**Adolescent diet and physical activity in the context of economic, social and nutrition transition in rural Maharashtra, India: a qualitative study**

**Abstract**

**Objective:** To explore the perceptions of adolescents and their caregivers on drivers of diet and physical activity in rural India in the context of ongoing economic, social and nutrition transition.

**Design:** A qualitative study comprising eight focus group discussions (FGDs) on factors affecting eating and physical activity patterns, perceptions of health and decision-making on food preparation.

**Setting:** Villages approximately 40-60km from the city of Pune in the state of Maharashtra, India.

**Participants:** Two FGDs with adolescents aged 10-12 years (n=20), 2 with 15-17 year olds (n=18) and 4 with their mothers (n=38).

**Results:** Dietary behaviour and physical activity of adolescents were perceived to be influenced by individual and interpersonal factors including adolescent autonomy, parental influence, and negotiations between adolescents and caregivers.The home food environment, street food availability, household food security and exposure to television and digital media were described as influencing behaviour. Lack of facilities and infrastructure were regarded as barriers to physical activity as were insufficient resources for public transport, safe routes for walking and need for cycles, particularly for girls. It was suggested that schools take a lead role in providing healthy foods and that governments invest in facilities for physical activity.

**Conclusions:** In this transitioning environment, that is representative of many parts of India and other LMICs, people perceive a need for interventions to improve adolescent diet and physical activity. Caregivers clearly felt they had a stake in adolescent health and so we would recommend the involvement of both adolescents and caregivers in intervention design.

**Key words: adolescence, caregivers; food choices; diet, physical activity; transition; qualitative research; rural India.**

**Introduction**

In 2016, India was home to 250 million adolescents (UNICEF 2017) and in 2011, 19% of Maharashtra’s population were adolescent ([3](#_heading=h.tyjcwt)). Adolescence is the period between 10 and 19 years of age ([1](#_heading=h.3znysh7)) and is divided into: early (10-14 years) and late adolescence (15-19 years) ([2](#_heading=h.2et92p0)).

The public health problems among adolescents in India include micronutrient deficiencies, stunting, underweight and overweight ([4](#_heading=h.3dy6vkm)). Our previous work has shown that being born into an environment deficient in calories and nutrients followed by later exposure to high-calorie environments can be the least favourable combination in terms of non-communicable disease (NCD) risk ([5](#_heading=h.1t3h5sf)). This phenomenon is increasingly likely in the context of the social, economic and nutrition transition putting the current generation at risk ([6](#_heading=h.4d34og8), [7](#_heading=h.2s8eyo1)). Between 2011 and 2017, the proportion of the population in rural areas has decreased from 70 to 66% ([8](#_heading=h.17dp8vu)) due to migration from villages to cities and the urbanisation and expansion of villages to towns and small cities ([9](#_heading=h.3rdcrjn)).

Adolescents worldwide consume too many refined grains, sugary foods and drinks, and insufficient fruit, vegetables and whole grains ([10](#_heading=h.26in1rg)).Over the last two decades in LMICs, the nutrition transition and reduced physical activity are contributing to increased prevalence of overweight and obesity ([11](#_heading=h.lnxbz9), [12](#_heading=h.35nkun2)).

Investments in adolescence benefit the individual’s current and future health, as well as that of their children ([2](#_heading=h.2et92p0)).Adolescence may be a critical period for later health and disease, improving nutrition may increase human capital and reduce NCD risk over the lifecourse([13](#_heading=h.1ksv4uv), [14](#_heading=h.44sinio)) .

Nutrition habits developed during adolescence are likely to track into adulthood ([15](#_heading=h.2jxsxqh); [16](#_heading=h.z337ya); [17](#_heading=h.3j2qqm3)). Factors reported to influence adolescent’s food choices in high-income settings include age, gender, autonomy, taste, food security, family influences, parental control, peer and institutional influence ([18](#_heading=h.1y810tw); [19](#_heading=h.4i7ojhp); [20](#_heading=h.2xcytpi)).

The Indian Government has initiated school health programmes including those aimed at empowering adolescent girls ([21](#_heading=h.1ci93xb)) such as iron and folic acid supplementation. Despite these initiatives, adolescents remain a largely neglected population. Little is known about rural Indian adolescents’ attitudes to diet and physical activity ([22](#_heading=h.3whwml4)) and we are not aware of any studies investigating caregiver attitudes and beliefs. Our aim was to explore drivers of adolescent food choice and physical activity patterns in a setting undergoing economic and social transition. We used focus group discussions (FGDs) to obtain in-depth responses and understand social norms around this topic ([23](#_heading=h.2bn6wsx)).

**Methods**

**Research setting, design and participants**

This study was part of an international collaboration, Transforming Adolescent Lives Through Nutrition (TALENT; for further details about the wider programme see Barker et al. this issue). The setting was three villages 40-60 km from Pune city (Pabal, Dhamari and Kendur) selected to enable recruitment of participants from a range of socio-economic backgrounds. The villages are currently transitioning in terms of the expansion of city limits and economic growth.

A prospective cohort, the Pune Maternal Nutrition Study, was established in this setting in 1994to examine associations between pregnancy diet and offspring outcomes ([24](#_heading=h.qsh70q); [25](#_heading=h.3as4poj)). At this time subsistence farming was common with little access to food markets. Most women were married and began child-bearing by 18 years. Underweight and stunting were prevalent and 31% of women were severely chronically energy deficient with a BMI<17kg/m2([24](#_heading=h.qsh70q)). Transport infrastructure was limited and agriculture was largely rain-fed.

Over the last 20 years, a dam system has improved farmland irrigation, generating capacity to grow cash crops e.g. sugar cane. The increased income has improved purchasing power, provided more permanent housing, and ownership of vehicles and domestic appliances. There are more varied employment opportunities due to the emergence of small industries and improved road connectivity. Most villages now receive electricity and literacy rates have increased. Housing varies from kuchha dwellings (made with temporary materials including mud and plastic sheeting) to concrete, pukka houses.

We recruited adolescents aged 10-12 and 15-17 years because we anticipated differences between early and late adolescence in terms of the influences on behaviour, the caregiver-adolescent relationship and the suggested solutions. Also, we expected that participants would feel more comfortable and talk more openly with others of a similar age.

Households known to include an adolescent of the target age were approached by TALENT project staff who were also residents of the study villages. Potential participants were given the opportunity to ask questions about the study before agreeing to take part. If adolescents and caregivers agreed to participate, written consent and assent was obtained from the caregivers and adolescents respectively.

Thirty-eight adolescents and their caregivers (mothers) were recruited for the FGDs from a wider pool of 81 adolescents. The wider pool were a convenience sample recruited to provide some context in terms of sociodemographic characteristics and anthropometric measurements.

**Data collection**

Eight FGD were conducted between May and August 2018: 2 with adolescents aged 10-12 and 2 with those aged 15-17 years (boys and girls separately); and 4 with their mothers. Four were conducted at a primary health centre in Pabal village, two at a health centre in Dhamari and two at a gymnasium in Kendur. After obtaining written permission to record the discussion, participants were given numbered badges for anonymity. A digital audio recorder (Olympus VN-541PC, Vietnam) was used. FGDS took 45-90 minutes. Those with adolescents were conducted by KJR and with mothers were conducted by AD/VK in Hindi and Marathi languages, field notes were taken by PK, RS, PS, RW. The facilitators were trained in qualitative research (Editorial issue)and had not met the participants previously.

A FGD guide was developed,to enable discussion of all levels of factors that might influence adolescent diet and physical activity levels (see conceptual map in Barker et.al. in this issue for details). The guide was then tested and validated with pilot groups of adolescents and mothers. The guide included (1) current diet habits and food preferences (2) physical activity patterns (3) opportunities and challenges to having a healthy diet and being physically active (4) parental involvement in adolescent diets (5) ideas about future interventions.

Among the wider pool of 81 adolescents, trained research staff administered socio-demographic questionnaires and measured height to the nearest 0.1 cm using a stadiometer (CMS Instruments Ltd., London, UK) and weight to the nearest 0.1 kg using electronic scales (TANITA India Pvt. Ltd, Mumbai, India) (for further details about the wider pool data see Fall et al. in this issue).

**Data Analysis**

FGD recordings were transcribed in Hindi-Marathi and translated into English. Transcriptions were produced by KJR, PK, VK and PS and translations were carried out by KJR, PK, VK and RW. A final check was carried out by KJR and NVivo (v12) software for qualitative analysis was used. A thematic approach was employed using Braun and Clarke’s step-by-step guide ([26](#_heading=h.1pxezwc)). KJR read the transcripts several times. Discussions about the emergent themes during a TALENT training workshop lead to the development of an initial coding framework. The emergent themes and codebook developed in the workshop informed the initial coding of the transcripts. As coding continued, the codebook was revisited and revised as necessary. Codes were checked by PJ, SW, and MB. The codebook was revised based on discussions with the research team to ensure the codes reflected the data. The final codes formed the themes that the researchers felt accurately represented the messages from the data. Once the key themes were categorised, revisited and refined, the key findings were presented visually (Figure 1). Figure 1 aims to conceptualise the relationships between themes. We adhered to the Consolidated Criteria for Reporting Qualitative Research ([27](#_heading=h.49x2ik5)).

**Results**

**Participant Characteristics**

Anthropometric data relating to the larger pool of 81 participants are presented in Table 1. Mean height-for-age was below the WHO growth standards ([28](#_heading=h.2p2csry)) for all adolescents, particularly for girls of both age groups who were on average approximately 1 standard deviation below the mean. Approximately 10% of the participants were stunted. BMI-for-age was below average for both boys and girls with girls at 10-12 years and boys at 15-17 years being almost 1 standard deviation below the mean.

Socio-demographic data relating to caregivers in Table 2 to provide context for the study. Mothers of older adolescents had, on average, been schooled for 7 years and those of younger adolescents for 10 years. Most mothers were self-employed with approximately a quarter being unemployed. Table 3 presents the age category, gender, number and location of adolescents in each FGD.

**Themes emerging from the Focus Group Discussions:**

Three major themes emerged from the data: (1) influence of growing autonomy and independence during adolescence (2) access, availability and effects of local infrastructure (3) preferences for interventions to improve diet and physical activity. We produced a thematic map to depict individual and environmental factors associated with themes 1 and 2 (Figure 1).

**Theme 1: The influence of growing autonomy and independence**

**Sub-theme 1.1: Autonomy and its influence on food choices**

Adolescents reported consuming foods based on preference, appearance, taste, smell, habit and peer influence. A few reported choosing foods based on their health benefits. The choices of younger adolescents were driven by television advertisements, and offers on food packets.

Respondent 1: **“***We choose food which is good, healthy, looks attractive”*

Respondent 2*: “Food which we always eat - habit*”. (FGD 3, older adolescent boys).

Respondent 1: “*If something new is available then we eat that and do not eat the same food*”

Respondent 2:*“TV advertisements…”;*

Respondent 3: *“If there is something free with it - offers..”;*

Respondent 4: *“If the packaging is simple only, then that food is not good….”;*

Respondent 5: *“Friend brought it. He said it is good, then [I] ate the same the next day”* (FGD 1, young adolescent boys).

 There was some indication that adolescent autonomy over food choices increases with age. For example, older adolescent boys chose to eat food made outside their homes.

 *“[I] eat outside food more, [I] do not like homemade food”* (FGD 3, older adolescent boys)

“*During and after school they [girls] might eat something outside*” (FGD 8 caregivers of older adolescent girls).

“*Mostly boys eat outside, girls are shy*” (FGD 8 caregivers of older adolescent girls).

Older boys and girls described how decisions about the foods that were eaten at home were made together by parents and children.

“*[Mother asks] everyone, what should I prepare, this or that? Which vegetable should I make? What do you want to eat? Will you eat, if I prepare this will you eat? We are asked before meal is cooked*” (FGD 4, older adolescent girls).

*“Buy things which kids like.” (FGD 7 caregivers of older adolescent boys).*

Most caregivers reported little conflict over food choices and tried to serve healthy foods to adolescents, whilst accommodating their preferences.

*“I make only what he will like. I mostly try [to ensure] that he eats everything. And I give him cucumber, etc in his school tiffin and I give him a fruit after he comes back. So other food items should also be included. I give him one litre water bottle for school and I make sure that he finishes it.”*(FGD 5, mother of young adolescent boys).

*“He doesn’t go outside and eat. He asks his father to bring it for him. Generally children of this age don’t go out and eat, they go when the elders take them”*. (FGD 5, caregivers of young adolescent boys).

However, some younger adolescents reported that their parents did not give them a choice and were reprimanded for eating unhealthy foods.

*“[Parents] ask [us] to eat given foods without any arguments.”* (FGD 1, young adolescent boys).

Among younger adolescents and their caregivers, were reports of parental disapproval of foods eaten outside the home and restriction on foods that were eaten.

*“Mother shouts if I eat outside food”* (FGD 2, young adolescent girls).

 *“what we should do is, we should not let them go near the food items which shouldn’t be eaten (laughter) if we don’t let them go then how will they eat?”* (FGD 6, caregivers of young adolescent girls).

The younger adolescents reported that in most cases the menu for the household was decided by others.

*“We eat whatever [vegetable] is made or which is available at home”* (FGD 1, young adolescent boys)

There were differing reports from younger and older adolescents regarding lunch time habits. Younger girls said that they took home prepared tiffins (lunch boxes) to school.

*“We carry tiffin from home and eat that at school”* (FGD 2, young adolescent girls)

Older adolescent girls talked about eating shop-bought snacks for lunch

*“Eat Chakli, chips, kurkure, chocolate, biscuits…from the shop”* (FGD 4, older adolescent girls).

Street food was perceived to be particularly desirable but more so by older than younger adolescents, it was disapproved of by parents and caregivers.

 *“My parents say that I should not eat street food items, I should eat homemade foods and cereals-pulses only.”* (FGD 2, young adolescent girls).

Younger adolescents were more dependent on parents agreeing to bring street food home. Some wanted to eat homemade rather than street food.

 “*Homemade food is fresh…. homemade food is tasty.”* (FGD2, young adolescent girls)

**Sub-theme 1.2: Autonomy, opportunities for, and challenges to, physical activity**

Mothers reported resistance to helping with chores such as purchasing groceries in favour of watching television or playing on mobile phones. Sometime adolescents were given tasks to encourage physical activity.

*“He doesn’t do any work. He complains that I ask only him to do the work. [He] doesn’t listen even after telling.”*

*“Children are mostly on the phone nowadays; there’s always somebody on the call. He takes games and keeps on playing. I think the old phones were better……”*

 *“Giving him small jobs like giving some message to someone, bringing something from the shop, then it makes him walk”*(FGD 5, mothers of young adolescent boys).

Adolescents reported that swimming, cycling, walking and running were their routine physical activities while cricket, badminton, kabbadi[[1]](#footnote-1) were among their favourite sports. However, there were negotiations between adolescents and their parents about opportunities for physical activity. Older adolescents reported resistance from parents and teachers to allowing them to go out and play before or during exams.

“*Parents do not allow to go for playing if there is work or exams, otherwise they do not stop.*” (FGD 3, older adolescent boys).

Some older girls disliked physical activity in addition to household chores.

*“We do not like to do anything extra like this - playing etc.”* (FGD 4, older adolescent girls).

A few girls said they had stopped being active as they got older while some talked about activities they enjoyed that were no longer available.

 *“[We] like dancing but no one teaches [it]. Before they used to but now have stopped.”* (FGD 4, older adolescent girls).

Some girls described being actively supported by parents and caregivers to exercise more.

*“[My] parents bought me badminton.”* (FGD 2, young adolescent girls)

*“If I am dancing in the evening, then mother tells me that you do this step. She also sometimes dances with me. I do get support.”* (FGD 4, older adolescent girls)

Parents described how recently children spent a lot of time in sedentary activities such as games and TV.

*“Nowadays children remain engaged in games, TV. Children are addicted to such things. They should get some knowledge about this”* (FGD 5, caregivers of young adolescent boys).

**Theme 2: Affordability, availability and effects of the local infrastructure**

**Sub-theme 2.1: Affordability and availability**

Most adolescents said there was enough food available in their households to fulfil their appetites. However sometimes availability of fruits and sweets was limited.

*Respondent 1: “We eat till [we] feel full.”*

*Respondent 2: “Sometimes the portions change, when everyone is very hungry.*”

*Respondent 3: “[We] eat as much as we want.”* (FGD 2, young adolescent girls)

 *“I get more [food]. (I) have younger brothers and sisters at home, so when something is brought into the house, then it is divided.”* (FGD 3, older adolescent boys)

Access to food was regular for most respondents with caregivers reporting that fresh vegetables and fruit were bought from the weekly market with few reporting daily purchases. Non-farming households and those without kitchen gardens or fruit trees had no access to fruit.

*Respondent 1: “[I buy groceries every]15 days. The vegetables [are] home grown.”* (FGD 5, mothers of younger adolescent boys).

*“[I buy]groceries once a month and vegetables once a week”* (FGD 6, mothers of young adolescent girls).

Adolescents said that what was eaten was a matter of availability.

*“[It is] decided based on the vegetable that is available in the house.”* (FGD 1, young adolescent boys).

In some households poverty was described as a barrier to consumption of foods such as fruit.

“*Farmers do not get fruit because of poverty. So we eat what we grow in our fields - green leafy vegetables, etc.*” (FGD 8, mothers of older adolescent girls)

Despite the fact that healthy foods were expensive, they were a priority in some households.

*“[We give] priority to nutrition. We pay and get nutritious food. I buy the food from which we get vitamins even if it is expensive.”* (FGD 5, mothers of young adolescent boys)

Some adolescents talked about a school nutrition programme where pupils were served a mid-day meal of rice with spices and vegetables. Additionally in some schools, older adolescents prepared food for other pupils.

*“There is a department where the students make their foods on their own at school with a teacher's guidance, and sell it in school. It is like a canteen. This activity takes place three times a week, it happens on rotational basis for each standard.”* (FGD 3, older adolescent boys).

**Sub-theme 2.2: Local infrastructure in relation to physical activity**

The villages had gyms which many older adolescent boys used. A few younger adolescents attended coaching for Karate and swimming. Mothers reported that some older girls found it difficult to spend time on physical activity due to the distances between home and school and the requirement to do chores.

*“Because school is far away, [my daughter] doesn’t participate in any sports activity.”* (FGD 8, mothers of older adolescent girls).

“*Due to time constraint, no [physical] activity can be done [with the girls]. … We have to go to the fields*” (FGD 8, mothers of older adolescent girls).

Adolescents said that local schools had started operating full instead of half days on Saturdays and two hours of this was dedicated to sports and yoga. Schools offered sports training for adolescents and opportunities to participate in competitions.

*“There is a Yoga session on every Saturday at school.”* (FGD 1, young adolescent boys)

*“Teacher gives training every day and also gives time to play.”* (FGD 3, older adolescent boys).

**Sub-theme 2.3: Knowledge of healthy eating**

All participants reported knowing about good health and nutrition. Their knowledge was derived from school teachers, parents and elders, social media and television advertisements. Older adolescents had greater exposure to social media and other digital tools whereas younger adolescents had access to television and occasionally to parental mobile phones. These sources provided information about food adulteration and contamination issues.

*“It was shown in a Whatsapp video that Kurkure[[2]](#footnote-2)has plastic [in it].”* (FGD 1, younger adolescent boys).

 *“Ice gola[[3]](#footnote-3) has colours in it which may increase anxiety.”* (FGD 1, younger adolescent boys).

*“Chinese food also has added colours which are bad. They can damage kidneys.”* (FGD 1, young adolescent boys).

*“Vadapav[[4]](#footnote-4)contaminated with the vectors from the feet of flies can go inside our stomach when we eat that Vadapav and spread diseases.”-*  (FGD 1, younger adolescent boys).

**Theme 3: Preferences for interventions**

Adolescents suggested various school-based interventions including improving the food environment and providing better facilities for physical activity.

*“The distribution of biscuits at school must be stopped and almonds should be given instead…dry fruits should be given.”* (FGD 1, young adolescent boys)

*“Vendors and food stalls serving unhealthy foods should be removed from the school premises.”* (FGD 3, older adolescent boys)

 *“Make a swimming tank [pool] in school.”* (FGD 1, young adolescent boys)

*“[The] number of yoga sessions should be increased.”* (FGD 1, young adolescent boys)

Caregivers talked about improved hygiene as a priority to enhance adolescent health and nutrition.

 *“Bathroom facilities in school, and water facilities should be there.”* (FGD 5, mothers of younger adolescent boys).

It was suggested that physical activity facilities be provided by the government

*“Villages are ignored by the government. A garden should be made here - swings, slides. A small swimming tank [pool] is required.”*(FGD 5, mothers of young adolescent boys)

There was a focus on difficulties for older adolescent girls. Mothers suggested that the government offer targeted classes and facilities, distribute bicycles or provided better local transport to enable safe travel.

“*The village should have karate class because if it is nearby then parents would also agree to send us, since the school is too far*.” (FGD 4, older adolescent girls).

*“They should provide cycles for girls.”* (FGD 8, mothers of older adolescent girls)

 *“Bus facilities should be provided, as it gets late while going and returning [to and from school*]*.”* (FGD 8, mothers of older adolescent girls).

**Discussion**

We explored eating behaviour and physical activity of adolescents living in transitioning villages of India. We spoke to both adolescents and their parents to compare their perceptions and understand how to support interventions in the context of cultural, social and economic transition.

As in other settings, older adolescents may experience more autonomy over their food choices and physical activity than younger adolescents, and boys more so than girls ([29](#_heading=h.147n2zr)). Parents and older adolescents described joint decision-making about food choices whereas parents of younger adolescents described a more restrictive approach, particularly to consumption of street foods. Increasing autonomy is a characteristic of adolescence involving a move to more independent thinking ([30](#_heading=h.3o7alnk)) and eating and physical activity are opportunities to exercise some choice and control ([18](#_heading=h.1y810tw); [31](#_heading=h.23ckvvd); [32](#_heading=h.ihv636)). There is evidence that increased autonomy can change family relationships whilst premature autonomy, i.e. too much choice or responsibility too soon, is linked with poorer health outcomes ([2](#_heading=h.2et92p0)).

**Effect of the economic, social and nutrition transition on adolescent diet**

While rural to urban transition was not directly described by participants, abundant access to street foods and lack of infrastructure and facilities for physical activity were discussed. Rural populations in LMICs have been at risk of food and nutrition insecurity due to lack of availability and access to affordable healthy foods and the time and means to prepare them ([33](#_heading=h.32hioqz); [34](#_heading=h.1hmsyys); [35](#_heading=h.41mghml); [36](#_heading=h.2grqrue)). In our study, most foods were available throughout the year, and adolescents were able to access enough food as well as food they liked eating. The exception was fruit when out of season. No participants described having insufficient food or struggling to buy food, and some caregivers reported that providing high quality, nutritious food was a priority whatever the cost, possibly reflecting increasing prosperity ([37](#_heading=h.vx1227)). Many families living in transitioning settings, have increased purchasing power as a result of changes in livelihoods from subsistence farming to cash crop farming and working in other industries. Some older adolescents had the option to purchase street, packaged and processed foods. As with previous research ([38](#_heading=h.3fwokq0)) we found that adolescents were attracted to street and packaged foods despite knowledge of the health implications. Adolescents were influenced by marketing practices. There is evidence that food companies are less likely to market healthy options in LMICs. A comparison of promotion activities between USA, Germany, Mexico, China, India and the Philippines found that three fast food and beverage companies promoted diet products and fresh dishes more frequently in the USA and Germany than in other countries. Also, McDonald’s in India has different marketing strategies for the poorer north with more advertising aimed at children than in the wealthier south ([39](#_heading=h.1v1yuxt)).

**Effect of the epidemiological transition on physical activity**

Participants reported engaging in traditional activities such as household chores and farming activities as well as ‘modern’ sport and recreational activities. Gym facilities in these rural villages would have been largely unavailable until recently but several participants mentioned using them ([37](#_heading=h.vx1227)). Most LMICs have limited opportunities in terms of resources and infrastructure ([40](#_heading=h.4f1mdlm); [41](#_heading=h.2u6wntf); [42](#_heading=h.19c6y18)). As has been described before in India, parental aspirations and the burden of academic studies limited the time adolescents were permitted to undertake sports and recreational activities ([43](#_heading=h.3tbugp1)) despite evidence that physical activity may improve academic performance ([44](#_heading=h.28h4qwu); [45](#_heading=h.nmf14n)). Academic pressure may be another side-effect of the transition increasing job opportunities, raising material expectations and earning potential. Adolescent girls have reported a lack of space and opportunity for physical activity but some have no interest in being active ([46](#_heading=h.37m2jsg)). This reduction in interest may be partly due to menarche onset ([47](#_heading=h.1mrcu09)) but possibly also to spend more time in sedentary activities such as engaging with social media ([48](#_heading=h.46r0co2)). Mothers in our study talked about giving jobs to adolescents as a means of encouraging activity. Being male, having higher educational attainment and more interest in health and appearance have all been identified as predictors of adolescents’ participation in physical activity in South East Asia (49). This information, in conjunction with our findings may improve targeting of physical activity interventions. For example, interventions aimed at girls may need to be designed differently to those for boys. Overall, the epidemiological transition has been associated with a reduction in physical activity and increased overweight and obesity in LMICs (50). The TALENT study villages may not yet be sufficiently transitioned for overweight to be observed but this may be a risk for the near future.

**Public health implications:**

The longer-term aim of the TALENT consortium is to develop and test context specific interventions to improve adolescent health in South Asia and Sub-Saharan Africa. The present study was carried out to provide insight into adolescent diet and physical activity habits and how we might address them from the perspective of the beneficiaries of prospective interventions.Participants in our discussions identified factors influencing adolescents’ diets and physical activity habits operating at all levels: individual, familial and national. They had an appreciation of the interplay between factors such as food preferences and choices, family socio-economic status and infrastructure issues such as transport, and the influence these exerted. Consequently, they understood that interventions to improve adolescent nutritional status would have to be wide-ranging and take into account multiple factors. Our data indicate that nutrition knowledge is generally not a barrier to healthy eating but the increasing availability of processed and high salt, fat and sugar foods in villages, particularly around schools may lead to unhealthy choices ([51](#_heading=h.111kx3o); [52](#_heading=h.3l18frh)). Interventions to reduce availability of these foods would involve a wide group of stakeholders including schools, local government and food retailers. It would be important that consideration is given to alternative livelihood opportunities for vendors who sell these foods at present.

In terms of physical activity, improving walkability and road safety for cyclists may encourage more active transport to school and provide opportunities in the context of increasing pressure to spend time on academic study ([5](#_heading=h.206ipza)3). Addressing the trend towards sedentary activities including watching TV, using computers and phones is likely to be important to prevent a sedentary lifestyle tracking into adulthood ([17](#_heading=h.3j2qqm3)). There has been little research conducted into provision of activity facilities in India ([5](#_heading=h.4k668n3)4) and it would be important to involve adolescents in the development of any interventions. Caregivers suggested the government was responsible for providing facilities and that villages were often overlooked in this sort of planning. Larger scale surveys are required to confirm this and to map stakeholders that could be engaged in implementing interventions.

**Strengths and Limitations**

This is the first study to generate qualitative data from rural Indian adolescents and their caregivers on drivers of dietary and physical activity behaviour. Adolescents were grouped by age ensuring perspectives from both early and later adolescence. The research team was trained as part of the TALENT collaboration in qualitative research by skilled researchers who supported data collection and analysis. FGDs were conducted separately for adolescents and caregivers to encourage them to share views freely and to explore their perspectives in greater detail.

A limitation was that fathers were not included in FGDs. Experience suggests that they are less involved in child’s diet and daily activities, so may have had less to contribute had they been involved. The majority of data coding was completed by KJR, thus limiting assessment of inter-coder reliability. The training team and other collaborators in TALENT sought to ameliorate potential bias in data analysis by reviewing and confirming codes, their definitions and the interpretation. The training team was engaged in discussing and resolving any discrepancies in coding, and adjusted code definitions as required.

**Conclusions**

The ongoing transition in these villages may be increasing accessibility to resources resulting in greater food security and some provision for leisure time physical activity. Adolescents reported that they were eating some unhealthy street food that they desired and understood the risks to health. Caregivers were involved in negotiating with their increasingly autonomous adolescents about access to food and physical activity, using a combination of enabling choice and authoritarianism.

The study could capture changing perspectives and expectations of the adolescents and caregivers over diet and physical activity due to current phase of transition and development. Both adolescents and caregivers believed there were opportunities to improve food choices and increase physical activity and had ideas about how this might be achieved. The study gave us a picture of the prospects, desires and expectations of the adolescents and their caregivers are changing with transition regarding diet and physical activity. Thus, future intervention development will need to involve extensive engagement with caregivers and adolescents as key stakeholders. Their needs and priorities should form the basis for effective interventions that are aligned with the changing environments in these transitioning villages.

**Table-1: Adolescent Anthropometry (n=81)\***

|  |  |  |
| --- | --- | --- |
| **Age** | **10-12 years** | **15-17 years** |
| **Anthropometry†** | **Boys** | **Girls** | **Boys** | **Girls** |
| N | 20 | 20 | 20 | 21 |
| Height for age Z | -0.35 (1.10) | -0.94 (1.11) | -0.77 (0.90) | -1.15 (0.72) |
| Stunting | 1 (5) | 2 (10) | 2 (10) | 2 (9.5) |
| BMI for age Z | -0.16 (1.53) | -0.89 (1.21) | -0.86 (1.37) | -0.22 (1.00) |
| Underweight | 1 (5) | 3 (15) | 4(20) | 1 (4.8) |
| Overweight | 1 (5) | 2 (10) | 3(15) | 3 (14.3) |
| Obese | 3 (15) | 1 (5) | 0 (0) | 0 (0) |

**\*Values are mean (SD) for continuous variables and N (%) for categorical variables. †**Height for age Z, BMI for age Z, stunting, underweight, overweight and obese are defined using WHO 2007 ([28](#_heading=h.2p2csry)).

**Table 2: Socio-demographic characteristics of caregivers\***

|  |  |  |
| --- | --- | --- |
| **Age** | **10-12 years** | **15-17 years** |
| **Occupation**  | **Mother** | **Father** | **Mother** | **Father** |
| Paid employed | 11 (27.5) | 10 (25) | 6 (14.6)  | 10 (24.4)  |
| Self employed | 18 (45.0) | 29 (72.5) | 25 (61.0) | 30 (73.2)  |
| Not employed | 11 (27.5) | 1 (2.5) | 10 (24.4) | 1 (2.4)  |
| **Education (years)** | 10 (3) | 9 (5) | 7 (3) | 9 (4) |

**\*Values N (%) for occupation and are mean (SD) for education.**

**Table 3 Composition of each of the eight focus group discussions**

|  |  |  |  |
| --- | --- | --- | --- |
| **FGD** | **Participants** | **N** | **Location** |
| 1 | Young adolescent boys | 9 | Pabal |
| 2 | Young adolescent girls | 11 | Pabal |
| 3 | Older adolescent boys | 9 | Dhamari |
| 4 | Older adolescent girls | 9 | Kendur |
| 5 | Caregivers of young adolescent boys | 9 | Pabal |
| 6 | Caregivers of young adolescent girls | 11 | Pabal |
| 7 | Caregivers of older adolescent boys | 9 | Dhamari |
| 8 | Caregivers of older adolescent girls | 9 | Kendur |

**Figure 1: Thematic map depicting individual and environmental factors associated with dietary and physical activity behaviour**

References

1. World Health Organisation (2014) *Health for the World’s Adolescents A second chance in the second decade*. Geneva.

2. Patton GC, Sawyer SM, Santelli JS *et al.* (2016) Our future: a Lancet commission on adolescent health and wellbeing. *Lancet***387**, 2423-2478.

3. Government of India Ministry of Home Affairs (2011) Census Data 2011. <http://www.censusindia.gov.in> (accessed 16/7/19 2019)

4. Christian P, Smith ER (2018) Adolescent Undernutrition: Global Burden, Physiology, and Nutritional Risks. *Ann NutrMetab***72**, 316-328.

5. Bavdekar A, Yajnik CS, Fall CH *et al.* (1999) Insulin resistance syndrome in 8-year-old Indian children: small at birth, big at 8 years, or both? *Diabetes***48**, 2422-2429.

6. Popkin BM (2006) Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. *Am J ClinNutr***84**, 289-298.

7. Popkin BM, Adair LS, Ng SW (2012) Global nutrition transition and the pandemic of obesity in developing countries. *NutrRev***70**, 3-21.

8.World Bank (2018) World Development Indicators.<https://data.worldbank.org/indicator/SP.RUR>.TOTL.ZS(accessed 17/7/19 2019)

9. Cyril S, Oldroyd JC, Renzaho A (2013) Urbanisation, urbanicity, and health: a systematic review of the reliability and validity of urbanicity scales. *BMC Public Health***13**, 513.

10. Development Initiatives (2018) *2018 Global Nutrition Report: Shining a light to spur action on nutrition*. Bristol, UK.

11. Popkin BM (2002) An overview on the nutrition transition and its health implications: the Bellagio meeting. *Public Health Nutr***5**, 93-103.

12. Tzioumis E, Adair LS (2014) Childhood dual burden of under- and overnutrition in low- and middle-income countries: a critical review. *Food Nutr Bull***35**, 230-243.

13. Viner RM, Ross D, Hardy R *et al.* (2015) Life course epidemiology: recognising the importance of adolescence. *J Epidemiol Community Health***69**, 719-720.

14. Hanson M, Gluckman P (2011) Developmental origins of noncommunicable disease: population and public health implications. *Am J ClinNutr***94**, 1754s-1758s.

15. Azevedo MR, Araujo CL, Cozzensa da SM *et al.* (2007) Tracking of physical activity from adolescence to adulthood: a population-based study. *RevSaudePublica***41**, 69-75.

16. Mikkila V, Rasanen L, Raitakari OT *et al.* (2005) Consistent dietary patterns identified from childhood to adulthood: the cardiovascular risk in Young Finns Study. *BrJNutr***93**, 923-931.

17. Craigie AM, Lake AA, Kelly SA *et al.* (2011) Tracking of obesity-related behaviours from childhood to adulthood: A systematic review. *Maturitas***70**, 266-284.

18. Bassett R, Chapman GE, Beagan BL (2008) Autonomy and control: the co-construction of adolescent food choice. *Appetite***50**, 325-332.

19. Rathi N, Riddell L, Worsley A (2016) What influences urban Indian secondary school students' food consumption? - A qualitative study. *Appetite***105**, 790-797.

20. Story M, Neumark-Sztainer D, French S (2002) Individual and environmental influences on adolescent eating behaviors. *J Am Diet Assoc***102**, S40-51.

21. National Health Mission (2018) RashtriyaKishori Shakti Yojana. <http://www.nrhmhp.gov.in/content/rksk> 17/07/19)

22. Correa N, Rajaraman D, Swaminathan S *et al.* (2017) Perceptions of healthy eating amongst Indian adolescents in India and Canada. *Appetite***116**, 471-479.

23. Krueger R, Casey M (2000) *Focus groups: a practical guide for applied research.* Thousand Oaks, California: Sage Publications, Inc.

24. Rao S, Yajnik CS, Kanade A *et al.* (2001) Intake of micronutrient-rich foods in rural Indian mothers is associated with the size of their babies at birth: Pune Maternal Nutrition Study. *J Nutr***131**, 1217-1224.

25. Yajnik CS, Fall CHD, Coyaji KJ *et al.* (2003) Neonatal Anthropometry: the thin-fat Indian baby. The Pune Maternal Nutrition Study. *Int J Obes***27**, 173-180.

26. Braun V, Clarke V (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology***3**, 77-101.

27. Tong A, Sainsbury P, Craig J (2007) Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care***19**, 349-357.

28. World Health Organisation (2007) *The WHO Child Growth Standards*. Geneva: World Health Organisation,.

29. Patton GC, Olsson CA, Skirbekk V *et al.* (2018) Adolescence and the next generation. *Nature***554**, 458-466.

30. Sawyer SM, Afifi RA, Bearinger LH *et al.* (2012) Adolescence: a foundation for future health. *Lancet***379**, 1630-1640.

31. Tiedje K, Wieland ML, Meiers SJ *et al.* (2014) A focus group study of healthy eating knowledge, practices, and barriers among adult and adolescent immigrants and refugees in the United States. *Int J BehavNutr Phys Act***11**, 63.

32. Brown C, Shaibu S, Maruapula S *et al.* (2015) Perceptions and attitudes towards food choice in adolescents in Gaborone, Botswana. *Appetite***95**, 29-35.

33. Kehoe SH, Dhurde V, Bhaise S *et al.* (2019) Barriers and facilitators to fruit and vegetable consumption among rural Indian women of reproductive age. *Food Nutr Bull***40**, 87-98.

34. Hawkes C, Ruel M (2011) Value chains for nutrition. 2020 Conference: Leveraging Agriculture for Improving Nutrition and Health. 2020 Conference Paper 4. Washington, DC: International Food Policy Research Institute.

35. Morgan EH, Vatucawaqa P, Snowdon W *et al.* (2016) Factors influencing fruit and vegetable intake among urban Fijians: A qualitative study. *Appetite***101**, 114-118.

36. Miller V, Yusuf S, Chow CK *et al.* (2016) Availability, affordability, and consumption of fruits and vegetables in 18 countries across income levels: findings from the Prospective Urban Rural Epidemiology (PURE) study. *Lancet Glob Health***4**, e695-703.

37. Aijaz R (2019) *India’s Peri-Urban Regions: The Need for Policy and the Challenges of Governance*. New Delhi.

38. Misra A, Singhal N, Sivakumar B *et al.* (2011) Nutrition Transition in India: Secular Trends in Dietary Intake and their Relationship to Diet-related Non-communicable Diseases. *J Diabetes*.

39. Bragg MA, Eby M, Arshonsky J *et al.* (2017) Comparison of online marketing techniques on food and beverage companies' websites in six countries. *Globalization and health***13**, 79.

40. Van Royen K, Verstraeten R, Andrade S *et al.* (2015) Factors affecting physical activity in Ecuadorian adolescents: a focus group study. *Journal of physical activity & health***12**, 340-348.

41. Adlakha D, Hipp JA, Brownson RC *et al.* (2017) "Can we walk?" Environmental supports for physical activity in India. *Prev Med***103s**, S81-s89.

42. Tarun S, Arora M, Rawal T *et al.* (2017) An evaluation of outdoor school environments to promote physical activity in Delhi, India. *BMC Public Health***17**, 11.

43. Rajaraman D, Correa N, Punthakee Z *et al.* (2015) Perceived Benefits, Facilitators, Disadvantages, and Barriers for Physical Activity Amongst South Asian Adolescents in India and Canada. *Journal of physical activity & health***12**, 931-941.

44. Alvarez-Bueno C, Pesce C, Cavero-Redondo I *et al.* (2017) Academic Achievement and Physical Activity: A Meta-analysis. *Pediatrics***140**.

45. Marques A, Santos DA, Hillman CH *et al.* (2018) How does academic achievement relate to cardiorespiratory fitness, self-reported physical activity and objectively reported physical activity: a systematic review in children and adolescents aged 6-18 years. *Br J Sports Med***52**, 1039.

46. Satija A, Khandpur N, Satija S *et al.* (2018) Physical Activity Among Adolescents in India: A Qualitative Study of Barriers and Enablers. *Health EducBehav***45**, 926-934.

47. Ravi R, Shah PB, Edward S *et al.* (2017) Social impact of menstrual problems among adolescent school girls in rural Tamil Nadu. *Int J Adolesc Med Health***30**.

48. Shah R, Chauhan N, Gupta AK *et al.* (2016) Adolescent-parent conflict in the age of social media: Case reports from India. *Asian J Psychiatr***23**, 24-26.

49. Chen C, Tsai LT, Lin CF *et al.* (2017) Factors influencing interest in recreational sports participation and its rural-urban disparity. *PLoS One***12**, e0178052.

50. Shetty P. (2013) Nutrition transition and its health outcomes. Indian J. Pediatr.,Mar:80suppl 1: S21-7.

51. Naidoo N, van Dam RM, Ng S *et al.* (2017) Determinants of eating at local and western fast-food venues in an urban Asian population: a mixed methods approach. *Int J BehavNutr Phys Act***14**, 69.

52. Joseph N, Nelliyanil M, Rai S *et al.* (2015) Fast Food Consumption Pattern and Its Association with Overweight Among High School Boys in Mangalore City of Southern India. *Journal of clinical and diagnostic research : JCDR***9**, Lc13-17.

53. Villa-Gonzalez E, Ruiz JR, Ward DS *et al.* (2016) Effectiveness of an active commuting school-based intervention at 6-month follow-up. *Eur J Public Health***26**, 272-276.

54. Katapally TR, Goenka S, Bhawra J *et al.* (2016) Results From India's 2016 Report Card on Physical Activity for Children and Youth. *Journal of physical activity & health***13**, S176-s182.

1. A sport of Indian origin played by teams of seven on a circular sand court. The players attempt to tag or capture opponents and must hold their breath while running, repeating the word "Kabaddi".  [↑](#footnote-ref-1)
2. Brand of corn puffs (corn snack baked in vegetable oil) [↑](#footnote-ref-2)
3. Ice lolly with artificial colours and flavours [↑](#footnote-ref-3)
4. Fast food snack consisting of a deep fried potato dumpling placed inside a bread bun [↑](#footnote-ref-4)