# *Towards more comprehensive analyses of the nutrition transition among adolescents in the rural South*

# Towards more comprehensive analyses of the Nutrition Transition among adolescents in the rural South: an empirical contribution

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Nutrition transition, adolescents, diets, physical activity, sustainability

## Abstract

The processes of rural transformation, defined as socio-economic changes that affect the ways people live and organise their livelihoods in agrarian contexts, can have profound impacts on diets and physical activity patterns. Such processes can change food environments in ways that can increase availability of calorie-dense and processed foods options. At the same time the introduction of technological innovation may modify the intensity of rural livelihood activities (i.e. work, travel, and leisure). Therefore, when designing research, policies and interventions that address the challenges to achieve the production and consumption of sustainable diets, there is a need to recognise the holistic nature of shifting lifestyles and what is needed to reverse the interconnected obesity and environmental crises from a food systems perspective. This chapter showcases a novel approach that integrates data from wearable activity-trackers in a mixed-method study design to further our understanding on the interplay between changing diets and physical activity among adolescents in rural Telangana (India). We also include reflections on the ethical and practical considerations when engaging with adolescents in research. The aim of the chapter is to demonstrate the advantages of engaging with a holistic concept of *sustainable lifestyles* (comprising diets and physical activity) to address the health challenges adolescents face in rapidly transforming societies.

## 1. Introduction

Contextual and historically embedded rural transformation processes, that include extensive societal and economic changes, can drive rapid dietary shifts and alterations in physical activity patterns (Kelly, 2011). Complex interactions between diets and physical activity are shaping increases of diet-related non-communicable diseases (DR-NCDs) (Popkin, 2006). Therefore, analytical frameworks and practices to achieve sustainable diets in transforming agrarian contexts, will benefit from incorporating in research, policy and interventions the

complex linkages between what people eat and how they work, travel and spend their leisure time.

These considerations are particularly important for interventions targeting adolescents, who are, especially in the Global South, at the forefront of dramatic shifts in diets and lifestyles caused by rural transformation (Aurino et al., 2017; Guthold et al., 2020). Since adolescence is a critical window of opportunity to recover from previous nutritional impairments and to enhance the health of the next generation (Prentice et al., 2013), identifying what is contributing to dietary and physical activity changes is key to contain the growing rates in the prevalence of DR-NCDs, food allergies and other chronic conditions (Bixby et al., 2019). For example, with food allergies growing in the Global South, often arising in childhood and persisting (or worsening) later in life, holistic research and policies to support human and environmental health through a food systems approach is critical. Food allergies emergence has been associated with several possible factors, with some being environmental exposure, genetic variants, and nutrient intake, including nutrition transitions (Cai, 2014; Mazzocchi et al., 2017). While this contribution does not directly focus on food allergies, we recognise the urgent need for more research in the area of sustainable diets and allergens. However, as the remainder of this chapter and book illustrate, better results can be achieved by embedding research of specific issues within the multiple facets that shape human and environmental health.

This chapter describes an empirical approach that aims to contribute to the nascent research on the interplay between changing diets and physical activity among adolescents in the context of rural transformation in the Global South. Through our contribution we aim to emphasize the importance of integrating considerations on *sustainable lifestyles* when designing interventions and policies to achieve sustainable diets.

The focus of the chapter is on rural India, where overweight and obesity rates have increased dramatically in the last decade (Aiyar et al., 2021; Barker et al., 2020). Our case study in rural Telangana (southern India), illustrates how to combine data derived from new technologies (i.e. wearable activity trackers), quantitative surveys and qualitative interviews. Together with reflecting on ethical and practical considerations when engaging with adolescents in research, our chapter aims to contribute to: 1) the research on the health challenges adolescents face in the context of rural transformation; and 2) raise questions that can guide

the design of interventions and policies that, in tandem, aim to target diets and physical activity levels.

## 2. Blind-spots in sustainable nutrition research with adolescents: a contribution from mixed-methods

Conventionally, research on adolescent nutrition and health in the global South has focused on the analysis of anthropometric indices and dietary intake at the individual level (Bassett et al., 2008; Stevano et al., 2019). Our *mixed-method sequential explanatory* [1] study design (Figure 1) addresses two broad gaps. Firstly, there is a lack of systematic data collection that links energy expenditure and physical activity patterns among teenagers in the agrarian South (Swaminathan et al., 2011). In turn, this limits the understanding of health risks that emerge from the interplay between variations in physical activity and dietary intake patterns among this important age group. A more comprehensive picture of the dietary and physical activity challenges that adolescents face in transitioning (rural) societies can be gained if dietary assessments go hand in hand with evaluations of physical activity patterns. To this end, 24h recall food intake data from 400 adolescent boys and girls in rural Telangana, was combined with energy expenditure data from accelerometer devices. Data were collected across six consecutive days and complemented with 24hrs recall time-use surveys during the same period. A household and individual survey administered before the above-mentioned instruments provided contextual information.

The second gap we aim to address relates to the missing links between individual-level dietary practices and physical activity, on the one hand, and household and community dynamics and enforced norms, on the other (Bassett et al., 2008). There is a growing recognition that researchers and public health practitioners should move beyond individual-level approaches to design and test interventions (Hunter et al., 2019). Importantly, adolescent boys and girls should be positioned within their households and communities where gender, age and carer-child relations of power shape intra-household food consumption and work allocation. To capture these dynamics and complement quantitative findings, we deployed a series of focus group discussions and in-depth interviews with a sub-sample of adolescents and their parents/carers.

[1] Mixed-methods sequential explanatory study design implies collecting and analysing first quantitative and then qualitative data in two consecutive phases within one study.

<insert Figure 1 here>

*Figure 1.* Mixed-method study design

Notes: *each focus group discussion included six members, one facilitator and one note taker. † Three in-depth interviews were conducted with the younger cohort of adolescent girls and three with the older cohort. The same sex/age structure was replicated for adolescent boys and respondent's parents. Source: work by authors

*Table 1 presents the methods and survey instruments used together with some examples of insights and type of outputs they can produce.*

<insert Table 1 here>

Notes: *Full definition of the terminology is provided in Box 1. Source: work by authors

*Box 1. Presents indicators produced using Actigraph accelerometer devices*

<insert Box 1 here>

Source: work by authors

## 3. India case study: Settings and Data

The study was conducted between 2019-2020 in Khammam and Mahbubnagar districts, located in the central and south agro-climatic zone of Telangana.

<insert Figure 2 here>

*Figure 2. Study sites: the state of Telangana and the districts of Mahabubnagar and Khammam.*

Source: work by authors

### 3.1 Quantitative data

#### 3.1.1 Sample description

The quantitative sample included 400 adolescents (11-19 years old) from 347 households. Table 2 reports household and individual characteristics. Physical activity parameters are

significantly higher for boys compared to girls. In terms of energy intake, boys exceed girls by 9% and 15% for younger and older cohorts, respectively. Average energy intake is lower than energy expenditure across all groups. The share of energy intake from processed foods is approximately 4% across the sample[2].

Table 2: Descriptive statistics of households and individual respondents by age group, and sex.

<insert Table2 here>

Notes: †Average number of days with valid data (non-wearing time less than 3 h throughout the day) out of the five days of the survey. ‡Total number of distinct day-level observations (individuals × valid days surveyed). Asterisks show level of significance ***= significant at 0.1% level, **=significant at 1% level and *=significant at 5% level. Source: work by authors

3.1.2 Combining food intake and physical activity data: two examples.

**Figure 3** plots the proportion of calories from processed foods to total energy expenditure (TEE), by sex and age groups. For ratios > (<) 1 energy intake from processed foods exceeds (is lower than) TEE. As rural transformation is taking place in many rural areas, diets and patterns of physical activities change. Convenient but unhealthy processed foods can become widely available and livelihoods that were physically demanding shift to more sedentary lifestyles.

The majority in the sample has a processed food to TEE ratio <1. Across both age groups, girls have relatively smaller proportion of energy intake from processed foods to TEE in comparison with boys. The relatively small ratio of processed foods derived calories to TEE ratio that is >1 (approximately 3% of the observations), is not surprising given our context of analysis. However, we should also question whether: any amount of processed foods consumption among adolescents is acceptable at all? Are some types of processed foods qualitatively less (more) harmful than others? Do higher levels of processed food intakes influence the intensity of activity patterns (i.e. PAL)? Are these patterns somehow linked with new findings that illustrate how increased ultra-processed food consumption is associated with increased appetite and development of food allergies (Hall et al., 2019)?

[2] The selection of processed foods was based on Monteiro et al. 2010. The ration include consumption of both processed and ultra-processed foods (Monteiro et al., 2010).

<insert Figure 3 here>

*Figure 3: Calories from processed foods as a proportion of Total Energy Expenditure.*

Notes: 95% confidence intervals computed over 1,000 bootstrapped repetitions. Two-sample Kolmogorov-Smirnov test for equality of distribution: Younger cohort (p=0.198) and older cohort (p=0.014). Source: work by authors

**Figure 4** reports the contribution (i.e. coefficients) of time spent across four main activities (i.e. education, economic, domestic, leisure) on PAL, by sex and age groups. The data show the marginal effects on PAL of a one-unit increase in the explanatory variables. For example, one-unit change of economic and domestic activities tends to have the largest marginal effects on PAL in both age cohorts of boys and girls. In the case of leisure and education, the marginal effect on PAL is higher in the younger cohort than the older cohorts. A unit-increase of leisure activities of boys has a larger marginal effect on PAL compared to girls. The data raises questions of the duration and nature of economic and domestic activities, how they change in relation to age and gender, and whether they represent an opportunity cost in relation to exercise and "formative" occupations.

<insert Figure 4 here>

*Figure 4: Contribution of activities on PAL, by sex and age groups.*

Note: Graph plots coefficients from a regression model of PAL on a set of activities (education, economic, domestic, and leisure). Sleeping and resting as baseline. The model controls for day of the week and missing hours. Standard errors clustered at individual level. Full regressions of determinants of Physical Activity Level (PAL) are presented in Table A at the end of the chapter.

Source: work by authors

## 3.2 Qualitative Themes [3]

FGDs and IDIs transcripts were read and analysed by a researcher familiar with the context of Telangana. A combined deductive and inductive approach was employed for theme identification and analysis. Once all data was coded, two researchers revisited and revised categories, that were in turn discussed and developed into main themes. Below we report a

[3] Information about the sample of the qualitative module is provided in Figure 1.

sample of themes, with some direct quotes from participants. Coding was conducted on Nvivo12. These themes enhance the evidence provided by quantitative data illustrated above.

Nutrition Knowledge

Younger and older adolescents demonstrate good nutrition knowledge and a detailed understanding of how nutrition influences health outcomes. This information is mainly obtained from their families, school, media and friends. Children listed a comprehensive range of vitamin-rich foods and distinguished them from foods that provide energy and strength. This knowledge was reinforced by interviews conducted with parents.

*"At home, mother, father and elders say if you drink milk, you will have more strength, and if you eat eggs, you will get energy" (Young adolescent girl FGD).*

*"At school, our physics madam (teacher), through experiments she showed us as well – in what foods, what nutrition is there" (Young adolescent girl FGD).*

While food consumption at home tends to be more supervised, eating out during recreational activities may be unmonitored. The options were regarded generally as "less healthy" and sometimes unsafe, but more enticing. As the ability to gather outdoors is more accepted among boys, this group tended to report higher levels of processed foods consumption than girls.

*"Outside food is good due to its colour and taste" (Young adolescent boy, FGD).*

*"Do not eat outside food – mother says. Asks me to eat good foods – potato, ladies finger, bitter gourd, all these, she asks me to eat" (Young adolescent boy, FGD)*

Gendered food allocation

Virtually all parents recognised that girls and boys should have the same diets. However, in practice diets were different between them and across age groups: leafy vegetables were prioritised for girls while animal protein was generally allocated to boys. Some of the main reasons reported included lesser body absorption of animal protein by girls, while boys needed protein and more calorific foods because they were more active. Reproductive health considerations for girls were also mentioned. These beliefs were reiterated by adolescents themselves.

*"If it's girls, for them chicken, mutton, the energy to assimilate it is not sufficient. If it's boys, as they can assimilate it, that is why they mostly eat non-veg, and so girls generally eat pulses, vegetables, leafy vegetables, eggs, to remain active. (FGD, Parent of young adolescent boy).*

*As [girls] grow older, non-veg [options] should be reduced, and as the age comes, even if you eat it, [they] will not digest." (IDI, Parent of older adolescent girl).*[4]

Changing food environments

During the IDIs, parents were asked to reflect on diets during their adolescence and compare them to that of their children. Adults talked about food shortage, both in terms of variety and quantity, and often cited that skipping meals was common during their childhood. Most of the focus was given on the availability and affordability of increased varieties of vegetables, fruits, animal source proteins and sweet options. However, interviews also highlighted a sense that some types of foods were no longer available.

*"Before, one meal would be there, another would not be there, it used to be like that – and [we went] to school like that only. Now there is no such deficit, how much ever hard it might be, for food there is not struggle." (IDI, Parent of older adolescent boy).*

*Now compared [to before], there is a lot more food. We're eating much more, sweetly, nicely" (IDIs, Parent of older adolescent boy).*

Opportunities and challenges to physical activity

Physical activity and mobility opportunities were heavily influenced by gender. Boys were more likely to participate in outdoor events and economic work. Girls' physical activity, on the other hand, was primarily domestic and agricultural work on family land.

*"My experience is that, as girls keep doing the cooking work – while we boys have food and go and roam around here and there. Boys have more freedom. But for girls, they will not have that freedom." (FGD, Older adolescent boy).*

[4] Wording included in the squared brackets are added by the authors to provide more context.

Parents fears for their daughters' safety and norms around good behaviour were among factors for restricting their outdoor physical activity opportunities. Parents would also articulate that lack of courage of girls would justify limited mobility. These narratives could often collide with adolescent's own voices, and girls would share a sense of uneven treatment compared to boys.

*"In our villages, if it is boys, they go around here and there. Now if the girls are going and coming, then they say "see how she is roaming around". Like that we shouldn't get a bad name, we should tell our girls to be disciplined, and keep them at home." (IDI, Parent of older adolescent girl).*

*"Now, if it will be the boys means, at whatever time they may go, they say – he is a boy, wherever, whenever, anywhere he can go and come." (IDI, Older adolescent girl).*

## 4. **Lessons from conducting research with adolescents**

The mixed-method study presented in this chapter is an adaptation of a methodology developed to study the rural livelihoods-nutrition-energy expenditure nexus among farmers in the global South (Zanello et al., 2017, 2020). Hence, various steps were taken to adapt the approach with adolescents in rural Telangana. Ethical and safeguarding protocols were developed following Santelli et al. (1995) and Brady and Graham (Brady & Graham, 2019) guidelines to conduct health and social research with children and young people. Conducting research with adolescent respondents represents a valuable opportunity in agri-health research as it enables to incorporate the experiences of a demographic group that was previously overlooked. This section present few core ethical and practical considerations applied during the preparation and execution of this study.

When conducting research with children and young people **no harm and providing benefits** is the key principle that shapes the study's lifecycle. The principle refers to the balance between the inclusion of children and young people's views and experiences while considering common risks of partaking to research activities (Brady & Graham, 2019). Inherent and unexpected risks should be anticipated, assessed and mitigated and distressing topics avoided or carefully planned. As well as benefitting society at large or improving policies, it is worth exploring what benefits participants may enjoy in return for providing time and data for research. Planning enjoyable activities while providing learning opportunities from research outputs, should be considered.

**Informed consent** addresses the questions of ensuring that young respondents fully appreciate the consequences of the research while assessing their ability to provide consent. The following principles should be integral to the design, planning and acquisition of informed consent (Brady & Graham, 2019; Santelli et al., 1995):

- *Working with gatekeepers* (people with parental responsibilities and/or work with minors) is common when conducting research with the under-age population. Their priority is to protect individuals under their responsibility and can have a better grasp of the commitment that the research would entail.
- *Autonomy* refers to the person's ability and rights to make their own decisions. Therefore, even if gatekeepers provide consent, the child's individual autonomy should remain intact and repeatedly checked. It is therefore important to use validated protocols to gain multiple level informed consents. Figure 5 illustrates the protocol used in this research. Treating consent as a live and ongoing dynamic is critical. For young respondents refusing consent may be expressed indirectly and/or non-verbally.
- *Capacity, age, cognitive ability* will determine whether a child or young adult is able to provide valid consent. To this end, technical jargon should be avoided, while information and consent processes should be accessible and age-appropriate.
- *Opt-out options* should be available and repeatedly reminded. This is valid also when data collection is terminated within a pre-defined timeframe.

Researchers need to anticipate and explore potential **confidentiality issues** and protect them together with **anonymity and privacy**. This refers to respondents as well as others impacted transversally by research activities. Confidentiality procedures should be explained at the beginning of each session, especially when running group discussions. Finally, **balancing safeguarding concerns with confidentiality** means that the welfare and safety of young respondents involved in the study override research interests. It is therefore best practice to anticipate and plan for safeguarding policies and providing training on how to use it to all involved in fieldwork.[5]

[5] Institutions working with under-age individuals will normally have pre-existing safeguarding procedures. Alternatively, the NSPCC provides guidance on writing adequate safeguarding policies (https://learning.nspcc.org.uk/safeguarding-child-protection/writing-a-safeguarding-policy-statement). This research was reviewed and approved by the Ethics Committee at the University of Reading and by the National Institute of Rural Development (India).

## 5. **Conclusions**

The cycle of sedentarization and nutrition transition unfolding in the Global South among adolescents is a complex and multifaceted process. The dominant narrative on rural areas is one that depicts daily and constant physical exertion in "traditional" livelihood activities and consumption of traditional diets. While these considerations are true, the transition of rural lifestyles and diets is ongoing in growing economies.

To help design and implement timely and comprehensive policies that address overweight and obesity among adolescents in rural contexts, conceptualizations, and practices on how to achieve sustainable diets will benefit from integrating considerations on sustainable lifestyles. Firstly, the concept of the sustainable diets in rural areas should be linked with: 1) the availability and access to nutritious foods; 2) environmentally sustainable food systems; 3) physically sustainable agricultural production in the absence of mechanization (for example, farmers will still require energy-dense foods if agricultural work continues to be physically demanding). Secondly, in the context of rapid societal transformation, the availability of unhealthy diets can be compounded by a decline in physical activity. Debates and interventions on how to render food systems more respectful of consumers and enhancing for ecosystems should go hand in hand with promoting inclusive built environments that encourage outdoors activities and safe access to recreational facilities for girls and boys of all ages.

We hope this chapter contributes to the conversation on extending the use of mixed-methods to holistically assess the quantity and quality of diets and physical activity when designing research and interventions to achieve production and consumption of sustainable diets. Structural transformations intersect with: i) social networks, parental guidance, school-based practices; and ii) historical and socio-economic factors, gender and age norms. In turn, these factors shape the interplay between food consumption and physical activity behaviours in youths. To understand these connections, context-specific and mixed-methods insights on food intakes and physical activity are central to inform the development of comprehensive interventions to address structural and environmental issues, as well as influences within households, schools and communities.

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## Appendix

**Table A: Full regressions of determinants of Physical Activity Level (PAL).**

<insert Table A here>

Notes: Regressions estimated at day/level. Sleeping and resting activities as baselines. Robust standard errors (in brackets) are clustered at individual level. ***Denotes statistical significance at the 1% level, ** at 5% level and * at 10% level. Source: work by authors