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of the school environment to close the micronutrient gap and address iron deficiency anemia in adolescents in low-and-middle-income countries

SEPTEMBER 5, 2023 | 11 AM | Room B2 University of Hohenheim, Stuttgart, Germany



Diet quality and NCDs in adolescents – challenges and opportunities

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September 5th, 2023

Content

- Diet quality and adolescence
- Variations and influencing factors for diet quality
- Diet quality and NCDs in adolescents
- Double burden of disease nutrient deficiency amidst the current obesity and NCD pandemic
- Opportunities and challenges



- Indices and scores indicate adherence to healthy(ier) dietary patterns, in line with national guideline recommendations
- Alternative Healthy Eating Index (AHEI)
- Dietary Approaches to Stop Hypertension (DASH)
- Mediterranean diet adherence
- Net consumption of 'healthy foods'



Diet quality in adolescence



- Diet quality is influenced by a variety of factors, including socio-demographic characteristics
- Adolescence is a particularly important life-stage as multiple aspects of development (cognitive, behavioural, physiological) will be shaped by what happens during the adolescent years
- During this period, adolescents more independent and often make food decisions on their own
- Peer-pressure to eat or avoid certain foods

Photo – courtesy Johns Hopkins Medicine <u>https://www.hopkinsmedicine.org/health/wellness-and-prevention/healthy-eating-during-adolescence</u>

Overall diet quality estimates worldwide, and by region (2018)

Global Dietary Database (GDD) 2018 data, based on individual-level dietary surveys around the world



World

Southeast/East Asia

Central/Eastern Europe and Central Asia High-income countries

Latin America/Caribbean

Middle East/North Africa

South Asia

Sub-Saharan Africa

5

Global and regional mean AHEI component scores by age in 2018



Global and regional mean AHEI component scores by age in 2018



Top scores in South Asia were for higher whole grains and lower red/processed meat and SSBs, while top scores in Latin American and the Caribbean were for higher legumes/nuts and lower sodium

Healthy components: fruit, non-starchy vegetables, legumes/nuts, whole grains, PUFAs and seafood omega-3 fat; unhealthy components: red/processed meat, SSBs and sodium.

Diet quality among adolescents

Diet quality in adolescents and young adults in the UK National Diet and Nutrition Study (2008–2016) (n=2,957)



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Diet quality in adolescents in LMICs – additional factors influencing food choices



- Household income
- Family size and structure Food availability
- Transport/accessibility
- School feeding programmes
- Reproductive age



Diet quality and NCDs



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The best science for better lives

Meta-analysis of cross-sectional studies (n=11) investigating diet quality (high vs. low) and metabolic syndrome (categorical) in children and adolescents



Test for heterogeneity Chi-square = 11.32, df=10, p=0.333, l^2 = 11.6%1 Test for overall effect z= -3.046, p=0.0022

N= sample size; Index= Diet quality index utilized; KIDMED, Mediterranean diet index for kids; MDP, Mediterranean Diet Pattern; AHEI, Alternative Healthy Eating Index; DII, Dietary Inflammatory Index; mHEI, modified Healthy Eating Index; HEI, Healthy Eating Index

1 Heterogeneity (I2) = 11.6%. So, we used a fixed effects model.

2 P value indicating level of statistical significance

Global Burden of Disease in young people (10-24 years of age)



DALYS per 1000 males

DALYS per 1000 females

Anaemia in poorresource settings

- The low-quality diets prevalent in LMICs are a poor source of iron
- Population is often exposed to infection
- Demographic characteristics result in a greater prevalence of adolescents at high risk of iron deficiency anaemia than in other parts of the world



Challenges

Challenges in tackling diet quality in light of the double-burden of disease in adolescents

03

01

Access to healthcare differs in HICs vs. LMICs

02

Complex food and social systems when planning community interventions

Private/public/poli tical sectors need to work together – often difficult

04

Groups of adolescents at greatest risk are possibly the most difficult to reach out to

Challenges in tackling diet quality in light of the double-burden of disease in adolescents



School interventions

02

Low-cost strategies

03

Potential for widespread impact 04

Globalisation can be an ally

Integrated approach to supporting adolescent health PROTECTING ADOLESCENT HEALTH NEEDS YOU!

Families who protect and nurture

Healthcare responsive to adolescents' needs

Schools that promote healthy development

Clean air, adequate water, sanitation and hygiene

A transport system that is safe

Laws to protect the rights of adolescents



WHO Adolescent Health Report 2022

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Known and overlooked causes of iron deficiency anemia among adolescents

Kesso Gabrielle van Zutphen-Küffer Director of Science, *Sight and Life*, Switzerland



The Need

- The world is home to 1.2 billion adolescents of which 90% live in low- and middle-income countries
- "Profound period of human growth and development in which the assets and capabilities that underpin future adult health and well-being, social relationships, parenting and employment are established"
- A transformative generation rather than one who is at risk
- The adolescents of today will be the policy makers of tomorrow.



Adolescence: a second window of opportunity

- In adolescence, height increases by 15 to 20%
- **50% of adult weight** is gained in adolescence.
- 40 to 60% of peak bone mass is attained.
- During times of peak physical growth, nutrient needs are at their highest, particularly for iron, calcium, zinc, vitamin A and vitamin D.
- Brain development (specifically prefrontal cortex) is not complete until near the age of 25 years.

Salkind, Neil J., ed. *Encyclopedia of human development*. Sage Publications, 2005.



Iron deficiency: Among the top ten causes of disability-adjusted life years (DALYs) among adolescents globally, by age group (UNICEF, 2019)



Adolescents aged 15-19

Iron deficiency is the leading cause among the nutritional conditions.



UNICEF data, WHO Global Health Estimates 2019: Causes of DALYs by cause, age, sex, by country and by region, 2000-2019 Geneva; 2019.

Adolescents aged 10-14

Anemia – the most off-track World Health Assembly target

 40% of children 6–59 months of age, 37% of pregnant women, and 30% of women 15–49 years of age are anemic (WHO, 2023).

> Nearly one quarter of the world's population, or 1.8 billion people suffer from anemia.

- Neglected issue
 - Adolescent nutrition overlooked in UN Decade of Action on Nutrition
 - UN Sustainable Development Goals for nutrition: no adolescent-specific targets
- Nutritional goal: build sufficient stores to prepare for pregnancy (serum ferritin >70 µg/L)





Filling the iron gap is the most important nutrient intervention for adolescent girls

What is anemia?

Anemia is a condition in which the number of red blood cells or the hemoglobin concentration within them is lower than normal.

Normal blood Anemic blood Many red Fewer red blood cells blood cells Normal hemoglobin Low hemoglobin





Anemia and its consequences among adolescents

Impact of anemia



Tiredness, weakness, shortness of breath Immune function & risk of infection Cognitive development & academic performance. Preterm delivery, low birth weight, maternal and fetal mortality.

Bleeding after childbirth



Framework for accelerating anemia reduction



For accelerated efforts and impact, tackling various causes of anemia is essential

How can school meals fill the iron gap?

IRON-SPECIFIC





Dietary diversity (animal source foods, iron-rich foods, vit C)





Iron fortified meals Phytase rich (home-fortification meals (meals including MNPs) low in inhibitors e.g, tannins and phytate)



Supplementation:

- Iron and folic acid supplementation
- Multiple micronutrient supplementation

Could schools serve as a holistic platform to fill the iron gap?

IRON-SENSITIVE



- Menstrual hygiene and management
- Prevention and treatment of heavy menstrual bleeding
- Use of hormonal contraceptives/NSAIDs



- Deworming
- Screen for malaria, and other infectious diseases
- Malaria treatment
- Use of insecticide-treated nets

Going beyond school meals

- School meals provide an excellent platform to fill the iron gap.
- Anemia reduction is dependent on a variety of determinants.
- For enhanced efficiency and impact, there is added value in considering these key determinants & integrating them as part of school interventions.
- Examples will be provided in the following presentations.





Delivering science-based solutions to close the nutrition gap

www.sightandlife.org

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School feeding programs with locally produced probiotic food *The story of Yoba for Life*

Wilbert Sybesma, Nieke Westerik and Remco Kort September 4-6 2023



School feeding programs with locally produced probiotic food The story of Yoba for Life

- Introduction Yoba for Life

- Locally produced probiotic yoghurt to enhance health and wealth in East Africa.
- Probiotic starter culture

School feeding programs

- Organisation
- Experiences from Uganda and Ethiopia
- Clinical trials conducted with Yoba probiotic yoghurt

Conclusion and RecommendationsAcknowledgements

Yoba for Life Foundation is a non-profit organization recognize Dutch state as a Public Benevolent Institution

Disclaimer: Wilbert Sybesma and Remco Kort founded the ro Life Foundation in 2009. Their work for the foundation is unput The reason why: Improving health and wealth by locally produced probiotic fermented food for people living in resource poor communities

Background:

- Africa ancient history with fermented foods
- Sub-Saharan Africa world's region with the highest % of chronically malnourished people and child mortality
- Mainly in the informal sector, locally produced probiotic fermented foods could contribute to increasing quality of life by providing business opportunities and a healthy product
- Western probiotic foods are not affordable for people living in resource poor communities

Lacticaseibacillus rhamnosus yoba 2012:

World's first generic probiotic bacterium

Applied and Environmental

FOOD MICROBIOLOGY Volume 79 Issue 7 https://doi.org/10.1128/AEM.03566-12

DOI: 10.1128/AEM.03566-12

Genome Instability in Lactobacillus rhamnosus GG

Wilbert Sybesma^a, Douwe Molenaar^b, Wilfred van IJcken^c, Koen Venema^d, Remco Kort^{a,b,e}

Forum: Science & Society

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DOI: 10.1016/j.tibtech.2012.09.002 **Probiotics for every body** Remco Kort^{1,2,3} and Wilbert Sybesma¹



Lacticaseibacillus rhamnosus yoba 2012 showing pili with mucin binding protein visualized by immuno-gold labeling

Yoba for Life INNOVATION

A tailor-made probiotic starter culture for small-scale producers in resource-poor settings



- 1 gram of starter culture costs 0.90 USD.
- To produce 100 liters of probiotic yoghurt

Kort et al. Microb Cell Fact (2015) 14:195 DOI 10.1186/s12934-015-0370-x MICROBIAL CELL FACTORIES

Open Access

RESEARCH

A novel consortium of *Lactobacillus rhamnosus* and *Streptococcus thermophilus* for increased access to functional fermented foods

Remco Kort^{1,2,3,4} , Nieke Westerik^{1,3}, L. Mariela Serrano⁵, François P. Douillard⁶, Willi Gottstein³, Ivan M. Mukisa⁷, Coosje J. Tuijn¹, Lisa Basten⁵, Bert Hafkamp⁵, Wilco C. Meijer⁵, Bas Teusink³, Willem M. de Vos^{6,8,9}, Gregor Reid^{10,11} and Wilbert Sybesma¹



THE YOBA FOR LIFE CONCEPT IS DESIGNED TO ADDRESS COMMON HEALTH PROBLEMS IN RESOURCE-POOR COUNTRIES



PRODUCING PROBIOTICOF LACTOBACILLUS RHAMNOSUYOBA YOGHURTYOBA ARE CONSUMED PER DAY



Local branding



300 ML

Keep refrigerated

BEST BEFORE

PRODUCED PER MONTH

https://youtu.be/sj0OFtkUzec https://youtu.be/iYtzi4pkdsM













Pre-primary and primary Yoba Probiotic School Feeding Program:

> 30,000 children in the Mbarara region in Uganda

- > 12,000 in Ethiopia,
- > 2,500 in Tanzania











Organisation of Yoba for Life School Feeding Programs

- Yoba school coordinators approach schools and convince directors and parents about advantages of probiotic fermented food
- Yoba yoghurt is produced by local producer
- Schools are supplied with Yoba yoghurt between 1 and 5 times a week, 100-125 ml
- Price is covered by school fees (5-15 ct/portion)
- Yoba yoghurt is very well received by children
- Some schools make publicity around Yoba for Life Schools.

Advantages of fermentation

- Production of vitamins by fermenting bacteria
- Production of immunity stimulating metabolites
- Multiplication of (probiotic) bacteria
- Unlocking of active biopeptides during protein hydrolysis
- Several clinical studies have been done to measure and monitor efficacy.

Note: The yoba yoghurt is not fortified with micronutrients.

 \rightarrow We think that micronutrient fortification will only work when it is made mandatory by authorities .



	Uganda	Ethiopia
Government involvement	The government has a high interest in school milk, as an increase in national milk consumption is of clear economic benefit to the country.	Apparently, the government had never considered the use of dairy products in school feeding programs. Potentially (?) their interest will grow as the uptake program is growing in Ethiopia.
School feeding culture at baseline	It is common for schools to prepare food and feed the children, as paid for by the parents, with the exception of the poorest public schools.	A habit of providing food at school is virtually absent, apart from donor-funded school feeding programs. For those who can afford it/prioritize it, children carry lunchboxes to school.
Price of milk per liter, farmgate	~ \$ 0.20	~ \$ 1.20
Familiarity with milk	In Central and South-western Uganda, milk is a very common product, though consumption still needs to be boosted (some households have a focus on sales instead of consumption).	In most areas where the program is promoted, familiarity with milk and milk products is lower as compared to Uganda.

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Four nutritional trials have been conducted with Yoba probiotic yoghurt in Uganda and Ivory Coast

1. Pilot study Uganda, skin rashes, open label, 245 children





Article

Improving Health and Wealth by Introduction of an Affordable Bacterial Starter Culture for Probiotic Yoghurt Production in Uganda

Nieke Westerik ^{1,2}, Alex Paul Wacoo ^{1,2}, Esther Anyimo ³, William Matovu ³, Gregor Reid ^{4,5}, Remco Kort ^{1,2,6,*} and Wilbert Sybesma ^{1,*}

3. Open label Uganda, 2 arms, 1116 children

frontiers in Nutrition ORIGINAL RESEARCH published: 09 December 2020 doi: 10.3389/fnut.2020.574792



A Comparative Interrupted Times Series on the Health Impact of Probiotic Yogurt Consumption Among School Children From Three to Six Years Old in Southwest Uganda

Nieke Westerik^{1,2}, Arinda Nelson¹, Alex Paul Wacoo^{1,2,3}, Wilbert Sybesma¹ and Remco Kort^{1,2*}

¹ Yoba for Life Foundation, Amsterdam, Netherlands, ² Department of Molecular Cell Biology, Vrije Universiteit Amsterdam, Amsterdam, Netherlands, ³ Department of Food Technology and Nutrition, School of Pood Technology Nutrition and Bioengineering, College of Arginizutural and Environmental Sciences, Makerere University, Kampala, Uganda



Westerik N., et al. Comparative Interrupted Times Series on the Health Impact of Probiotic Yogurt Consumption Among School Children From Three to Six Years Old in Southwest Uganda. Front Nutr. **2020** Dec 9;7:574792. Brett B., et al. Salivary biomarkers of stress and inflammation in first graders in Côte d'Ivoire: Effects of a probiotic food intervention. Psychoneuroendocrinology. **2021** Jul;129:105255. Brett B., et al. Normative cognition and the effects of a probiotic food intervention in first grade children in Côte d'Ivoire. Sci Rep. **2022** Nov 14;12(1):19491. doi: 10.1038/s41598-022-23797-3.



Psychoneuroendocrinology 129 (2021) 105255

Contents lists available at ScienceDirect

2. Semi-randomized controlled trial, 3 arms, 251 children

ClinicalTrials.gov

Home > Search Results > Study Record

COMPLETED (

ClinicalTrials.gov Identifier: NCT04144491

Effect of *L. rhamnosus* Yoba on RTI and Other Health Outcomes Among Children (3-6 Years) in Uganda September 12 November 22

Information provided by Remco Kort, VU University of Amsterdam (Responsible Party) Last Update Posted: 2021-04-28

Daily monitoring by qualified school nurses

Primary outcome:

Incidence of respiratory tract infections (cough, rhinitis)

Secondary outcomes:

- Incidence of skin disease (incidence of skin rashes)
- Weight-for-age
- Length-for-age
- Metabolic profile of children's urine
- Microbial load of children's stool
- Immune markers of children's saliva

Reference: NCT04144491 (clinicaltrials.gov)





Daily dose of 125 ml, approx.: 1-3 x 10⁹ cfu *L. rhamnosus* yoba 2012, 1-2 x 10¹¹ cfu *S. thermophilus* /day

Conclusions and recommendations

School feeding programs

- Yoba yoghurt well received and appreciated
- Program is sustainable at low cost

Outcome of intervention studies

Strong level of cross infections week 1-4 start of school term

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- Decrease of BMI for Age in both groups
- Microbiome and metabolic effects (Hippurate, LAB and total bacteria, SLP1)
- Locally produced probiotic yoghurt tend to provide protection against skin infections and respiratory tract infection

Recommendations for follow up studies

To enhance the level of certainty of the impact of probiotic yoghurt, conduct a RCT, with

- A longer intervention period, and/or
- More children, and/or
- More uniform study environment (e.g. boarding school, or orphanage)?
- A third control group, in addition to yogurt and custard

What we would like to do next

- Repeat clinical trials in real life setting of locally produced probiotic yoghurts
- Expand Yoba for Life concept in scale and scope
- Aim to expand to national school feeding programs with locally produced probiotics food
- Find a solution for sustainable packaging (e.g. edible packaging and/or dispensers)
- Go beyond dairy with locally produced probiotic Kwete, Zomkom, Obushera, Soy, Munkoyo, and more

→ Investigate options for starter cultures producing phytase for release of iron.

 Investigate opportunity to use locally sourced probiotics









Science & Society



Locally sourced probiotics, the next opportunity for developing countries?

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DOI: 10.1016/j.tibtech.2015.01.002

The Yoba for Life Team and Partners

Insights to share:

- Give away control (Inspire and Shape Aspirations)
- Look for partnerships with organizations to whom you can add value





Uganda Team



Tanzania Team







MAKERERE UNIVERSIT





Yoba for Life Foundation is a non-profit organization recognized by Dutch state as a Public Benevolent Institution

>25 publications and 2 PhD thesis









Going beyond school meals

Leveraging the school environment as a holistic platform for adolescent nutrition and health

Lucy Murage, Marion Roche Nutrition International

SEPTEMBER 2023



Nourish Life



School-based delivery of health and nutrition interventions

- Education sector and schools as equal partners more than a platform
- "Whole school approach" The schools provide a platform for potentially wide range of interventions
 - School curriculum
 - Opportunity to increase adolescents' understanding of their own health and wellbeing and potential to benefit from improved nutrition and health practices
 - Opportunities to embed nutrition to improve dietary diversity, the wider food environment, as well as practical skills around growing and preparing food (school gardens)
 - Facilitation and promotion of physical activity and active transport
 - Creating a healthy food environment
 - Supporting monitoring, screening **and referral**, supplementation programs (as needed) and reinforcement through individual engagement by school staff
 - School feeding programs
 - They have the potential for long-term, multi-sectoral benefits
 - However, many do not include specific nutrition objectives, include poor quality foods, not coupled with nutrition education

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Adolescent health and nutrition in Africa

90% live in low- and middle-income countries (LMICs) and form 23% of the population in Sub-Sahara Africa (SSA). The East, Central and Southern Africa Region (ECSA) is home to 46M adolescents

Early marriages — Approx. 24% of girls married before age 18

45% of the 1.2M adolescent deaths reported globally in 2015 were from Africa. 34 deaths per 100,000 are attributed to malnutrition Both undernutrition, and obesity and overweight, in adolescents are public health concerns in LMICs in Africa

Adolescent pregnancy — Approx. 23% of girls pregnant before age 18 Anaemia prevalence — Approx. 30% anaemic

Effective interventions and actions

- 1. Weekly iron folic acid supplementation (WIFAS)
 - Anaemia reduction

Effect size for WIFAS estimated 35% reduction in relative risk of anaemia*

*Fernández-Gaxiola AC & De-Regil LM, 2020

- 2. Gender responsive nutrition education
 - Informed and empowered adolescents

Adolescents have an increased understanding of their growth, development, nutritional and health needs



WHO effective actions for improving adolescent nutrition — 2018

- 1. Promoting healthy diets in adolescents
- 2. Providing additional micronutrients through fortification and targeted supplementation
- 3. Managing acute malnutrition in adolescents
- 4. Preventing adolescent pregnancy and poor reproductive outcomes
- 5. Promoting preconception and antenatal nutrition in adolescents
- 6. Providing access to safe environment and hygiene for adolescents
- 7. Promoting physical activity for adolescents
- 8. Disease prevention and management



Implementing effective actions for improving ADOLESCENT NUTRITION



Our approach: bridging evidence to action, from national to regional, to global



Program strategy — demonstration, expansion and scale-up

Demonstration phase (2015–2018)

- Objective: to identify effective delivery platforms that could inform national scale-up to reach adolescent girls in and out of school system with WIFAS and nutrition education
- Countries: Tanzania, Ethiopia, Senegal, Kenya
- Partners: Ministries of Health (MoH), Education (MoEd), Agriculture (MoA), Youth and Gender

Expansion and scale-up phase (2018–to date)

- Institutionalizing project learnings
- Increasing coverage and reach





Behaviour change interventions (BCI) — Kenya approach

- Formative research conducted to inform context specific BCI strategies, messages and tools
- Co-creation approach to BCI strategy and gender responsive messages
- Awareness creation and community sensitization activities — drama and music festivals, football tournaments and essay writing competitions
- Nutrition education by teachers in schools and peer educators/motivator girls for out-of-school girls



Behaviour change interventions (BCI) — motivator girls Ethiopia approach

- Motivator girls selected
- Implementation framework developed
- Training and skills building
 - Materials and tools provided to teachers, health extension workers and woreda officers
- Deliver WIFAS and nutrition education in school
- Empowered advocates of their own health and girls out of school
- Supervised by teachers and community health volunteers





Monitoring and reporting systems — Senegal approach

- Development of a parallel project specific monitoring system — manual registers, tally sheets
- Manual recording and transmission of data from local schools up to subnational level from MoEd to MoH
- Support to automate data from manual to electronic recording and transmission
- Support to review HMIS indicators and National Education Management Information System (NEMIS) to include adolescent nutrition specific indicators



Supply and logistics

- Supplement recommended in guidance not available at affordable price, not on EMLs
 - Solution working with MoHs to use IFA (60mg iron & 400mcg folic acid)
 - Forecasting and procurement coordinated for antenatal IFA and adolescent WIFAS where the same supplement is being used
 - Nutrition International conducted a randomized controlled trial (RCT) with partners to establish
 potential of folic acid once weekly to increase plasma folate levels at level that is associated
 with protection of NTDs
 - Nutrition International's submission to WHO to include WIFAS in the WHO model List of Essential Medicines (EML) for 2023 EML
- Using age range of girls 10–19 girls means not all girls are menstruating, but menarche is unlikely to be confirmed (not appropriate)
- 10–19 years of age means often crossing two school systems (primary, secondary, junior/senior high, etc.)
- Logistically challenging to do three months on three months off, not well understood by health workers or teachers
 - Statement on option to align with school calendar in the WHO policy has been enabling and preferred system

	World Health Organization
Guideline: Intermittent i acid supplem menstruating	iron and folic entation in women

Global action to address affordable supplies

Inclusion of WIFAS on the WHO Essential Medicines List (2023)

 Nutrition International led the submission of WIFAS in the WHO model list of Essential Medicines (EML) to ensure enabling environment to increase access to supply and to catalyze scale up WIFAS.



Global support from evidence to action



Global and regional action

- Nutrition International is represented on Global Adolescent Nutrition Network (GANN) core group and was a founding member of the broader GANN initiated by ENN
- African Union: AU Regional Adolescent Nutrition Strategy (ARSN); SGII Campaign
- East Central. Southern Africa (ECSA): adolescent nutrition advocacy and communications strategy
- African Union Home-grown school feeding (HGSF) technical working group





Selected results — Africa



11M

adolescent girls who consumed the recommended scheme of WIFAS



adolescents who received nutrition education



1.3M cases of anaemia in adolescent girls averted



289K teachers and key intermediaries trained

Thank you!

Questions/comments?



Nourish Life











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Lucy Murage

Regional Technical Advisor, Maternal, Newborn, Child & Adolescent Health and Nutrition - Africa, Nutrition International

Concluding Remarks

- Improving diet quality of adolescents is a critical public health priority to reduce the burden of NCDs and of nutrient deficiencies in this group.
- For accelerated impact, there is added value in considering the various determinants of anemia & integrating them as part of school interventions
- School feeding programs including locally produced probiotic fermented food, contribute to improving health and wealth in East Africa
- Schools provide an avenue for a wide range of schoolbased collaborations, where both the education and health sectors are invested in the **wellbeing of adolescents** and should therefore be considered a '**partnership**' rather than just a delivery 'platform'.







If you're curious to view our poster (#11) on breakfast skipping in adolescents, we invite you to join Jordie at the foyer of the bio building.

