

Physical activity, time allocation, and food intake among adolescents from lower caste groups in rural Telangana, India

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Contents

1. Introduction	2
2. Role of caste on food intake, energy expenditure, and time use	5
3. Methodology	8
3.1 Study setting	8
3.2 Study design and methods	9
4. Policy landscape in support of households from backward and scheduled castes	13
4.1 Agriculture	13
4.2 Nutrition	17
4.3 Health	17
4.4 Education	18
5. Time use, physical activity, and food intakes	19
5.1 Caloric adequacy ratio across age and gender among adolescent of different caste groups	19
5.2 Energy and time allocation across scheduled and backward caste adolescent boys and girls	23
5.3 Endowment and allocation of time and energy across scheduled and backward caste boys and girls	25
6. Discussion	28
7. Conclusion	31
Acknowledgments	32
Appendix	32
References	36

Abstract

In India, caste continues to have a strong association with social class and it plays a visible and critical role in influencing societal, institutional, and household factors, which in turn affect adolescents' health and nutrition. This study examines intra- and inter-caste differences in physical activity, time use, and food intake among lower-caste adolescents in rural India and contextualizes the results within the local and national policy landscape. Using a mixed-methods design, the study integrates data from wearable activity trackers and key informant interviews to provide comprehensive insights into the lives of 400 rural adolescents in two rural districts in Telangana state. Results disentangle the relationship between lower castes and patterns of time use, physical activity, and calorie adequacy. We find that differences in energy intake and patterns of time use drive differences in the caloric adequacy ratio between castes, particularly among late-adolescent girls. Scheduled Caste (SC) adolescents spend more time and energy on educational activities, while Backward Caste (BC) adolescents spend more time on unpaid economic activities. Within castes, asset endowments appear to mitigate differences in time allocation and energy expenditure. These findings underscore the role of caste in defining pathways to health and nutrition and highlight the need for policy interventions that consider the occupational patterns, physical activity demands, and constraints on access and utilization of resources and infrastructure associated with caste.



1. Introduction

Despite significant progress made over the last decade, malnutrition remains pervasive with 690 million people chronically undernourished and around 2 billion experiencing food insecurity throughout the world (FAO et al., 2020). While both under-nutrition and over-nutrition among children under five and adults continue to receive much-needed attention, the international health and development agendas are more recently starting to align with the 2013 Lancet nutrition series call for an increased focus on adolescent nutrition (Bundy et al., 2018; Patton et al., 2016; World Health Organization, 2017). The focus on adolescents is built on the recognition that adolescence is a critical window of opportunity to recover from previous nutritional impairments (Pearson et al., 2009). Increasing evidence suggests that behavior and preferences related to nutritional habits and physical activity adopted during adolescence influence both present and future health and nutritional outcomes (Grygiel-Górniak et al., 2016; Patton et al., 2016; WHO, 2006). Investing in adolescents' health and well-being is also crucial for achieving the Sustainable Development Goals (SDGs). Healthy adolescents fuel high

socioeconomic returns by contributing to increased productivity, reducing health expenditure, and breaking the intergenerational transmission of poor health, poverty, and discrimination (Patton et al., 2016; Sheehan et al., 2017). This study aims to expand the current focus on adolescents' nutrition by looking at the interplay of physical activity and time use, two key dimensions that have been identified as research priorities in adolescent health (Nagata et al., 2016) but where evidence is sparse in Low- and Middle-Income Countries (LMICs) (Barbosa Filho et al., 2016; Vancampfort et al., 2019, 2018). In particular, empirical assessment of adolescents' physical activity appears to be limited to high-income countries (Allen et al., 2017; Guthold et al., 2020). We focus on rural India, where half of the 253 million adolescents are malnourished (Sethi et al., 2019; Singh and Swain, 2014), hampering development and human capital investment (Anthony, 2011; Mukherjee et al., 2020).

Adolescent health and nutrition are interrelated with social, cultural, and economic trajectories, including family, education, and labor participation (Madjdian et al., 2018; National Research Council, 2005). As a socially stratified axis of Indian society, caste has a profound influence in defining socio-economic opportunities for rural livelihoods (Deshpande, 2011; Dutta et al., 2020; Thorat and Neuman, 2012). The caste system in India is a closed social stratification where a person's social status is determined by their birth into a particular caste (Debnath et al., 2015). Some castes historically enjoyed privileges and power, while others were marginalized. In particular, in India the scheduled caste (SC) have been socially and economically disadvantaged for centuries and have been subjected to exploitation by upper castes. Members of SC have historically been treated as 'untouchables' and are positioned among the lowest-ranked sub-castes. Lower castes continue to face discrimination along multiple dimensions in accessing livelihood opportunities and public services such as schools, hospitals, nutrition feeding centers (Mamgain and Diwakar, 2012; Thorat and Neuman, 2012). The Constitution of India devised a framework for affirmative action to close the glaring gap between the different caste groups and to improve opportunities and outcomes for disadvantaged groups. Over the last 70 years after independence, the implementation of Affirmative Action (AA) programs has substantially improved social mobility for disadvantaged caste groups and the gaps (economic, education, employment, political) between caste groups have become narrower (Deshpande and Ramachandran, 2019). However, in rural areas caste remains an important determinant of livelihood opportunities and

socio-economic status. In fact, the sources of livelihood are primarily determined by the caste group into which the person is born or belongs to (Deshpande, 2001). At the same time, special educational opportunities and infrastructure intended for SC provided over several decades put some sections of them in an advantageous position over other disadvantaged castes, such as Backward Caste (BC). Members of BC are from low to middle-ranking, which are considered socially and economically 'backward'. Caste-based prejudice and discrimination hinder economic advancement for the lower castes (Sekhon, 2000). BC households are considered to be affected by backwardness based on social and economic disadvantages. Yet, BC caste and economic status have been closely associated, and therefore BC households may not be eligible for similar provisions as SC ones.

Caste has a direct link in determining households' endowments, occupation, parental characteristics, and access to resources, which in turn shape adolescents' opportunities and health. In particular, the nutritional and health status of adolescents is determined by their food intake and the physical activities required by the households' livelihoods and social norms. Some households may require adolescents to contribute to economic or domestic activities. By bringing together data on physical activity and energy expenditure (captured with research-grade accelerometer devices) with time use patterns and food intake, this work contributes to the literature, addressing the following research questions:

- What is the association of caste with patterns of food intake, energy expenditure, and time use of rural adolescents?
- What are the gender and age disparities in food intake, energy expenditure, and time use within and between lower caste groups?
- Do households' endowments mitigate or exacerbate differences within castes?

This study focuses on two rural districts in the Telangana state of India where agriculture is the primary economic activity for households. The study uses key informant interviews to map the policy landscape and contextualize the results within the policies and support available for lower castes in the area. The results and discussion of the study provide insight into the relationship between lower castes, their access to and utilization of resources, their asset endowments, patterns of time use, physical activity, and calorie adequacy.

2. Role of caste on food intake, energy expenditure, and time use

Caste plays a key role in determining adolescent nutrition and health through its association with socioeconomic endowments and opportunities, with an effect on physical activity, energy expenditure, time-use, and food intake (Fig. 1). While the literature on the direct role of caste on adolescent health and nutrition is scarce, there is a substantial body of literature that focuses on the influence of caste on household, institutional and societal factors that are linked to occupations, access to resources and infrastructure. These are the key factors in determining adolescents' opportunities and health status. Caste is still an important determinant of opportunities in life (Anderson, 2011; Gang et al., 2017) and there is a substantial body of literature that provides evidence for the persistence of caste disparities in different rural livelihoods dimensions (Borooah, 2005; Singh, 2011; Zacharias and Vakulabharanam, 2011). For instance, people belonging to SC are clustered in lower-paid work and manual labor, determining a caste-based differentiation in the labor market (Deen, 2020; Mehentar, 2018). The occupational structure differences account for a large

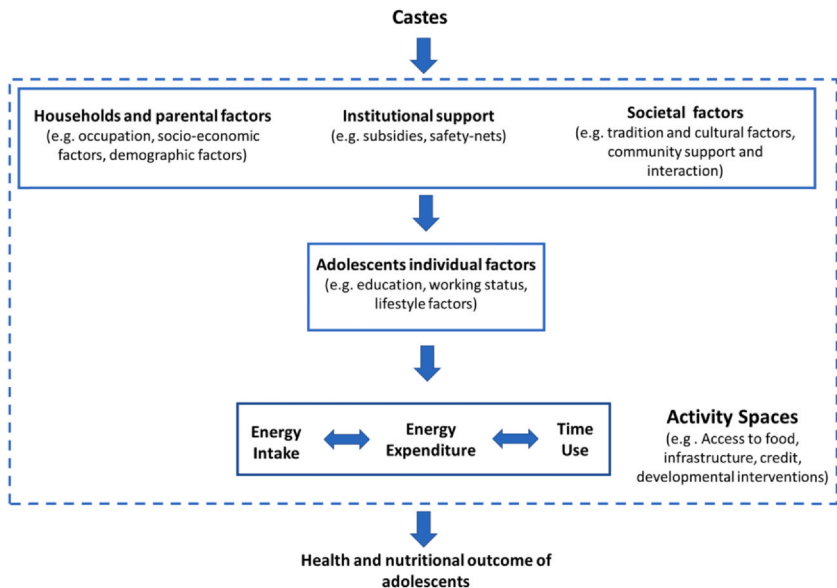


Fig. 1 Conceptual framework: Factors shaping the health and nutritional outcomes of adolescents.

proportion of poverty rates between lower castes and other caste groups (Deshpande, 2001; Gang et al., 2017; Thorat and Madheswaran, 2018), indicating the strong linkage between caste and occupation. A longitudinal study from 1983 to 2004 showed the direct effect of caste identity on occupational segregation over time and indirectly through other determinants (demographic characteristics of the household, education, and land ownership) of occupational choice (Gang et al., 2017).

Households belonging to different castes have inherently different activity spaces—the places within which people move or travel during their daily activities—which in turn determine different access to food, infrastructure, credit and developmental interventions and public services. Several scholars mention that caste is also crucial in determining households' welfare patterns and access to public services and resources (Dutta et al., 2015; Krishna et al., 2019; Van Landeghem and Vandeplass, 2018). However, occupational opportunities for castes may be constrained by the lack of access to educational and skill development opportunities and the inability to compete with better-endowed castes, in the context of the social legacy of discrimination. Recognizing the problems and historical differentiation of disadvantaged groups, over the years both the state and central governments in India have enacted large-scale supportive policies and programs for building their human capacities and capabilities (Marcus et al., 2016; Thorat, 2009). Particularly for SC, the Government has taken affirmative action for the promotion of educational and economic interest through measures such as reservation in educational institutions, building inclusive institutional policies and programs and prioritization in all government services.

Several studies have reported that health and nutritional statuses among adolescents are significantly associated with various dimensions of socio-economic status and resources, parental characteristics, occupation, household pattern, and size (Kumar et al., 2021; Tigga et al., 2015; Venkaiah et al., 2002). Differences in adolescents' nutritional status have been mainly attributed to cultural dietary patterns and socio-economic conditions that vary with caste groups (Madjdian et al., 2018; Mengesha et al., 2020). For example, stunting is more prevalent in adolescents from SC households that are deprived of asset ownership and access to resources (Kumar et al., 2021; Pal et al., 2017), as well as being more vulnerable to nutritional inadequacies (NFHS, 2017).

Energy intake patterns in relation to energy requirements are an essential element in understanding adolescents' nutrition and health.

Multiple factors influence adolescents' food and activity choices (Barker et al., 2020; Story et al., 2002). Caste has a significant impact on the social and environmental contexts that adolescents find themselves in, including their community, family, occupation, and school. Additionally, caste plays a role in defining adolescents' education, psychosocial, behavioral, and lifestyle factors, which in turn influence the different activity spaces they have access to. The physical activity levels of adolescents are linked to their parents' occupation, which is strongly associated with caste. This means that caste influences the patterns of adolescent physical activity, with different occupations being associated with different castes. Furthermore, adolescent energy expenditure is also linked to the activity spaces they have access to. These activity spaces are determined by a combination of household and parental, institutional, societal, and adolescent individual factors that are influenced by caste, education, and financial means. These factors shape their parents' or family background or the community they grew up in.

The concept of activity space is represented in Fig. 1. Activity space is the environment in which adolescents are situated. It encompasses the physical locations, settings, and contexts where adolescents conduct various routine activities, including places of residence, work, school, socializing, shopping, and leisure activities. These activity spaces, which are available within the parental, institutional, and societal contexts, have a significant impact on adolescents' health and nutritional outcomes. Studying the energy expenditure profiles of adolescents can provide a better understanding of the role of caste in determining health and nutritional outcomes for individuals.

The conceptual framework underscores the role of caste in shaping adolescent nutrition and health outcomes, encompassing factors such as socioeconomic opportunities, physical activity, energy expenditure, time-use, and food intake. This aligns with the UNICEF conceptual framework on maternal and child nutrition (UNICEF, 2021), which recognizes social determinants as crucial in influencing health and nutritional outcomes. The framework emphasizes the need to address underlying determinants, including socioeconomic status, resource access, and social and environmental contexts. Caste acts as a determinant impacting opportunities and resource access for adolescents, influencing their health and nutrition outcomes. Moreover, the framework emphasizes the importance of creating an enabling environment and implementing supportive policies and programs to address disparities and enhance the capacities of

marginalized groups, aligning with the impact of caste on households' welfare patterns, access to resources, and educational constraints. The interconnectedness of caste with cultural, socioeconomic, and environmental factors is also acknowledged, in line with the UNICEF framework's understanding of diverse influences on nutrition outcomes. The concept of activity space, which considers the broader social and environmental contexts affecting health and nutrition, acknowledges the influence of caste on adolescents' access to food, infrastructure, and developmental interventions. Recognizing the intersectionality between caste and adolescent nutrition, the conceptual framework aligns with the UNICEF framework's multi-sectoral approach to address disparities and improve maternal and child nutrition outcomes.



3. Methodology

3.1 Study setting

The study was conducted in Khammam and Mahbubnagar districts located in the Telangana State's central and south agro-climatic zones (Fig. A1 in Appendix). These zones are characterized by red soil tracks and predominantly rainfed agriculture. About 80% of the study district's population lives in rural areas, and close to 75% of the population depends on agriculture, with a predominance of small and marginal landholders (Agriculture Census, 2016). The principal crops grown in the districts include paddy, cotton, maize, chilli, groundnut, mung beans and sorghum, and pulses. The study districts are endowed with rich animal husbandry resources (dairy, poultry, sheep rearing, and piggery). These resources play a critical role in improving rural livelihoods, particularly for small and marginal farmers and agricultural laborers. Additionally, these livelihood activities supplement the diet of people with protein-rich milk, eggs, and meat.

In the study sites, agrarian society remains fragmented along caste boundaries, which profoundly influences assets ownership, access to resources, and livelihoods. As in most parts of India, the pattern of household landholding is often based on the caste hierarchy. In Khammam and Mahbubnagar districts, most households are part of the BC, 44%, and 60% respectively. However, this category is not homogenous. There are at least five subcategories among the BC, and these categories differ in terms of the percentage of reservation afforded to them in government recruitments, mainly based on their traditional occupation and income. A longitudinal

analysis from 1956 to 2014 showed that landownership in Telangana state (including the study sites) shifted over the period from upper caste to BC (Prasad, 2015). Similarly in the study sites, ownership of the land is largely in the hands of BC households. However, the average landholding size of these households is small at 1.37 ha which is somewhat higher than the average landholding size of the State of 1.02 ha (CESS, 2019). Due to the very nature of farming and the economic necessity, children of BC households often work on the family land, and undertake farm-related work as helping hands to their parents even from early childhood. Nonetheless, BC households are often excluded from rural development programs (Deshpande, 2011) in the context of prioritization of limited resources to other disadvantaged groups such as households from a SC background. SC are at bottom of the social hierarchy, have smaller landholdings than other caste groups or are landless and constitute 22% and 16% of the Khammam and Mahbubnagar districts' population respectively. Historically, most of the people in the SC category earn their livelihood either through agricultural labor or working in public programs, such as the Mahatma Gandhi National Rural Employment Guarantee Act (known as MNREGA), the biggest wage employment program in rural India. Children of these households generally cannot participate in such wage employment programs or any other wage labor activities because of child labor laws.

3.2 Study design and methods

This study integrates qualitative and quantitative research methods. To better understand the local policy support for SC and BC households, we conducted a series of Key Informant Interviews (KIIs). These insights were used to provide context for the quantitative data collected from 400 adolescents on their physical activity levels (through the use of accelerometers) and time use and food intake (through surveys). The data was gathered using a combination of accelerometers devices and surveys. The study design and data collection for this study were approved by the Ethical Committee at the University of Reading (1113D) and the National Institute of Rural Development and Panchayati Raj.

3.2.1 Qualitative approach

In September 2021 we conducted six Key Informant Interviews (KIIs) using the WebEx platform and phone (following the prevalent Covid protocol at the time) from a sample of policymakers, community organizers, government officials, and researchers from both study districts. The

primary objective of the KIIs was to gain insights into decision-makers' experiences, opinions, and perspectives on caste-based policies. Additionally, we collected comprehensive information on the eligibility criteria, factual access, and utilization of support services for different caste groups in the districts in order to understand the realities faced by SC and BC households in the study sites. The key informants were interviewed using an open-ended, semi-structured questionnaire, and we obtained consent before recording their responses for transcription and analysis. We selected the interviewees through personal networks and snowball sampling methods, mainly consisting of development functionaries and community mobilizers.

All interviews were transcribed. A researcher who was familiar with the context of the study districts then read through and analyzed the transcripts using a combined deductive and inductive approach. The inductive approach helped to identify emerging themes from the transcripts, while the deductive approach focused on pre-identified themes related to the study questions. All transcript data were manually coded, organized into categories, and analyzed. The themes that emerged from the analysis mostly dealt with programs related to agriculture, nutrition, health, and education. Specifically, the themes addressed issues related to the accessibility of these programs, policy gaps, bias and discrimination, knowledge of educational and nutritional programs, as well as understanding of caste-based specific programs and services. To capture the reflective knowledge, opinion, and perception of the interviewees regarding the caste-based policy landscape of the study districts, we distilled information about eligibility, access, and utilization of support services for different caste groups into a tabular form. The aim of this analysis was to gather insights into the potential direct and indirect impacts of existing policies on adolescent nutrition and physical activities, as well as to contextualize the results from the survey.

3.2.2 Quantitative approach

The empirical analysis is based on individual and household data from 400 adolescents (347 households). The sample was stratified to provide equal representations of boys and girls within age groups [early adolescence (10–14 years) and late adolescence (15–19 years)], caste, and geographical area (Khammam and Mahbubnagar districts). The data were collected from October 2019 to March 2020. We followed (Zanella et al., 2020) to combine three main data streams: a household and individual questionnaire, a daily individual questionnaire on time-use and food consumption, and data from accelerometer devices to capture energy expenditure.

3.2.2.1 Household, individual and daily questionnaires

The household questionnaire was administered to the parents/carers of the household at the start of the study. The questions included demographic information, dwelling characteristics, employment and labor force activities, land and agriculture, livestock, assets ownership, decision-making in the household, and food consumption. On the first day of the data collection, a detailed questionnaire was also administered to collect information on anthropometrics, demographic and schooling information, employment, and health of the respondent adolescents. Finally, an individual daily questionnaire was administered to each adolescent for five consecutive days while they were invited to wear an accelerometer. The questions elicited 24-hour food intake recall (Gibson and Ferguson, 2008) and 24-hour time-use (Chatzitheochari et al., 2015).

3.2.2.2 Accelerometers data

The selected adolescents were invited to wear an accelerometer device for five consecutive days to capture energy expenditure. Adolescents were instructed to wear the accelerometer devices using an elastic belt around the waist at all times, except during sleep at night or bathing. We deployed ActiGraph WGT3X-BT, a tri-axial research-grade accelerometer that provides the end-user with raw data on movement and has been used in multiple studies involving free-living humans including adolescents (Keino et al., 2014; Pawlowski et al., 2016; Robusto and Trost, 2012; Santos-Lozano et al., 2013). The downloaded raw movement data from the accelerometers at the end of the fifth day was initially compressed into 3-second epochs and then to half-hour intervals to match the time-use data interval. Using validated algorithms for adolescents (Santos-Lozano et al., 2013; Sasaki et al., 2011), the movement data were converted into energy expenditure (kilocalories).

3.2.2.3 Data collection protocol

Before proceeding to data collection, field enumerators were trained for a week on the survey, data collection, and ethical considerations around the participants. The questionnaires were coded in Kobo Toolbox and administered in tablets in Telugu, the local language in the area. Before sampling, we organized village meetings to brief the local population about the overview of the study. The parents/guardians of eligible adolescents

were invited to the meeting and obtained parents' informed consent for their children to participate in the survey (these were read to them if they could not read). Later, enumerators showed the accelerometers to adolescents and invited them to wear the devices.

At the beginning of the data collection, household questionnaires were administered to the parents or carers of the participant adolescents. The adolescents were then taking part to the study for 6 consecutive days. On the first day of the survey, the individual questionnaire was administered and the accelerometers given to the participants. For the following 6 days, the daily survey was administered every day around 6 pm (before the last meal of the day and after any other activity the adolescents were involved in). The time for the survey was agreed based on the livelihood patterns of the households in the study area. Throughout the survey, field coordinators made frequent site visits to monitor data collection and the local principal investigators conducted weekly debriefing sessions to identify and resolve challenges.

3.2.2.4 Data analysis

The final dataset includes data from 380 individuals (330 households) for a total of 1730 participants/day. Twenty adolescents (4.5%) were excluded as they were from different castes than BC or SC. We also excluded nine per cent of participants/day due to low compliance, i.e., the accelerometers data for a participant had in a day more than 3 h gaps during awake time (6 am to 9 pm), and 0.7% daily observation in which the food intake data were implausible. We used descriptive and inferential statistical techniques to highlight trends and patterns in the physical activity of adolescents among different age groups and castes. The data were processed using Stata 16 and we present three sets of results. Following sample descriptions and statistical test (independent samples t-test) to capture significant differences between SC and BC households, we use kernel density estimation and a Kolmogorov–Smirnov test for equality of distributions to capture differences across castes and sex in the Calorie Adequacy Ratio (CAR), the proportion of energy expenditure over the food intake (in calories). To calculate the calorie intake, we converted the data from the daily 24-hour recall food intake surveys into calorie intake values using food composition tables specifically designed for India (Longvah et al., 2017). Finally, we matched the accelerometer data with the time use data to test significant differences across castes in the proportions of time and energy spent in activities, by sex and age groups (t-tests) and wealth (ANOVA). The

original forty-three pre-compiled time use activities were grouped into eight macro-activities (wellbeing, education, economic activities, domestic, work, leisure activities, travel, and others) and fifteen micro-activities. Wealth is captured through the construction of a wealth index based on the ownership of a set of assets and dwelling characteristics and built using a principal components analysis as described in (Rutstein and Johnson, 2004).



4. Policy landscape in support of households from backward and scheduled castes

Insights from the KIIs draw a map of the policy landscape in support of the local BC and SC households. Over the past few decades, there has been an increase in institutional support for households belonging to SC and BC through various policies and programs related to agriculture, nutrition, health, education, and other welfare schemes. Eligibility for these programs varies based on caste-based reservations, quotas, and household economic status. Table 1 distills the access and utilization of support programs in the study districts, by different caste groups. The access to schemes and programs depends upon the outreach and awareness and knowledge of the beneficiaries of the programs. The utilization/coverage of the programs varies depending upon the socio-economic conditions and ownership of resources of the households. After becoming eligible and receiving equal access, BC beneficiaries tend to use agricultural programs more frequently than SC beneficiaries because of greater ownership of resources and have greater access to education and information. In contrast, SC households utilize nutrition, education and health programs more frequently because of their socio-economic status and due to quotas based on population size in that particular site. BC households tend to benefit more from the health-related programs, particularly the Aarogyasri program, as a result of increased knowledge of the program.

4.1 Agriculture

Several initiatives and schemes aimed at supporting smallholder agricultural activities are in place in the study districts. The schemes/programs sought to promote sustainable agriculture practices, increased crop yields, and improved farmer livelihoods. The eligibility for such schemes is based on land ownership and primarily focused on small and marginal farmers. Some of the key common agriculture-related programs implemented across caste

Table 1 Support programs/schemes for scheduled and backward caste in the study area.

Schemes/programs	Access	Utilization/coverage
<i>Agriculture</i>		
Rythu Bandhu ^a	Equal access and opportunity	BC households benefit more due to land ownership compared to SC households.
Rythu Bima ^b	Equal access and opportunity	BC households benefit more due to land ownership. They are better informed on insurance benefits.
Rythu Vedika ^c	Equal access and opportunity	BC households have greater exposure due to political contacts at village level and major land owning group.
Farm Mechanization	Equal access and opportunity	SC households benefit relatively more due to higher subsidy rate.
Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)	Equal access and opportunity	BC households benefit more in terms of water accessing and watershed components. However, SC households has higher subsidy rate for micro-irrigation.
Soil Health Card Scheme (SHC)	Equal access and opportunity	BC households benefit more due to more land owning and better access of information about benefits.
Paramparagath krishi Vikas Yojana (PKVY),	Both castes have limited access	Coverage in both communities is limited.
Extension supports and capacity building	Both castes have limited access	BC benefit more due to better education.

Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS)	Equal opportunity	Both SC and BC benefit. BC households are covered more due to population and effective use in their own land development.
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Nutrition

Kishori Balika scheme	Equal access and opportunity	SC households have greater utilization due to socio-economic conditions.
Balamrutham	Equal access	Depending on population size within village, households varies.
Integrated Child Development Services (ICDS) scheme	Equal access	SC households have greater utilization compared to BC ones. Depending on population size with in village, households' coverage varied.
Mid-day meal programs	Equal opportunity	SC utilization is greater. Depending on school enrollment, coverage varies.

Health

Aarogyasri	Equal opportunity	Utilization is greater for BC households due to better information about the scheme.
K. Chandrashekar Rao Nutrition Kit	Equal opportunity	Utilization is similar for both SC and BC households.

Education

Pre-Matric Scholarships	Both are accessing (based on reservation rate)	Depending on information access and school enrollment. Coverage varies year to year.
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(continued)

Table 1 Support programs/schemes for scheduled and backward caste in the study area. (*cont'd*)

Schemes/programs	Access	Utilization/coverage
Post Matric Scholarships	Both are accessing (based on reservation rate)	Depending on information access and school enrollment. Coverage varies year to year.
Pre-Matric hostels	Equal access and opportunity	SC households benefit more due to better coverage by the number of hostels.
Overseas Scholarship Scheme	Equal access and opportunity	BC households benefit more due to high level aspirations and better household income.
Residential Schools	Both are accessing	SC households benefit more to better coverage by the number of residential schools.
Regular government schools	Equal access and opportunity	Similar benefits for SC and BC households. Cover for BC households is higher due to population size and high enrollment.
Coaching and entrepreneurship development programs	Equal access and opportunity	BC households have more coverage due to high aspirations and more accessing information
Skill Development & Motivation programs	Equal opportunity	BC households benefit more.

Source: Own analysis.

^aAgriculture Investment Support Scheme.

^bFarmers Group Life Insurance Scheme.

^cCreated cluster wise platform for farmers to address their problems and also to get higher returns for their produce.

groups in the study districts include Rythu Bandhu (Agriculture Investment Support Scheme), Rythu Bima (Farmers Group Life Insurance Scheme), Rythu Vedika, Farm Mechanization, Pradhan Mantri Krishi Sinchayee Yojana (Agriculture Irrigation scheme), Soil Health Card Scheme, Paramparagath Krishi Vikas Yojana, extension support, and capacity building programs. These schemes and programs play a crucial role in increasing agricultural productivity, improving the livelihoods of farmers, and contributing to the overall economic growth of the state. Due to the fact that concerns relating to agricultural development and farmers' welfare affect people from all castes and communities, SC and BC households are given equal access to and opportunities under the majority of these agricultural programs (Table 1). However, anecdotal evidence suggests that BC households benefit more than SC ones as a result of land ownership and access to information.

4.2 Nutrition

Mid-day meal programs, Kishori Balika scheme (providing food provision in the form of take-home rations to school-going adolescent girls), Balamrutham (nutritional mix for infants), and the Integrated Child Development Services (ICDS) scheme are among the nutrition-related initiatives that are put into place to address the nutritional needs of the population in the study area, particularly targeting women and children based on their socio-economic status. Although SC and BC households have equal access in the study area, utilization depends on the socio-economic conditions of the households. For example, the ICDS program, which is a government-run program that provides a package of services to pregnant and lactating mothers as well as children under six years of age, targets vulnerable populations such as SCs and BCs but SC households have greater utilization compared to BC ones.

4.3 Health

To improve the health and well-being of the people in the study area, the Telangana government implemented the Aarogyasri and K. Chandrashekar Rao Nutrition Kit (KCR kit) programs in the health sector. Aarogyasri is a Community Health Insurance flagship program, striving to provide high quality health care to the poor. Additionally, the program offers financial protection up to Rs two lakhs (~\$2500) in a year to the families living below the poverty level for the treatment of major illnesses that call for hospitalization and surgery. The KCR kit, on the other hand provides

essential items to pregnant and lactating women to ensure that they receive adequate nutrition and healthcare during and after childbirth. All sections of society, especially poor and marginalized, are to receive accessible and cheap healthcare as a result of health initiatives. Access and utilization of KCR kit was similar for both SC and BCs. Whereas, in case of Aarogyasri schemes, BCs' utilization was higher than that of SCs due to the better information.

4.4 Education

In addition to the Right to Education Act of India where all children aged between 6 and 14 years are eligible for free and compulsory education in government schools, the law requires 25% reservation quotas in government-aided and private schools for children from marginalized communities (10% for SC and 6% for BC) ([Telangana State Government, 2009](#)). SC and BC have also a reservation of 70% and 9% in the Pre-Matric Hostel facilities (free lodging, boarding, books, and four pairs of dresses) and pre-Matric scholarships based on parental income to ensure continued education. Out of the 268 residential schools run by the Telangana State's Social Welfare Residential, Educational Institutions Society, SC and BC have a 75% and 12% reservation quota respectively ([TSWREIS, 2020](#)). To curb the high dropout rate and bring sustainability in education, Telangana State also runs a series of programs separately for SC and BC aimed at facilitating the employability of the students through respective corporations. For example, coaching and training programs are organized for state services, Overseas Scholarship Schemes, banking, and other examinations for SC and BC with a reservation quota of 75% and 15% respectively ([Government of Telangana, 2018](#)). Further, residential skill development and entrepreneurship development activities training programs are implemented to enable them to take self-employment and to generate income. In addition to state-level programs, there are also local initiatives in place to support lower caste adolescents. For instance, the Kasturba Gandhi Balika Vidyalaya (KGBV) Scheme runs residential schools for the empowerment of dropout adolescent girls belonging predominantly to the SC, Scheduled Tribes, and minority communities. The Rajiv Gandhi Scheme for Empowerment of Adolescent Girls (known as SABLA) provides a supportive environment for self-development. Access to and utilization of education related schemes in both SC and BC beneficiaries produced mixed results, depending on information access, reservations quotas and school enrollment. Educational schemes coverage also varies based on the

number of hostels of residential schools and access to information regarding the scholarships. Nonetheless, due to high aspirations, networks and access to information, BC households benefit more than SCs from overseas scholarships and entrepreneurship and skill development programs.



5. Time use, physical activity, and food intakes

Table 2 presents the household demographic and socio-economic characteristics of the sample by caste. Households are nuclear in nature, with on average four members. The heads of the BC households tend to be older and less educated on average than the heads of SC households. Average land ownership among BC households was significantly higher at 1.37 ha versus 0.67 ha for SC households. The results show the higher involvement of BC households in agriculture, which is attributed to their historical access and ownership of land. Such differences are also reflected in their occupation patterns, where SC households depend on wage labor (40%) in contrast to BC households whose dependence is predominantly on family agriculture (41%). While we do not observe any significant difference in the ownership of livestock, the wealth index based on the ownership of a set of assets (Rutstein and Johnson, 2004) was significantly higher for BC households, indicating higher economic status.

Table 3 shows key anthropometric characteristics of the adolescents, by caste, age group, and sex. Statistics show a higher energy intake for SC adolescents compared to BC ones. In particular, energy intake is greater by 10% for SC early and late adolescent girls than BC. While there is no significant difference in activity energy expenditure across castes, BC households' total energy expenditure far exceeds that of SC across gender and age groups. Physical activity levels (PAL), a weighted indicator of physical activity that is computed by dividing total energy expenditure (TEE) by basal metabolic rate (BMR), is similar across age groups and gender, except for late adolescent boys where BC adolescents are more active than SC ones.

5.1 Caloric adequacy ratio across age and gender among adolescent of different caste groups

Fig. 2 depicts the distribution of Caloric Adequacy Ratios (CAR) among early and late adolescent boys and girls in both BC and SC. CAR represents the ratio of energy intake to energy expenditure and is a crucial indicator of

Table 2 Descriptive statistics of households, by caste.

	Schedule caste (SC)		Backward caste (BC)		Difference t-test
	Mean	SD	Mean	SD	
Head of the household age (years)	43.43	8.54	46.47	11.91	-3.03***
Head of the household education (years)	7.30	5.67	5.91	5.50	1.39**
Household size (# of members)	4.17	1.06	4.49	1.39	-0.31**
Quantity of total land (ha)	0.67	1.23	1.37	1.96	-0.69***
Quantity of leased in land (ha)	0.02	0.16	0.04	0.24	-0.01
Quantity of leased out land (ha)	0.03	0.14	0.03	0.21	-0.01
Net cultivated area (ha)	0.18	0.45	0.45	0.82	-0.27***
Tropical livestock unit (TLU)	0.39	1.38	0.50	1.33	-0.11
Wealth Index (based on assets ownership)	-0.37	2.30	0.53	2.42	-0.91***
Observations	151 (46%)		179 (54%)		

Notes: The tropical livestock unit (TLU) is a standard measure used to compare and express the livestock holding of households in tropical regions. Asterisks show level of significance *** = significant at 0.1% level, ** = significant at 1% level and * = significant at 5% level.
Source: Own analysis.

Table 3 Descriptive statistics of individual respondents by caste, age group, and sex.

	Boys						Girls					
	Early adolescent (10–14 years)			Late adolescent (15–19 years)			Early adolescent (10–14 years)			Late adolescent (15–19 years)		
	SC	BC	t-test	SC	BC	t-test	SC	BC	t-test	SC	BC	t-test
<i>Individual characteristics</i>												
Height (in cm)	145.72	147.38	-1.66	164.39	164.00	0.39	146.24	145.67	0.57	152.94	154.89	-1.95**
Weight (in kg)	33.39	35.44	-2.05*	48.89	49.46	-0.57	36.11	34.09	2.02**	42.75	44.80	-2.05**
Body Mass Index (BMI)	15.65	16.08	-0.43	18.13	18.34	-0.21	16.84	16.00	0.85**	18.33	18.66	-0.34
<i>Daily energy consumption and intake</i>												
Basal Metabolic rate (BMR)	1177.51	1218.60	-41.09*	1488.66	1500.12	-11.46	1110.96	1088.24	22.72**	1185.51	1208.54	-23.03**
Activity energy expenditure (AEE)	485.45	480.73	4.72	403.65	454.23	-50.58**	395.77	393.37	2.39	334.43	355.52	-21.09
Total energy expenditure (TEE)	1662.95	1699.32	-36.37	1892.31	1954.35	-62.04**	1506.73	1481.61	25.11	1519.95	1564.07	-44.12**
Food intake (kcal)	1623.03	1567.02	56.01	1718.28	1700.04	18.24	1548.81	1388.54	160.27**	1577.20	1416.46	160.73**
Physical activity level (PAL)	1.42	1.40	-0.02	1.27	1.31	0.04**	1.36	1.36	0.01	1.29	1.29	0.01

(continued)

Table 3 Descriptive statistics of individual respondents by caste, age group, and sex. (*cont'd*)

	Boys						Girls					
	Early adolescent (10–14 years)			Late adolescent (15–19 years)			Early adolescent (10–14 years)		Late adolescent (15–19 years)			
	SC	BC	t-test	SC	BC	t-test	SC	BC	t-test	BC	t-test	
<i>Compliance with accelerometer wear</i>												
Avg. number of days per participant ^a	4.64	4.84	-0.20***	4.47	4.75	-0.27***	4.81	4.83	-0.01	4.48	4.81	-0.32***
Total number of days ^b	164	213		211	247		191	227		191	255	
Observations	169	215		217	252		193	230		197	257	

Notes: The basal metabolic rate (BMR) is the amount of energy or calories required by the body at rest to maintain vital functions and represents the minimum amount of energy needed by the body to sustain life. The activity energy expenditure (AEE) refers to the energy or calories expended by the body during physical activity, such as exercise, work, or leisure activities and includes both the energy required for movement and the energy needed to maintain body posture during activity. The total energy expenditure (TEE) is the total amount of energy or calories expended by the body in a day, adding BMR and AEE. The physical activity levels (PAL) is calculated by dividing a person's total energy expenditure (TEE) by their basal metabolic rate (BMR). BC, backward caste; SC, schedule caste. Asterisks show level of significance *** = significant at 0.1% level, ** = significant at 1% level and * = significant at 5% level.

Source: Own analysis.

^aAverage number of days with valid data (non-wearing time less than 3 h throughout the day) out of the five days of the survey.

^bTotal number of distinct day-level observations (individuals × valid days surveyed).

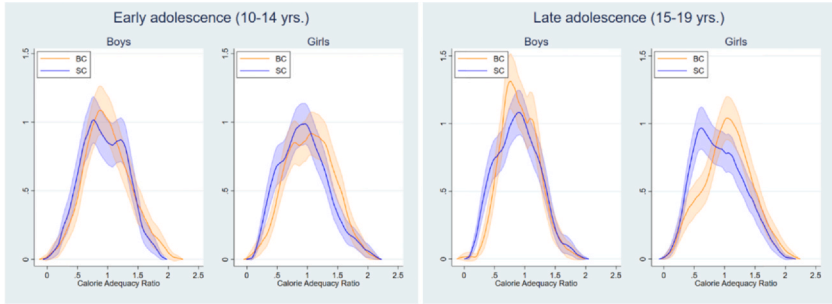


Fig. 2 Caloric adequacy ratio (energy intake/energy expenditure) among early (left) and late (right) adolescents, by sex and caste [backward caste (BC) in orange and schedule caste (SC) in blue]. *Notes:* BC, backward caste (in orange); SC, schedule caste (in blue). 95% confidence intervals computed over 1000 bootstrapped repetitions. Two-sample Kolmogorov–Smirnov test for equality of distribution: Early-adolescence boys ($p = 0.396$), early-adolescence girls ($p = 0.103$); late-adolescence boys ($p = 0.017$); late-adolescence girls ($p = 0.000$).

adolescents' overall health, nutritional status, and well-being. A sustained CAR less than 1 indicates that the population is not consuming enough calories to meet their energy requirements, which can lead to malnutrition and stunted growth. However, a sustained CAR greater than 1 can lead to overweight. In the two-sample Kolmogorov–Smirnov test for equality of distribution, the results reveal that calorie adequacy ratios are significantly different across castes for late adolescent boys and girls. The summary statistics help identify possible drivers of these differences. Specifically, the findings suggest that SC boys and girls tend to have significantly lower calorie intakes than their BC counterparts. However, it is worth noting that the similar BMI across castes and adolescents may indicate that the differences observed are only seasonal and specific to the time of data collection.

5.2 Energy and time allocation across scheduled and backward caste adolescent boys and girls

The proportions of time and energy spent by adolescents from BC and SC households on different macro-activities are shown in Fig. 3A. A more granular analysis with micro-activities is included in Table A1 in the Appendix. The zero line represents the point where differences in time and

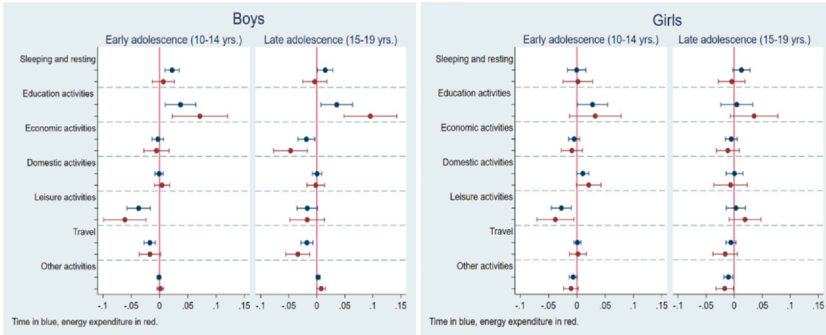


Fig. 3 Difference (SC–BC) in the proportion of time (in blue) and energy expenditure (in red) spent on different activities, by sex and age. Note: Proportion (BC over SC) of time in blue and energy expenditure in red color. Early adolescence includes adolescents between 10 and 14 years old, while late adolescence between 15 and 19 years old. Full breakdown of micro-activities is reported in Table A1 in the Appendix. Horizontal axis shows significance at 95% confidence intervals.

energy expended on any given activity between the two castes are not statistically significant than zero. We found significant differences in education, economic, leisure, and travel activities between the two castes.

SC early and late adolescent boys spent a higher proportion of time and energy on educational activities, about 5% more than BC boys. This suggests that SC adolescents have higher utilization of programs and policies aimed at improving their education, which was also confirmed in our qualitative interviews. BC early and late adolescent boys spent a higher proportion of their time and energy on economic, leisure, and travel activities, with a particular focus on unpaid economic activities like family labor. This reflects the stronger connection between occupational patterns, asset ownership, and the energy expenditure of households from a BC background.

We did not observe any significant differences for females except in education and leisure activities during early adolescence. However, from the activity patterns, we observed that BC girls are involved in unpaid economic activities. Overall, these findings provide insights into the different time and energy allocation patterns between BC and SC adolescents, and highlight the importance of targeted policies and programs that support education and economic activities for both castes.

5.3 Endowment and allocation of time and energy across scheduled and backward caste boys and girls

Castes are fixed constructs and caste affiliations do not change during people's lifetime. Table 4 presents a detailed analysis of how wealth differences affect the allocation of time and energy among adolescents from different households, revealing whether the differences within castes can be mitigated or exacerbated by the households' endowments. The results show that the differences in wealth have an effect on the allocation of time and energy on different activities among adolescents of BC households. For instance, late adolescent boys of wealthier BC households are allocating five per cent more time and spending 11 per cent more energy in economic activities compared to late adolescent boys in BC class from the lower wealth households. Similarly, late-adolescent girls who belong to wealthier BC households allocate more time and energy to economic activities compared to lower wealth BC households. These results suggest that opportunities for participation in economic work for adolescents in BC households are dependent on the wealth endowment of the household. Results also revealed similar wealth effects in education activities among the adolescents of BC households. Early and late adolescent boys of lower wealth BC households spend more energy (13% and 15% respectively) and allocate more time (5% and 7% respectively) on educational activities compared to wealthier BC adolescent boys. However, we do not observe any effect of wealth in the allocation of time and energy on economic and educational activities of adolescent boys and girls in the SC category except early adolescent groups in economic activities.

The results showed that the effect of wealth on domestic activities was more significant among late-adolescent girls in BC households, who spent 9% more energy and allocated 5% more time to domestic tasks than their counterparts from lower-wealth BC households. Conversely, late-adolescent girls from lower-wealth BC households spent 6% more energy on domestic activities than those from wealthier BC households. Regarding leisure and travel activities, wealth had a mixed effect. Findings suggest that adolescent boys from wealthier BC and SC households tend to spend more time on leisure activities than those from less wealthy households, and early and late adolescent boys in the wealthier group dedicate more time to travel activities, with the exception of early adolescent SC boys. Wealthier early and late adolescent boys in BC households allocated 3%

Table 4 Difference between the top and bottom wealth in the proportion of time and energy expenditure spent on different activities, by sex, age and wealth.

	Boys						Girls					
	Early adolescence			Late adolescence			Early adolescence			Late adolescence		
	SC	BC	SC	BC	SC	BC	SC	BC	SC	BC	SC	BC
Education												
Time	-0.033	-0.051**	-0.033	-0.078***	-0.025	-0.025	0.018	-0.011				
EE	-0.072	-0.132***	-0.068	-0.154***	-0.074	-0.096***	-0.032	-0.084***				
Economic												
Time	0.022*	0.025**	0.008	0.054***	0.023**	0.021*	0.004	0.029***				
EE	0.048**	0.049**	0.017	0.114***	0.043**	0.039*	0.009	0.053***				
Domestic												
Time	0.026***	0.008	0.031***	0.015	0.038***	0.044***	0.006	0.046***				
EE	0.043**	0.018	0.046***	0.025	0.061***	0.085***	0.003	0.092***				

Leisure								
Time	0.063***	0.033*	0.021	0.031*	0.001	-0.009	0.014	-0.024
EE	0.105***	0.037	0.005	0.016	-0.025	-0.038	0.005	-0.067***
Travel								
Time	-0.025***	0.033***	0.022***	0.029***	-0.019**	0.001	0.004	0.001
EE	-0.073***	0.029	0.039***	0.029	-0.029	-0.001	0.042**	0.029*

Notes: The table reports differences in the marginal effects of ANOVA, using Bonferroni corrections for multiple comparisons. Early adolescence includes adolescents between 10 and 14 years old, while late adolescence between 15 and 19 years old. SC refers to schedule caste and BC to backward caste. Energy expenditure (EE) is captured in kcal. *** = 1% significant, ** = 5% significant, * = 10% significant.

Source: Own analysis.

more time to leisure activities than boys from lower-wealth households, whereas adolescent boys from wealthier SC households spent 6% more time and 10% more energy on leisure activities than those from lower-wealth SC households. In terms of travel, early and late adolescent boys from wealthier BC households spent more time on travel activities than those from lower-wealth BC households. Late-adolescent boys from wealthier SC households also allocated 2% more time and spent 4% more energy on travel activities than their counterparts from lower-wealth SC households. However, early adolescent boys from lower-wealth SC households allocated 2% more time and spent 7% more energy on travel activities than those from wealthier SC households.



6. Discussion

Caste is a significant factor that affects various aspects of adolescents' health and nutrition, including household, institutional, and societal factors. This study focused on disentangling the influence of the caste system on the allocation of time and energy on different activities and the calorie adequacy of male and female adolescents belonging to BC and SC. Our findings indicate that the caste system plays a crucial role in shaping the opportunities available to adolescents. SC adolescents have higher CAR compared to BC adolescents. The disparity in calorie adequacy between the two castes can be attributed to several factors, with the utilization of supportive public policies playing a crucial role. SC adolescents had better coverage and more comprehensive utilization of public policies, which had a significant impact on their overall health and nutrition.

Qualitative interviews revealed that SC adolescents tend to make better use of education-related policies compared to BC adolescents. This is due to differences in the level of reservations, scholarships, and quotas for SC adolescents in educational programs in the study area. However, BC households tend to utilize agriculture-related policies more frequently, which may influence the energy expenditure of BC adolescents. Economic necessity may be driving BC adolescents to participate in agricultural operations in addition to their household chores. This reflects the greater linkage of occupational patterns and differential endowments in defining the energy expenditure of BC households. Nutritional programs that are

part of educational programs in the study districts, such as mid-day meals, residential schools, and hostels, are more frequently utilized by SC adolescents, resulting in increased energy intake as reflected in their kcal per day food intake. This finding highlights the role of educational policies in promoting adolescent nutrition and underscores the need for targeted interventions to address the differential utilization of policies among different caste groups.

The disposable income of SC adolescent parents may have a positive role in promoting higher CAR. Despite not having any land, SC households are involved in wage labor operations that provide them with regular disposable income, which they can use for food. Furthermore, during school time, SC adolescents reside in school, which reduces the financial burden on their households. In contrast, BC households rely mainly on agricultural operations for their livelihood, which generates seasonal income, affecting their cash flow. The involvement of BC adolescents in agricultural activities, in addition to household chores, might influence their energy expenditure more than calorie intake, which in turn affects their CAR.

Unpaid economic activities in which the boys of both early and late adolescent groups and girls of late adolescent groups of BC households participate are not translating into calorie adequacy, as reflected in their CAR. This could be due to various factors, such as poor dietary habits or insufficient access to nutritional programs. Moreover, SC households are more likely to send their children to hostels and residential schools due to their poor economic condition, as reported by the majority of the key informants during the survey.

The profiles of energy expenditure and time-use pattern among SC and BC adolescents underlines the importance of caste's role in shaping household activities that influence opportunities for adolescents. There is a significant difference between SC and BC adolescents in time use and energy spent on economic, educational, leisure, and travel activities, primarily defined by their differential endowments, participation and utilization of the programs, these in turn influenced by caste. As documented in (Bapuji and Chrispal, 2020), caste ultimately influences adolescents' future because the range of future opportunities among adolescents born in certain castes by tradition is limited.

Although SCs have historically been disadvantaged in terms of income, occupation, and access to resources, some educational programs in the study area have acted as push factors that improve their prospects, as reflected in the

key informant interviews. The majority of SC households lack access to land and due to the nature of their labor in non-agricultural activities, SC adolescents do not take part in the work unlike BC adolescents, highlighting caste-based inequalities in many aspects of rural livelihoods. Caste-based disparities in several elements of rural livelihoods have been shown extensively (Borooah, 2005; Borooah et al., 2014; Singh, 2011).

The role of wealth in determining the allocation of time and energy by late adolescent boys and girls to economic and domestic activities is significant within caste groups. Wealthier households in the BC caste group tend to have more land, which leads their adolescents to commit more time and energy to economic and domestic activities. Due to economic necessity and domestic needs, both late adolescent boys and girls in BC households engage in unpaid work, which can negatively impact their CAR. In contrast, due to the lack of economic opportunities, adolescents in the SC category spend more time and energy on educational activities. Similarly, late adolescents from lower wealth BC households spend less time and energy on education compared to the wealthier group. It is possible that lower wealth BC and SC households, which have minimal land endowment, have adolescents who are not engaged in agricultural activities.

Policies supporting the agricultural system may indirectly affect adolescents' engagement in unpaid work and increase educational opportunities and access to nutritional programs. Therefore, redesigning agricultural policies is necessary to shift children from unpaid household agriculture work to educational pursuits. Interventions in agricultural programs, such as mechanization, could have a secondary effect on adolescent schooling while also meeting the nutritional needs of children, as nutritional programs are often part of the educational system. For example, subsidies for small mechanized agricultural tools may alleviate the burden of working in the fields for adolescents and adults, promoting physical health and freeing up time for education.

Caste has a significant impact on the opportunities available to adolescent boys and girls, with differences in energy expenditure and time use profiles highlighting the gender disparities between BC and SC adolescents. Adolescent boys, particularly from BC backgrounds, are more involved in economic activities compared to girls of the same age group, regardless of their caste background. While there are few differences in energy expenditure and time use between SC and BC adolescent girls, significant differences exist between SC and BC

adolescent boys. These disparities are shaped by contextual and socio-economic factors, which determine the allocation of time and energy towards economic, educational, domestic, travel, and leisure activities. Gender differences are present in inter- and intra-caste relations, with domestic activities remaining largely associated with femininity among adolescent girls.

Based on interviews with key informants, it has been found that the majority of parents belonging to lower castes in rural areas do not send their daughters to residential schools or to schools located outside their village. This is mainly due to a lack of awareness about the long-term benefits of higher education and cultural restrictions on the mobility of girls. Addressing these issues requires policy-level efforts to sensitize parents about the importance of girls' education and to reduce gender disparities in access to education. By enabling both SC and BC girls to participate fully in educational activities, they can transform their lives and break the intergenerational cycle of malnutrition that is fueled by gender disparities, low socioeconomic status, limited decision-making authority, and a lack of knowledge about the importance of family care (Desai et al., 2015; Rawe, 2012). Empowering girls with skill-based work can help them climb the social ladder and lead to a more prosperous society. Thus, policies that enable girls to access such opportunities are necessary to reduce gender disparities and promote equality. By creating an enabling environment for girls to achieve their potential, policies can help to break the cycle of poverty and improve the overall well-being of society.



7. Conclusion

Nutritional interventions aimed at addressing undernutrition in India have historically prioritized increasing food intake among marginalized populations. However, the varying patterns of energy expenditure across different caste groups have not been thoroughly considered, despite their potential impact on nutritional outcomes. The key insight from this paper reveals that adolescents' energy expenditure is interlinked with their food intake and physical activity, which, in turn, can have a larger effect on calorie adequacy and nutritional outcomes. Such effects are strongly mediated by caste which affects occupation, asset endowments, access and utilization of resources, household and parental characteristics,

societal and institutional factors. These factors can vary significantly among different caste groups and ultimately impact the outcomes of nutrition interventions. Additionally, the substitution of time and energy both within and across caste groups offers unique insights into the livelihoods of rural households. Therefore, interventions aimed at improving the health and nutrition of adolescents must take into account differences in physical activity, time-use, and food intake associated with caste, in order to better understand the role of caste in shaping pathways to improved nutrition.

Acknowledgments

This research was supported by an IMMANA Fellowship, 2020–21 (Nithya Gowdru) funded by UK Aid from the UK Government and the Bill and Melinda Gates Foundation and by the University of Reading Research England GCRF QR allocation. IMMANA Fellowships are facilitated by Tufts University. The views expressed do not necessarily reflect the UK Government's official policies. We are also grateful to all respondents for contributing their time and insights to this research.

Appendix

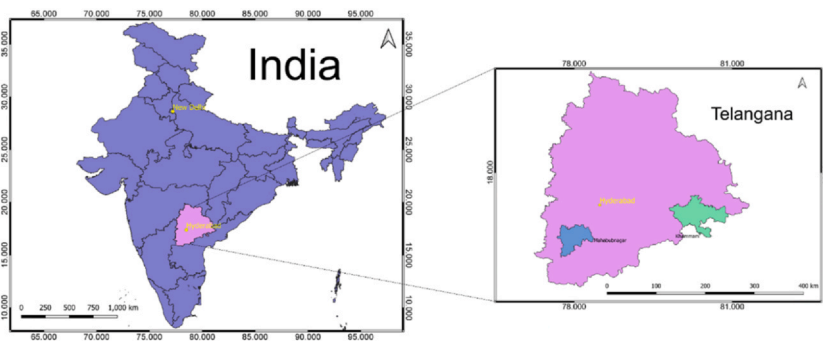


Fig. A1 Geographical location of the research sites in Telangana, India.

Table A1 Average 30 min energy expenditure (AEE, in kcal) and time use (proportion over 24 h) in macro- and micro-activities among adolescents by sex and age-groups across caste.

	Boys						Girls									
	Early adolescent (10–14 years)			Late adolescent (15–19 years)			Early adolescent (10–14 years)			Late adolescent (15–19 years)						
	SC	BC	AEE	Time	AEE	Time	SC	BC	AEE	Time	SC	BC	AEE	Time		
Well being	2.68	51	2.81	49	2.48	50	2.89	49	2.76	52	2.62	52	2.46	51	2.62	50
Sleeping and resting	0.98	45	0.69	42	0.92	44	0.93	42	1.13	45	1.05	45	1.17	45	0.97	43
Self-care	15.06	6	15.2	7	11.78	6	14.79	7	13.08	7	12.6	7	11.31	7	12.93	7
Education related	14.66	25	12.33	21	10.40	20	8.7	16	11.34	25	10.4	22	7.8	20	7.77	20
Studies	14.24	22	11.68	19	10.08	18	7.41	14	11	22	9.96	19	7.49	18	7.54	18
Non-study activity	13.5	3	12.63	3	7.46	2	8.51	2	9.9	3	10.11	4	5.89	2	5.24	2
Economic activities	2	1	4.87	1	3.75	3	7.91	5	2.71	1	3.71	2	2.41	2	3.72	2
Paid work	0.31	0	0.1	0	1.12	1	1.81	2	0.67	0	0.32	0	0.58	1	0.33	0

(continued)

Table A1 Average 30 min energy expenditure (AEE, in kcal) and time use (proportion over 24 h) in macro- and micro-activities among adolescents by sex and age-groups across caste. (*cont'd*)

	Boys						Girls									
	Early adolescent (10–14 years)			Late adolescent (15–19 years)			Early adolescent (10–14 years)			Late adolescent (15–19 years)						
	SC	BC	AEE	Time	SC	BC	AEE	Time	SC	BC	AEE	Time	SC	BC	AEE	Time
Unpaid work	1.68	1	4.77	1	2.69	1	6.52	3	2.17	1	3.51	2	1.89	0	3.39	2
Domestic work	12.76	3	12.44	3	8.09	3	9.66	3	11.48	6	10.55	5	11.33	9	13.17	9
In-house work	12.02	3	9.71	2	7.08	2	8.02	2	11.35	5	10.44	4	11.44	7	12.77	8
Outside work	3.26	1	6.58	1	4.45	1	5.7	1	3.82	1	3.35	1	5.43	2	4.56	1
Leisure activities	15.86	13	16.03	17	12.84	14	14.22	16	13.44	11	13.45	14	10.24	12	10.02	12
Sports activities	10.89	3	10.61	4	4.85	1	4.57	1	5.9	1	5.73	2	0.65	0	0.43	0
Attending events	0.8	0	1.73	1	1.24	1	1.81	1	0.63	0	0.97	1	0.6	0	0.91	1
Socializing	12.58	5	15.38	6	12.16	7	13.86	8	10.27	4	11.75	5	9.46	5	10.1	5

Digital entertainment	8.81	4	9.91	6	7.2	5	8.81	6	8.37	4	8.68	5	7.40	6	5.59	5
Creative activities	2.78	1	0.95	0	2.43	1	0.93	0	2.36	1	1.67	1	1.72	1	1.9	2
Traveling & commuting	18.06	6	19.42	8	15.12	8	16.78	10	15.63	5	15.6	5	11.67	5	14.15	5
Others	1.61	0	2.45	1	2.41	1	2	1	2.07	1	2.62	1	2.29	1	3.82	2

Notes: BC, backward caste; SC, schedule caste; AEE, activity energy expenditure.

Source: Own analysis.

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