'Mandela sandwich' of bread and peanut butter later replaced by a hot meal. The programme has three pillars: a) feeding nutritious meals to learners; b) providing education to increase nutrition knowledge that enables making healthy food choices; c) school gardens to improve food production knowledge and skills, protect natural resources and contribute to the school meal. An evaluation in 2018 recommended that NSNP should provide a) provide breakfast as well as lunch; b) lunches should include a wider variety of protein-rich foods, with canned fish and soya mince that meet approved standards offered at last once weekly; c) seasoning with all meals; d) fresh green, yellow or red vegetables or fruit, served daily and e) UHT full-cream milk or pasteurised amasi (sour milk curds) served once weekly. Benchmarks for the programme include meeting 25–30% of children's RDAs per meal. NSNP feeds 9, 465,798 learners in 21,156 schools at a cost of ZAR 9.8 billion, equivalent to R3.96 per learner. NSNP employs 61,314 food handlers paid a minimal honorarium of ZAR 1640 each who lack long-term appointments and require extensive training. NSNP is expected to last at

least 10y longer than originally envisaged. Some private sector businesses - Kellogg's SA, Nestle, PepsiCo/Pioneer Foods, Siqalo and Tiger Brand Foundation - provide breakfasts comprising fortified cereal (sorghum or maize meal) porridges in some schools. Tiger Brand's evaluation of the impact of a combination of breakfast and lunch in Eastern Cape showed that malnutrition was alleviated. South Africa's NSFP programme is devolved to each of its 9 provinces. The 3 more rural provinces devolve to school level. The NSFPs in other less rural provinces, being more centralised, procure from fewer provider 'consortia' that offer economies of scale unavailable to the 3 more rural provinces.

Since the COVID pandemic, NSFPs face many challenges: there is more hunger due to an increase in poverty following higher levels of unemployment. This has led to pressure to expand NSFPs to reach more indigent learners (in Q4-5) and to early child development facilities. The cost of the programme rose because food inflation is higher than consumer price inflation (CPI) due to, for example, escalating fuel costs. No benefits accrue from economies of scale. Too often food is procured from retailers instead of from manufacturers at wholesale prices. There are management shortcomings such as poor stock control that fails to curb pilfering and corruption; procurement of below standard protein-rich foods or foods that are mixed with inappropriate additives; seasonings being discarded wastefully; deliveries of fresh fruit and vegetables fall short of requirements; poor quality food delivered is accepted; and finally, there is no batch management. DBE has made several proposals to improve NSFP: by developing a) a new model that takes advantage of economies of scale; b) a modern stock management system (right quantity & right quality); c) better quality assurance and food quality standard compliance; d) use of a modern integrated logistics system to deliver high quality fruit & vegetables consistently; e) efficient warehouse and delivery systems; f) extensive local economic empowerment with a focus on women, youth and people with disability (VFH); g) using HGSF to form direct links with smallholder farmers.

However, academics disagree with DBE's approach because it is not evidence-based. Professor Swart outlined some independent work on NSFP. In 2019, UNICEF funded a working group to develop guidelines for NSFP improvement that led to a holistic approach called the Blue Print. UNICEF funded a Durban University of Technology pilot implementation of the Blue Print in KwaZulu Natal. Following their formative evaluation with focus group discussions and in-depth interviews with a wide variety of stakeholders, several scale-up manuals were produced in order to improve the school environment including tuck shops, to improve menus, to manage donations, to address marketing to schoolchildren, to build VFH capability and capacity, and to manage vendors plying their trade outside schools. Professor Swart is working to form an informal consortium of all 23 South African universities in which each 'adopts' schools in their areas and trains VFHs with effect from 2025. UNICEF has funded an initiative entitled PRICELESS comprising University of Witswatersrand and a social justice pressure group, SECTION 27, to develop an investment case for 1) providing nutritious breakfasts in schools; 2) safeguarding children from unhealthy diets by developing policies and devising rules of engagement and regulatory frameworks. In conclusion, Professor Swart acknowledged the contributions of Ms Carina Muller, Nutrition, DBE, Mr Gilbert Tshitaudzi, UNICEF and Professor Ashika Naicker, Durban University of Technology.

Responsibilities of Education and Country Nutrition Societies for the Next Generation. Professor Kingsley Pereko, Ghana Academy of Nutrition and Dietetics (GAND) & University of Cape Coast (UCC)

Professor Pereko began by defining a generation as people "who belong to the same age group, experience or will experience accordingly similar life experience in the years that may shape their lives" (Hung & Gu & Yim, 2008). He quoted commonly used social scientific terms for successive generations, starting with World War II-born 'traditionalists,' post-war born 'baby boomers,' through subsequent generations identified as X (1965-79), Y (1980-94), Z (1995-2009), Alpha (2010-24) and forthcoming, Beta (2025-39; Berkup, 2014). Dr Pereko used information from the Global Nutrition Report 2022 to paint a picture of disappointing experience in nutrition and health in which only one target, for exclusive breastfeeding is likely to be met in 2025. Targets for wasting, stunting, anaemia, low birth weight and overweight will all be missed. Caring about the next generation matters not just for their own health and well-being but because they will provide care for young and old dependents, in cash and kind. Dr Pereko referred to 'An Intergenerational Approach to Break the Cycle of Malnutrition' (Arlinghaus et al, 2018) envisaged to stop malnourished children growing up to be malnourished mothers in a vicious cycle. Causative factors identified include a decline in nutrient density, including changes in food composition, due to growing for high yield not for nutritional quality, climate change with elevated carbon dioxide levels, and the excessive use of agrochemicals, and to changes in agricultural practices. These have led to deterioration in post-harvest handling and storage,

nutrient concentration in arable lands to decline, and lack of knowledge about nutrient-rich crops (Bharwaj et al 2024). Outlining why it is difficult for societies to make progress, Dr Pereko noted that Ghana was negotiating to restructure its U$3billion national debt repayments at the time of speaking. He highlighted the important role national nutrition societies can play in advocacy for research-informed, evidence-based priority-setting in action and practice, in setting and raising standards for researchers, practitioners and educators and of curricula for use in training and in mentoring the next generation of nutritionists. He concluded by saying that a strong focus on nutrition could boost public health, improve productivity and drive economic growth, making bailouts less necessary in the long run. Finally, Dr Pereko reminded the audience that food and health are human rights not gifts.

Summary of experiences from School Health Initiatives to date; data support, informed policies and challenges, Sophia Ashipala, Head of Education Division, African Union (AU).

In a video-presentation Ms Ashipala explained that she spoke for AU, not for AU/ NEPAD that is constituted as a separate implementation entity. SFP tackle the opportunity cost of skipping school that scholars and society pay. SFP save of the order of 10% of the budgets of vulnerable households. HGSF galvanise local communities and dynamise local economies, generating up to US$9 for every US$ spent. Complementary programmes can include dental health, WASH, hearing and eye tests, deworming, menstrual hygiene, and measuring weight and height. Integrated SFP improve school enrolment, retention and completion. AU has Guidelines on HGSF for its members. The Education for Health and Wellbeing Strategy that AU launched at the end of 2023 is being rolled out and promoted. The African Day of School Feeding every 1st March, provides an occasion to create a space for convening stakeholders, undertaking advocacy, stocktaking, sharing best practice and approaches to meeting challenges. It provides a focal point to galvanise political support and an occasion to report on progress annually. Some challenges Ms Ashipala highlighted were budgetary constraints, weak linkages, lack of capacity in national ministries to plan and implement SFP; problems with phase-over, sustainability of funding and of activity; climate change, pandemics and political will. AU recommends that governments increase funding, improve partnership-working and build capacity to develop and implement of HGSF initiatives and to promote buy-in.

Civil society advocacy in promoting School Health Initiatives; experiences, support, data informed policies and challenges, Judith Kabore, Scaling Up Nutrition (SUN) Secretariat.

Scaling Up Nutrition (SUN) including School Health and Nutrition, comprises a network of 66 Countries. SUN forms alliances with civil society to raise voices and bridge gaps, notably in West & Central Africa. SUN exerts influence through advocacy, mobilising champions who had been empowered with data to promote collaboration, conduct research, harness visions, formulate plans and identify indicators. SUN pays attention to areas that experience conflict and to food insecure areas, such as in Mali. It campaigned successfully for education and for a larger budget share to be spent on school feeding for the vulnerable. In Burkina Faso, Civil Society Alliances (CSA) collaborate with agencies and NGOs. In Niger, CSAs organise teacher training around school feeding and malnutrition. In Ghana, CSAs are active in programme planning. In Benin, CSAs have lowered barriers to good health. Ms Kabore enumerated such challenges as insecurity of funding, unaffordability of staff and equipment, and weak capacity. Some countries struggle with monitoring and evaluation as well. Regional workshops have been conducted for CSA on the use of data in evidence and the use of tools. She finished by highlighting as a key lesson to share, the value of involving students and parents in the entire process.

A Transformative Approach to School Food and Nutrition Through Food Systems. *Stacy Kalua, Global Alliance for Improved Nutrition (GAIN)*

GAIN has been involved in programmes in 12 countries since 2002. Twenty countries are members of GAIN. It works to connect nutrition and food supply chains involving private and public sectors. Ten key concerns are a) fortification; b) enhancing value chains; c) SMEs involved N3F/ SBN; d) whole food nutrition; e) social protection; f) empowerment; g) demand; h) data; i) system and j) gender. GAIN's remix facility has existed since 2009. Tanzania has longstanding experience with HarvestPlus and commercialisation of bio-fortified crops. By end of 2022, it reached 108 million students in 118 schools comprising 771,00 provitamin maize and 88,000 high iron beans. Local businesses fortify maize flour for use in Tanzania's SFPs. By July 2024, this programme had reached 124 schools and catered for 74,000 students. Ongoing projects with 5 SMEs include efforts to fortify yogurt. New work will look at school nutrition education and raising the voices of the youth. In Uganda, a new programme is about to start because the country's School Feeding Policy is being finalised along with agreements and guidelines for

government and NGO funding.

Report from the Southern African Development Community (SADC) Workshop. *Ms Kwadzanai Nyanungo, Zimbabwe*

During the AU Year of Education, a 3-day Southern Africa Regional Workshop on Home-Grown School Feeding (HGSF) Programmes, was organised by SADC in July 2024, in South Africa. WFP provided the secretariat, with technical support supplied by AUDA-NEPAD, UNICEF, FAO and the AU Commission. More than 60 participants from 15 of the 16 SADC member states attended. SADC sought to break silos by inviting teams from each member country comprising representatives of the 3 key ministries, Education, Health and Agriculture. Private and public sector actors were also involved. The workshop occurred in context of the recognition, firstly of innovative tools being critical to the delivery of school meals to achieve the best results in education, nutrition and health and secondly, that school meals enhance equitable, inclusive access to education for the most vulnerable children.

The workshop had 3 main objectives, to:

1) Share experiences, good practices and lessons learnt
2) Galvanise scalable actions for advancing HGSFPs in the region
3) Establish plan of action to transition towards integrated programming for improved health, nutrition and educational outcomes.

SADC has several areas of focus: to prevent or reverse the high prevalence of up to 50% of stunting in the region; on the AU's 2016 decision still being implemented in the region, with Ministries of Education adopting a recommendation to increase investment in school meals in 2022; the magnitude and complexity of issues require strategies to strengthen the improved attainment of better education, health, social protection and economic resilience as the major indicators of the successful, sustainable implementation of HGSFPs; hard-to-reach areas require attention; all states are affected by resource constraints, weak monitoring and evaluation systems needed for the attainment and documentation of tangible results through tangible action; and finally, SADC's School Health and Nutrition Toolkit developed using continental documents and the SADC School Meals Guidelines.

WFP's focus and six indicators of HGSFPs' success are: climate smart schools; diversified diets; sustainable food production strategies; structured markets for local farmers; capacity development of local farmers and implementers of the HGSFP and increases in jobs in local economies. UNICEF's presentation stressed the importance of adjusting school meals to local contexts; that it had developed School Nutrition Guidelines; and focuses on integrated programming for better health, nutrition and educational outcomes: supporting school meals in order to achieve better learning for more children given the evidence of a learning crisis in that 9 in 10 children in Grade 4 are unable to read or write short sentences. Poor nourishment in early years affects learning and a healthy diet in and out of school is important for children to be ready to learn. A malnourished child cannot benefit effectively from education given global statistics showing 30% of children to be anaemic, 9% undernourished

11%, overweight. UNICEF's five priorities are to support, nutritious food at schools, healthy food environments in schools and beyond (banning of unhealthy foods and beverages, their sale in and near schools); micronutrient supplementation and deworming; food and nutrition education in the curriculum;
healthy dietary practice through social behavioural change while bearing in mind the importance of preventing the consumption of foods high in salt, fat and sugar. Schools have a responsibility and the advantage of being the authoritative voice on nutrition education able to disseminate new knowledge related to healthy dietary habits. The easy availability of unhealthy snacks is harmful to the nutritional outcomes for children. Schools are advised not to promote snacks because this message is unauthorised. Schools should also disassociate the use of advertisements to build brand loyalty for life. While their use is discouraged, refined foods may be allowed if laboratory quality assurance assures that additives are not used. One example of a refined food that has have been disallowed is beef in Botswana. Governments should not endorse unhealthy foods in schools. In Latin America, high taxation has been introduced on unhealthy foods and beverages. FAO promoted its Food Systems Dietary Guidelines from Farm to Fork.

The AU Commission focuses on ten outcomes that link HGSFPs with the SDGs, with the understanding that a healthy mind goes with a healthy body physically and psychologically. Among ten indicators being monitored are the numbers of (a) states feeding pupils in schools; (b) cooks contracted; (c) schools feeding pupils; and (d) farmers linked to HGSFPs. The AU Commission's Comprehensive African Agriculture Development Programme (CAADP) focuses on local production for local consumption. The

Malabo Declaration that expired in 2024 will be replaced by the Kampala Declaration in 2025, that spells out action and priorities for the next ten years. In terms of HGSF, the focus is on providing farm fresh and locally produced foods because no child can learn on an empty stomach. The AU has established that the average cost of school meals is the equivalent of U$35 per pupil per year. Across the region, in 2022, 89 percent of African countries had adopted a school meals policy, compared to 68 percent in 2020: so, progress is being made. It is important to align HGSF with the CAADP and post-Malabo agenda as well as food systems, meaning that National Food Systems (NFS) pathway agreements in principle (AIPs) should be aligned. The AU signed declaration on food fortification and biofortification that recognises eggs as a cheaper protein-rich food to be promoted in HGSFPs. AU encourages members states to monitor the number of jobs created for every child fed, including those in food production, in logistics and supply chains, in catering and in related services. Effective nutrition education leads to resilient educational systems in which children are prepared to meet 21st Century challenges. Sharing experience took the form of good practices found and lessons learnt from the AU Commission study as well as presentations from individual countries. The SADC workshop ended with teams working on draft country-specific action plans using a standard format provided for scalable actions within available resources. The next step is for the draft action plans to be decided upon at the SADC Ministers' meeting. Member states are to continue domesticating the AUDA-NEPAD Guidelines on the Implementation of Home-Grown School Feeding Programmes in their local contexts. Delegates (and AU) are to alert Ministers to expect invitations to the Kampala event at which the Malabo Declaration successor document will be discussed.

Plenary Discussion

Agency guidelines: There were several replies mainly from local perspectives to the questions 'how easy is it for overburdened local staff to apply guidelines from multiple agencies? Could the agencies agree on a synthesis of their key messages to facilitate action?' In Gambia agencies provided help to first design guidelines and then with implementation. Tanzania faces challenges around translation from technical to user-friendly formats that are suitable for dissemination to different audiences through multiple media, ranging from actionable recommendations to cartoons. Every country cannot afford to employ external consultants to design SFP from scratch, yet one size does not fit all. In Zimbabwe, all representatives of relevant ministries – agriculture, education, health, gender, etc were convened to adapt guidelines to local needs, capabilities and capacities. The local committees pay for 59 - 90% of the costs. Finding the outstanding balance requires capability and capacity to extend throughout the system and pragmatism about the money.

Nutrition societies: Someone identified a need for nutrition societies to supply or facilitate access to support and mentoring. Nutrition Societies have a role to play as agents for change across the continent. They can support educationalists and their institutions. The workshop had identified building blocks. There is scope for optimism about curricular innovation that is feasible through integrating nutrition as a cross-curricular themes that supply examples for history, geography, science in existing syllabuses, not in a new free-standing subject. This could be achieved by developing guidelines and practical teaching aids. Some speakers noted that UCC, the top university in Ghana, has faculties devoted to health and nutrition and to teacher training. Zimbabwe uses Design and Technology Teachers (DAT) assisted by nutritionists who advise on nutritional values and safety e.g. allergies.

A participant proposed the selection for advocacy of examples of good, if not best, practice (i.e. that work) as exemplars to inspire, if not emulate. Nutrition advocacy should encompass an economic cost benefit and return on investment as well as health and nutrition outcomes to make the case that SFP benefits everyone, not just the poorest or most vulnerable.

National planning and collaboration: In contrast to the points speakers made, a member of the audience remarked that there was the need to transcend silos in global fora and at local levels, since the passing of the era of widespread use of UNICEF's Life Skills in Schools across the continent. Opining that national planning downplayed nutrition, SFP notwithstanding, it was important to learn from the past how to foster integration over coordination for effective programme and policy planning. Legal, governance and policy frameworks are only as good as the available capacity and budget permit. Pragmatism was necessary, given the variability within and between countries that often constrains decentralisation of authority and accountability. Another contributor highlighted AU's commitment to SFP being sustainable among all its members. Other points made were that donors finance capacity-building for sustainability and that GAIN and SUN have examples of good supportive efficient coordination.

FAO pointed out that the private sector could leverage need into demand to make profit. One participant reminded everyone not to forget the first 1,000 days as we extend our

efforts to the next 7,000 days.

Session 4: Developing professional capability and capacity to advance sustainable school health and nutrition, chaired by Professor Paul Amuna (ANS & UHAS) and Dr Jackie Landman (ANS & University of Southampton).

Information platform for community of practice: WHO KAP, chronic on-communicable diseases – cancer and nutrition in Children, Teenagers and Young Adults as an initial example. Dr Stephen Wootton PhD FAfN OBE, Associate Professor, University of Southampton for ICONIC.

Dr Wootton said he valued Wenger's Communities of Practice particularly exemplified in new web-based collaborative learning environments created to connect, communicate and conduct community activities. Prosecuting the school feeding agenda has led to several CoPs, to build independent evidence through research to inform effective policy-making (Research Consortium), to facilitate knowledge exchange and build solidarity and community around food systems (Food Systems Leadership Network) or leverage the voice and response of the UN agencies and partners to enhance the role of schools as a platform for multi-component nutrition action (UN-Nutrition, School Nutrition CoP). He advocated for a 'bottom-up,' non-hierarchical bi-directional approach that enables members to collaborate, share and learn together towards serving a common purpose of transformative practice. One that diagnoses and fixes, not merely describes as captured in the slogan 'share seamlessly, take shamelessly.' CoPs reflect pedagogically sound theories about group learning as they offer formal training to develop capability and capacity. While playing important roles, such CoPs do not directly address the concerns raised by the United Nations System Standing Committee on Nutrition (UNSCN) on schools as a system to improve nutrition (2017). Specifically, the need to train teachers in order to equip them and support them in providing a suitable learning environment in schools that deliver food and nutrition education that considers nutrition to be a demand-led process, alongside consideration of food production, availability and access. Changing the school environment and implementing nutrition and health-related interventions requires capable, trained agents of change. Teachers, school staff, students, parents, and caterers all play essential roles in promoting positive nutritional behaviour but cannot do this without support from nutrition professionals. Competent, trained nutrition professionals are needed to work together with those in schools to enable intersectoral collaboration, set standards, identify and solve operational problems, and generate secure and reliable data that can be used to monitor and evaluate interventions.

Dr Wootton spoke about an activity of ICONIC that brings together oncologists, nutrition professionals, health professionals with children, teenagers and young adults (CTYA) with cancer to form a CoP to advance nutritional care. This intersectoral collaboration is hosted virtually through the WHO Global Co-ordination Mechanism on the Prevention and Control of Noncommunicable Disease using their Knowledge Action Portal (KAP) to share knowledge and promote action. Developing the CTYA KAP offers insight into an approach that might help fill the gap identified by UNSCN. Building a CoP to support change agents in schools is the responsibility of nutritional professionals and offers a bottom-up approach, to complement the top-down approaches around policy and food system change, to improve nutrition, prevent disease and prepare children for their life ahead. Ghana and Nigeria produce surplus nutritionists able to 'hit the ground running' in relation to CTYA. Dr Wootton concluded by saying that the ICONIC model could be a useful way to engender a School Nutrition Community of Practice to help meet the challenge in SCN (2017) to equip and thus harness the potential of schools and teachers to act as agents of positive change in school health and nutrition.

Establishing a quality assurance framework for assessing nutrition-related health as integral to service-based activities and M&E. Associate Professor Reginald Annan, Kwame Nkrumah University of Science and Technology (KNUST).
Associate Professor Annan reported on another activity of ICONIC to establish a quality assurance framework for assessing nutrition-related health in Africa, initially for anthropometry. ICONIC's ambition is to achieve a sub-Saharan African Quality Assurance Framework and Nutrition for Africa (QAFANA) for the collection and curation of secure nutritional data that can be used with confidence for policy-making, policy-planning, monitoring and evaluation in critical areas of the health sector (cancer), the education sector (childhood obesity) and the agricultural sector (food and nutrition security). As a first step, training and competency assessment required at the level of trainer took place in Southampton, UK with colleagues from Ghana who subsequently led the training and competency assessments of students and national service personnel in two institutions in Ghana. These experiences are subject to appropriate monitoring and evaluation used to refine the training programme.

The approach used is 'training the trainers,' applying

standard operating procedures (SOPs) for weight and height in adults in the first instance. Training starts with a baseline assessment during which participants' practices are observed and analysed. The training addresses observed issues followed by post-evaluation at the end of 2-day process. Fifty people have completed training to date. Slides were used to illustrate some of the issues identified and addressed so that trainees attained a high professional standard, such as ensuring that observers introduced themselves and explained the procedures they were about to use, before they began to measure subjects. Observers are expected to wash their hands between each measurement and adopt best practice with respect to their subjects' postures during measurement and the appropriate use of bony markers. The programme rigorously establishes participants' capability to train to a common high standard of proficiency. The goal is to attain international certification and thereby ensure that accurate, precise measurements are made in routine surveys or during surveillance, as well as in research, for the full range of anthropometric measurements, to better inform nutrition and health policies and programmes.

Research Agenda for Population-level Information on Nutritional Health: Cancer and Nutrition for Africa (CANA), Dr Keiron Audain, CANA and University of Ghana (UG)

Dr Audain explained that Cancer and Nutrition for Africa (CANA), an ICONIC/ANS initiative was designed to address the lack of research funding in Africa. It focuses on building research capacity among African scientists to undertake large-scale epidemiological studies into diet-cancer relationships, similar to the European Prospective Investigation into Cancer and Nutrition (EPIC). It fosters collaboration in cancer and nutrition research with a focus on large cohort studies on diet and cancer risk undertaken through ongoing collaboration with African researchers and institutions. The focus on cancers is because its incidence is increasing rapidly, with high rates of young-onset cancers. Africa bears a disproportionate burden of cancer deaths. Internationally, there is compelling evidence for the association of diet with cancer that implicates the high levels of consumption of processed foods, high-fat and high-sugar diets and the low consumption of fruits, vegetables and fibre, alongside high rates of obesity and increasingly sedentary lifestyles. In Africa, limited research on dietary and lifestyle risk factors prevents planning effective prevention or care policies or programmes. CANA aims to promote exploration of the contributions that diet, nutrition, and lifestyle factors make to enable early detection, improved prevention and care of cancers on the continent. CANA seeks to raise awareness of the links between nutrition and cancer, establish cancer registries and advocate for the integration of nutrition into cancer care across Africa. Because the literature provides evidence that nutrition can play a role in treatment outcomes, CANA advocates that the integration of nutritional counselling into cancer care is needed across Africa.

CANA has developed the Cancer and Nutrition Epidemiology in Africa online grant-writing course for African researchers who want to gain knowledge of and experience with writing grant proposals in this specialist area. The course covers such aspects of grant-writing as formulating a research question, designing the most appropriate study, calculating study size, planning and budgeting, among other relevant skills. Dr Audain also outlined the training offered during 9-week courses on the design of epidemiological research that provide peer review and mentorship. Based on their success, CANA will scale-up training of researchers and health professionals. Significant challenges lie ahead before success is achieved in terms of securing funding and building the capacity required for large scale studies, as well as overcoming the difficulties inherent in setting up registries. So far, CANA has trained over 31 researchers in cancer and nutrition epidemiology. The numbers of applications for grant proposals for cancer research submitted has increased. After 3 years, CANA has built a growing network of collaborators across African institutions that has contributed to increased research output in Africa. Dr Audain highlighted a recent success achieved by Dr Reginald Annan (CANA founding member) and the team he leads secured a project grant from the World Cancer Research Fund (WCRF) as part of their Regular Grant Programme, to investigate aspects of breast cancer among sub-Saharan women. Dr Audain concluded with a call for more nutritionists to enter the nutrition and cancer space for the good of our profession, our children, our communities, our countries and our continent.

Developing a Curriculum for Nutrition Professionals to Become School-based Nutrition Extension Officers. Professor Basma Ellahi, University of Chester & ANS.
Professor Ellahi started by reminding us of the value of nutrition as a subject because it is inherently integrative of the breadth of knowledges applied in nutrition practice. She referred to work reported at the conference in two abstracts by Tetteh et al. One study1 reported a web-based survey of 67 key informants in 19 countries. It focussed on the extent to which guidelines were used for the implementation of SFP, the presence of legal frameworks,

regulations and M&E of school meal delivery, and the nature of the school food and health environment. The survey revealed a significant majority (96%) of the African countries represented have SFP for children and young people aged 2 - 20 y. In over a third of countries, food for the SFP was sourced at administrative (34%) rather than central levels (8%). More than half (54%) operated SFP all year round. Usually (54%) the responsible department was the Ministry of Education, followed by the Ministry of Gender and Social Protection (27%). A few SFPs operated under the auspices of multidisciplinary ministries (7.5%) or the Ministry of Health (1.5%). Seven countries (37.3%) have Food-Based Dietary Guidelines that 18% used to guide the implementation of their SFPs. Only 40% of African countries use M&E systems to assess the impact of school meal delivery on the health and nutrition of children and adolescents. A minority (16%) of pupils in survey had access to safe drinking water and 20% had access to basic handwashing facilities. The findings indicate constraints on food safety and hygiene as well as on effective management of the impact of SFP programmes.

When the informants in the second study2 were asked their opinions about the value of a Quality Assurance Framework (QAF) for SHN in Africa, they suggested that a QAF should include nutrition policies, nutrition quality scores, a food systems approach, WASH, the presence of well-structured nutrition and health curricula in schools delivered by trained personnel, the presence of minimal (threshold?) levels of health and nutrition services in schools as well as systems for M&E. Study participants considered that the main barriers likely to impact the development or implementation of the QAF were lack of specific school feeding policies, lack of or inadequate M&E systems and structures, insufficient capacity and capability of the teachers or school management involved in SFP to deliver, administrative bottlenecks, inadequate funding for SHN as a whole including SFP, low coverage of SFP, nutritionists not being involved in the implementation of SFP, and finally, diversity of school meals being so inadequate as to impede the sustainability and impair the quality of SFP and SHN. These contemporary studies showed unmet needs for capability and capacity-building in school nutrition, with challenges for nutritionists, among others.

Professor Ellahi recalled that the SCN (2017) had drawn attention to the unmet potential of nutrition and health interventions for the school-aged and to the significant potential of well-equipped teachers, provided to teach their scholars to attain nutrition literacy. To this end, an ANS ad hoc Group, including Professor Ellahi had started work to support nutrition in schools, by developing a statement of key principles and values together with key information for adaptation in practice. BSc degree students of Professor Zotor had been asked to evaluate the document. Their feedback was overwhelmingly positive about the scope and coverage of the document and its readability while suggesting improvements its presentation such as including illustrations. The ANS ad hoc Group plans to develop the document to include practical guidance and supporting materials following further evaluation.

The ANS ad hoc Group also proposes to encourage more nutrition graduates to work in schools, as they already do in health, by promoting the specialist role of School Nutrition Extension Officers (SNEOs) that was first proposed in a presentation at the School Meal Coalition in 2022. The ad hoc Group is aware of nutritionists who already work in schools who are not called SNEOs or recognised as specialists and whose responsibilities vary from place to place. The ad hoc Group's aim is to promote the recognition and systematising of SNEOs who would be expected to work with schools to advise on the nutritive value of meals on integrating nutrition into school curricula in order to develop nutrition literacy in the children and young people, to help undertake M&E, help liaise with the community, stakeholders and service providers and agencies. SNEOs were envisaged as employees of the government ministry in charge of the SFP. Professor Ellahi invited anyone interested to collaborate with the ANS ad hoc Group on this initiative by commenting on their draft outline role descriptor and whether this promoting its adoption could foster effective collective action for the benefit or our children counties and continent, by signing up via a QR code.

Plenary Discussion

Starting and acting local: To counter fears of external imposition of a new role (SNEO), members of the ad hoc Group stressed that they work as ANS members, at the behest of ANS. Their work is being evaluated in Ghana among other countries. These speakers stressed their unwavering commitment to cultural competency based on collaboration with civil society and underscored their utmost respect for local customs.

Meeting capability and capacity needs: Health promotion practitioners and nutrition technicians were mentioned as other capable actors. There is a need to integrate nutrition, food safety and health as well as competence in governance, supported by enforced regulatory frameworks.

School Nutrition Extension Officers (SNEO): Some questioned the feasibility of SNEOs, a new occupation. However, community nutritionists are already employed in schools, for example in Upper West Region, Ghana. In South Africa, some nutrition students perform community service in schools during their training. These contributions

illustrated the role of SNEOs could build on and extend current good practice. Some spoke about constraints. For example, in Ghana, there is a lag between nutritionists' graduating and appointment to district posts. When there are funding shortages, recruitment of nutritionists is frozen. Moreover, occupational roles need to be attractive to nutrition graduates. Because too few nutritionists take up community nutrition posts, nurses and food science graduates are employed In Nigeria. There is less training capacity in Francophone countries, a shortfall that ECOWAS is seeking to resolve. Reflecting on push and pull factors that had emerged during the discussion, a speaker foresaw a paradigm shift in nutrition education and training.

Session 5: The future: Way Ahead, plenary discussion chaired by Professor Alan Jackson, CBE, ICONIC & IMTF.

Professor Jackson summarised the key lesson he had learned as a need 'to do simple things well and to listen to frontline staff.' He had learned this from the experience of applying research to the treatment of severe malnutrition that led to case fatality rates falling by an order of magnitude, to less than 5%. These experiences led to the Manual for the Treatment of Severe Malnutrition (WHO). Nutritionists in SFP have a desire and duty to help. That they are needed has been well-known and accepted for years. The challenge is to turn a need into a demand. Having listened to presentations about the work of agencies and NGOs, the extent of harmonisation of their approaches and where this harmony is modelled remained unclear and invited contributions from the audience.

Agency-government working: A speaker said that WFP engages with each national government on an individual basis and did not prescribe an approach or model. The speaker called for all relevant currently employed workers in SHN and SFPs to be up-skilled.
It is all politics: A participant observed that everything is political, not least in WHO regional offices and in the AU. Observers produce and facilitate cooperation, going on to advocate for the consistent inclusion of north Africa in maps, illustrations, documents, activities and events in place of a focus on sub-Saharan Africa. The Nigerian Minster for Reconstruction and Economic Planning said that there should be more and sustained efforts to advocate for nutrition at all levels. She suggested members of the audience should be prepared for a call for bids in 2025 providing opportunities to ensure that nutrition is properly resourced. In order for nutrition to succeed, she said, ambitious nutritionists should aim to be appointed to roles in which they can move the levers of power, such as at senior, even the highest echelons in government
Scaling up research and effort: A participant said she appreciated having her eyes opened to gaps in nutrition information and research and called for efforts to be increased in all areas of need, particularly in SFP. Another speaker highlighted the need for more applied research to fill the gaps in data and evidence.
Integration and dialogue: A participant stressed the need for SHN to be integrated into national food and nutrition policy planning, and for nutritionists to use the language of value for money as well as extolling health benefits. Legal frameworks signify political and regulatory support in, for example The Gambia and are important, but did not negate the need for continuous dialogue between meetings as at them. A further speaker stressed the need for national frameworks and the need for more consultation.

Summary and conclusion: Chair, Professor Jackson summed up the tenor of the discussion as indicating a will to proceed to the next steps. He gave an undertaking that the ANS ad hoc Group would prepare a full report on the workshop that would include a justification for a multi-sectoral planning committee to be established to develop an action plan whereby ANS, its partners and stakeholders could chart the progress of nutrition in schools in Africa, by the end of 2025. The report and allied documents would be shared with speakers, panellists, chairs and attendees and other interested parties.

Close

Closing Remarks by Provost Professor Martins Ekor, chaired by Professor Kingsley Pereko, Vice-Dean School of Medical Sciences, University of Cape Coast.

Professor Ekor, on behalf of the Vice-Chancellor and Management of the University of Cape Coast, of the leadership of the College of Health and Allied Sciences, UCC, congratulated attendees on successfully completing the 2d Africa Regional Pre-Conference Workshop. He said that the workshop witnessed experts from different parts of our great continent, Africa, and beyond, coming together to address the importance of school health and nutrition, and the special role professional nutritionists could play. Professor Ekor extended his heartfelt gratitude to each delegate for their active participation and invaluable contributions, saying that their commitment to advancing the health and nutrition of our school-aged children is not just commendable; it is essential for building a healthier, more prosperous future for Africa. Professor Ekor noted that in addition to holding the title of Professor of Pharmacology, he had a special interest in toxicology. Notwithstanding this he said he did not feel qualified to offer an expert view on the major theme of the workshop, but asked the audience to allow him to share some thoughts in the course of his closing remarks:

1. Professor Ekor called for the audience to agree that the critical role proper nutrition plays in the academic success and overall well-being of our students cannot be overemphasised. There is no gainsaying that a well-nourished child is not only healthier but also more focused, engaged, and ready to learn. The alarming rates of poor feeding and malnutrition among school-age children, underscore the urgent need for effective interventions. As professional nutritionists, you are pivotal in this endeavour. Your expertise allows them to assess dietary needs, develop tailored meal plans, and provide essential education on healthy eating habits. By collaborating with schools, you (nutritionists) can ensure that our children have access to nutritious meals that support their growth and learning. You serve as advocates for health, guiding students toward making informed food choices that will benefit them throughout their lives.
2. Professor Ekor said he strongly felt it to be essential to continue to reflect on the pivotal role that the "School Nutrition Extension Officer" can play in enhancing nutritional outcomes for our children and communities. The establishment of this professional role is not merely an addition to the current frameworks; it represents a transformative approach to integrating nutrition into our educational and agricultural systems. By equipping School Nutrition Extension Officers with the necessary training and resources, we empower them to act as vital conduits between agricultural practices and nutritional education. This integration is crucial, as it allows for a more holistic understanding of how food systems impact health outcomes.
3. Professor Ekor expressed his personal view that the key responsibilities of School Nutrition Extension Officers should, among other things, include:
    a. Education and Training: They will be responsible for delivering tailored nutrition education programmes that address local dietary needs and cultural practices. This involves not only imparting knowledge about nutrition but also fostering skills that enable communities to make informed food choices.
    b. Community Engagement: By actively engaging with community members, these officers can facilitate discussions around nutrition-related challenges and collaboratively develop solutions. Their role as facilitators will help in building trust and encouraging community participation in nutrition initiatives.
    c. Collaboration Across Sectors: Effective implementation of nutrition strategies requires collaboration with various sectors, including health, agriculture, and education. School Nutrition Extension Officers can bridge these sectors, ensuring that nutrition is prioritised in all relevant policies and programmes.

Professor Ekor said that he did not doubt that the development of the School Nutrition Extension Officer role is a strategic step towards achieving improved health outcomes for children across Africa. By investing in their training and support, we are not only enhancing individual well-being but

also contributing to broader societal goals such as food security and sustainable development. Professor Ekor urged everyone to take the insights gained from this workshop back to your communities; to advocate for the integration of nutrition education into school curricula, support initiatives that prioritise healthy school meals, and collaborate with local nutrition professionals to create sustainable programmes. Together, we can foster environments where our children thrive physically, mentally, and academically.

The key takeaways from this Workshop in my opinion are:

i. Collaboration: I have no doubt that the discussions over the past two days have highlighted the necessity of collaboration among stakeholders—governments, NGOs, educators, and health professionals—to create comprehensive school health programmes.

ii. Implementation: We must translate our discussions into actionable strategies that can be implemented in our respective countries. The insights shared here should serve as a foundation for developing tailored interventions that address local challenges.

iii. Sustainability: It is crucial to ensure that our initiatives are sustainable. This involves not only securing funding but also fostering community ownership and engagement to support long-term success.

In concluding Professor Ekor exhorted everyone to leave the workshop inspired and motivated to advocate for policies that prioritise school health and nutrition, recognizing that healthy children are the cornerstone of a thriving society. Together, we can make a significant impact on the lives of our youth, ensuring they have the opportunity to learn, to grow and to contribute positively to their communities. Let us commit to this vision and work collaboratively to make it a reality and reiterating how much he appreciated attendees' dedication and active participation in this vital dialogue and more importantly for the noble cause of enhancing school health and nutrition across our continent.

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