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Do Boys Eat Better than Girls In India? Longitudinal Evidence on Dietary Diversity and Food Consumption Disparities among Children and Adolescents

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ABSTRACT

This paper examines the dynamics of gender-based disparities in the intra-household allocation of foodduringchildhood and adolescence in India by using three rounds of longitudinal data from two cohorts. While no gender-based disparities in dietary diversity occur at 5, 8 and 12 years old, a marked pro-boy gap emerges at 15 years old. Specifically, mid-adolescent girls tend to consume fewerprotein- and vitamin-rich foods such as eggs, legumes, root vegetables,fruit and meat.This result is robust to gender differences between adolescents in terms of puberty onset, time use and dietary behaviours. Finally, gender disparitiesin dietary diversityinmid-adolescence do not vary by maternal education, poverty or place of residence, whilst they are moderated by levels ofthe caregiver's educational aspirations. Specifically, the pro-boy bias is particularly marked amongst adolescents with 'academically aspiring' caregivers.

Keywords: Gender; Dietary diversity; India; Intra-household dynamics; Adolescents

Classification codes: J130; J160; I140; I132

PAPER

1. Introduction

In India,undernutrition and micronutrient deficiencies are widespread, despite rapid economic growth (Deaton andDrèze 2009). Analysis of the latest national-level data available (from 2005)shows no significant differences in stunting between boys and girls under the age of 5 years (Tarozzi 2012;Corsiet al. 2015).Employing the same data, Tarozzi (2012) documents a gender-neutral situationin terms of anaemia for children under5 years old. The evidence on gender-based discrimination in feedingpractices, conversely, is mixed: while infantgirls appear to be systematically breastfed for shorter periodsthan boys (JayachandranandKuziemko 2012; Barcelloset al. 2014; Fledderjohann et al. 2014),there is no conclusive indication of a female disadvantage with regard to the intra-household allocation of foodin the case ofpre-schooland school-age children. For instance, Borooah (2004) demonstratesa pro-boy bias in dietary diversity only in the case of children aged up to 24 months born to illiterate mothers, whileDasGupta (1987) reportsthat infant girls and boys receive similar caloric intakes, although girls tend to be fed with more cereals while boys are given more milk and fats. In a more recent paper, Fledderjohann et al (2014) also report higher chances of milk consumption for under-5 boys as compared to their peers.Further, Kehoe et al. (2014) report no gender differentials in the dietary patterns of 10-year-olds in South India.

The absence of evidence related to gender-based gaps in anthropometric indicators[1] and the relativelynuanced picture with regard to feeding practicescontrasts to a wide literature documenting stark pro-boy biases in other dimensions of child development in India. Girls' disadvantage is systematically reflected in higher selective abortions and under-5 mortality rates (Jha et al. 2011; Tarozzi 2012), as well as in lower levels of immunisation (Prustyand Kumar 2014),worse educational outcomes (Derconand Singh 2013; Woodhead et al. 2013) and lower aspirations (Derconand Singh 2013; Beamanet al.2012).These pro-boy biases appearto start early – often even before children are born – and tend to increase as children are reaching adolescence (Pells 2011; Derconand Singh 2013).

In contrast to the evidence for young children, the 2005 nationally representative data revealsizeablegender inequalities in diets and nutrition indicators in the case of adults.

[1] Possible explanations for the absence of gender gaps in nutrition can relate to the mixed evidence on dietary practices or, as suggested by Marcoux (2002), to the higher biological resilience of girls.

Compared to males, Indian femalesaged 15–49 years old appear to be systematically consuming nutrient-rich foods less frequently and to be twice aslikely asmen to suffer fromanaemia,anon-communicable condition often caused by nutritionally inadequate diets (IIPS 2007; Arnold et al. 2009). The question of when such gender differentials in dietary and health outcomes emerge is, as yet, open, owingmostlyto adearth of large-scale surveys for groups other than pre-schoolers and adults (Kehoe et al. 2014). Longitudinal data are particularly scarce. In turn, the lack of systematic evidence on nutritional indicatorsdisaggregated by age and genderstands as a critical knowledge gap for the optimal design of policies that targetgroups at particular risk,such as adolescent girls and pre-pregnant women (Haddad et al. 1997; Coffey 2015).

This paper attempts to address this question for the first time by employingrich, longitudinaldata from Young Lives.Specifically, by using three rounds of survey data collected in 2006, 2009 and 2013 on two cohorts of children in Andhra Pradesh and Telangana, which together account for the fifth-largest population in any state in India[2], to document the associations between dietary diversity and gender at 5, 8, 12 and 15 years old, after controlling for a large set of child and household characteristics.

Individual dietary diversity is a synthetic measure of dietary quality(Ruel 2002). The indicator is associated with intakes of macro- and micronutrients, as well as with anthropometrics and health outcomes (Arimond and Ruel 2004). A diet that includes a balanced mix of foods rich in protein and vitamins – from items such as dairy products, eggs, meat and fish, and fruits and vegetables – is fundamental for the proper physical and cognitive development of children and adolescents, who are particularly vulnerable to malnutrition owing to their higher nutrient requirements and vulnerability to infectious diseases (Steyn et al. 2006). Qualitative evidence shows that both children and parents in theYoung Lives India sample attach intrinsic value to a varied and good-quality diet, beyond its role in promoting health outcomes (Aurino and Morrow 2015).

The analysis presented in this paper shows that while no gender disparities in dietary diversity existed at 5, 8 or 12 years old, or only slight ones, a pro-boy gap of almost half of a food group emergedat 15 years. Boys' advantage in dietary quality is mostly driven by the consumption of protein- and vitamin-rich foods, such as eggs, legumes, root vegetables, meat and fruit. The result is robust to the inclusion of indicators related to puberty, time use and dietary behaviours. Moderation analysis explores furtherwhether the pro-boy advantage during mid-adolescence varies by levels of maternal education, poverty, place of residence, orcaregiver'seducation aspirations as a proxy measure for parental attitudes towards the adolescent.

While no differences are detected along the maternal education, poverty orplace of residence axes,the treatment of adolescent boys and girls in respect of receiving a nutritious diet varied according to the levels of caregivers'aspirations.Specifically,the pro-boy gap is particularly marked amongst adolescents with 'academically aspiring'caregivers.Although the framework employed in this paper only allows for descriptive evidence and not full causal analysis, this result is suggestive that parental attitudes and aspirations towards the adolescent may constitute an exacerbating factor for gender differentials in diet during mid-adolescence. This evidenceis particularly relevant to the Indian context, for several reasons. First, the country is home tothe highest population of 10-to24-year-olds in the world (UNFPA 2014). Adolescent health, particularly that ofgirls, has been madea key policy priority in order to enable the country to benefit from the demographic dividend, as underscored by the 2014 National Youth Policy (Government of India 2014). Secondly, India bears one of the highest burdens of malnutrition globally, both for children and women (Coffey 2015). As child-bearing is concentrated in the age range in which Indian women are most likely to be underweight, improving dietary habits for adolescent girls and pre-pregnant women, beyond representing a development objective per se, can helpto break the transmission of malnutrition from one generation to the next (Black et al. 2013; Coffey 2015).

This analysis contributes to the literature in various ways. First, it adds to previous economicsresearch on gender-based inequalities in children's dietary practices in India (Borooah 2004; JayachandranandKuziemko 2012; Barcelloset al. 2014; Fledderjohann et al. 2014). In contrast to these studies, which focus on children under5 years of age (usually with cross-sectional data), this paper focuses on school-age children and adolescents, and presents adynamic picture of gender differentials in dietary qualityas children grow up and transition to adolescence.Further, by providing evidence from a large sample, it complements two strands of literature: on the one hand, it adds to the knowledge base on children and adolescents' dietary diversityin low-resource settings, which is still quite limited, and usually relies on rather small and cross-sectional samples (Kehoe et al. 2014).[3] On the other, it complements previous anthropological and demographicevidence that documents gender-based variation in the intra-household allocation of food to children ofdifferent ages in India and South Asia (Gittelsohn 1991; Dasgupta 1987, 1997;Palriwala 1993;Harriss 1991; Messer 1997; Mondal 2009).

The paper proceeds in the following way: Section 2 introduces the data, while Sections 3 and 4 respectively present the basic results and some possible explanations for the emergence of the gap during mid-adolescence. Section 5 explores the role of potential moderating factors in exacerbating or moderating gender differentials during mid-adolescence. Section 6 concludes.

[2] Thesestateswereuniteduntil June 2014, with a joint population of 84 millionpeople in 2011. Since the data I use werecollectedbefore the division, I will from nowongenericallyrefer to "AndhraPradesh".

[3] An exception is Woldehannaand Behrman (2013) who use data from the Young Lives Younger Cohort children in Ethiopia to analyse dietary diversity for children at 5 and 8 years old.

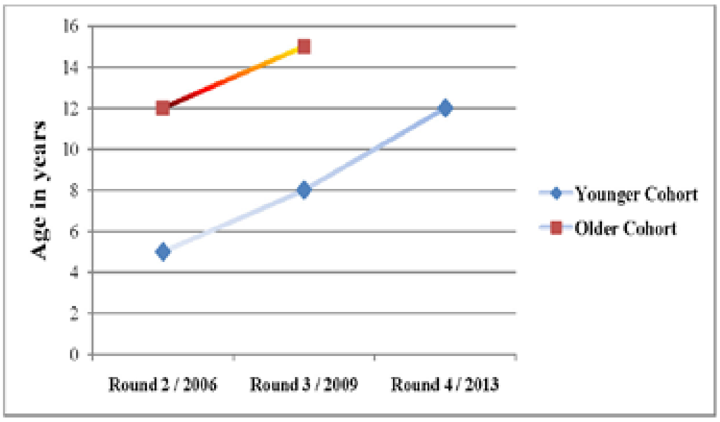
2. Materials and Methods

2.1. Sample

This paper draws on data on two cohorts of children collected by the Young Lives study in the state of Andhra Pradesh, India[4]. The sample was selected through a 'pro-poor' and multi-stage sampling procedure: first, local experts selected 20 'sentinel sites' or clusters per country whileoversampling sites covering more disadvantaged areas. Within each sentinel site, 100 households with a child born in 2001–02 and aged between 6 and 18 months (Younger Cohort) and 50 households with a child born in 1994–5 aged between 7 and 8 years (Older Cohort) were randomly selected (Barnett et al. 2012). For this reason, the sampleis not nationally representative, although careful comparisons with nationally representative surveys show that the variability in the Young Lives sample is comparable to the variabilitythat can be observed in the population as a whole (ibid.).

This analysis draws on data collected in Rounds 2, 3 and 4 of the survey, which took place in 2006, 2009 and 2013 respectively. Younger Cohort children were aged approximately 5, 8 and 12 years old in Rounds 2, 3 and 4, while Older Cohort children were aged 12 and 15 years old in Rounds 2 and 3 (see Figure 1). The first round of survey is not included in this analysis as it didnot includea section on dietary diversity, while the latest round of data for the Older Cohort sample is excluded for two reasons: first, this paper focuses on childhood and adolescence, and second, about half of the Older Cohort sample, at 19 years old,had left their households to get married, which could potentially lead to issues of comparability of dietary patterns with previous rounds. Attrition in the Young Lives sample is extraordinarily low: 95 per cent of the initially surveyed Younger Cohort children were still in the sample in Round 4, and 97 per cent of the Older Cohort sample was tracked until Round 3. Nonetheless, the analytical sample for this analysis was restricted to those children that were present in all the relevant rounds (n=1,915 for the Younger Cohort and n=976 for the Older Cohort) in order to address potential concerns that changes over time may be partially driven by different sample sizes and sample composition.[5]

Figure 1. Data structure, by cohort and round



2.2. Dependent variables

Dietary diversity relates to the number of food groups consumed by an individual in a given reference period (Ruel 2002). The Young Lives study collected data on the child's consumption in the previous 24 hours of 13, 17 and 15 food items in Rounds 2, 3 and 4 respectively[6]. Data werereported by the caregiver in the case of children aged 5 and 8 years old, and by the child in case of 12- and 15-year-olds.

Data on food items were rearranged into seven food groups in order to construct the dietary diversity measure proposed by Swindale and Bilinski (2006):(i) grains, roots or tubers; (ii) fruits and vegetables; (iii) meat, offal and fish,[7] (iv) eggs; (v) pulses and legumes; (vi) milk and dairy products; (vii) food cooked in oil or fat.

[4] Young Livesis an internationalstudy of childhoodpovertythatfollowstwocohorts of children in Ethiopia, India, Peru and Vietnam. More information isavailableat www.younglives.org.uk.

[5] Results are robust to the use of the full sample for each round.

[6] This information does not include quantities of food consumed, which implies that it is not possible to conduct any further analysis beyond consumption of the items.

[7] In Rounds 2 and 3, fieldworkers were instructed to code eggs meat and fish as 'not applicable' if the child was vegetarian. In practice they were however coded as missing values. In order to avoid the loss of information stemming from these missing values, meat and fish were recoded as if they had not been consumed if the following conditions held: (i) both variables simultaneously missing; and (ii) all the remaining questions related to the consumption of the other food items were not missing. The same was done in the cases of children having simultaneous missing values for eggs, meat and fish and all the remaining food groups not missing. This resulted in a recoding of 56and 40 observations in Round 2 and 106 and 54 observations in Round 3 for the Younger Cohort and Older Cohort respectively. A vegetarian variable was created following this recoding and used as a control in the analysis.

The dietary diversity measure accordingly ranges from 0 to 7, which respectively indicates whether the child has consumed any or all of the food groups in the past 24 hours. This index was selected as it is specifically validatedto provide a proxy of nutritional status of children and adolescents in low- and middle-income countries.[8]

In order to allow for an in-depth analysis of which food items would drivethe variation in the aggregate dietary diversity measure, dichotomous variables related to the consumption of the following ten food items were also constructed: (i) cereals, (ii) starchy roots; (iii) legumes; (iv) milk and dairy products; (v) eggs; (vi) meat; (vii) fish; (viii) oil and fats; (ix) fruit; and (x) vegetables.

Descriptive statistics regarding dietary diversity and the consumption of food items ineach round and by each cohort are reported in Table 1.In comparison to other studies conducted in low-resource settings,[9] dietary diversity in this sampleisrelatively low at all ages and for both cohorts, with an average consumption of about four food groups in the previous 24 hours. Most young peopletended to consume cereals, oil and vegetables, with substantial variation with regard to the consumption of animal-source foods or fruits, rootsand legumes.

Table 1 - Descriptive statistics: Dietary diversity and consumption of different food items among children at different ages and in both cohorts (mean withstandard deviation in parentheses)

	Younger Cohort			Older Cohort	
	Age 5	Age 8	Age 12	Age 12	Age 15
Dietary diversity	4.22	4.25	4.16	4.13	4.17
	(0.92)	(0.80)	(0.87)	(0.98)	(0.84)
Cereals	0.99	0.98	0.95	0.99	0.97
	(0.08)	(0.15)	(0.23)	(0.11)	(0.16)
Roots	0.30	0.36	0.41	0.30	0.37
	(0.46)	(0.48)	(0.49)	(0.46)	(0.48)
Legumes	0.45	0.29	0.24	0.39	0.33
	(0.50)	(0.45)	(0.43)	(0.49)	(0.47)
Milk	0.65	0.83	0.74	0.64	0.78
	(0.48)	(0.38)	(0.44)	(0.48)	(0.41)
Eggs	0.18	0.20	0.24	0.19	0.19
	(0.38)	(0.40)	(0.43)	(0.39)	(0.39)
Meat	0.10	0.11	0.14	0.10	0.13
	(0.30)	(0.31)	(0.34)	(0.30)	(0.34)
Fish	0.05	0.02	0.03	0.06	0.02
	(0.21)	(0.15)	(0.18)	(0.25)	(0.16)
Oil	0.96	0.94	0.97	0.92	0.90
	(0.20)	(0.23)	(0.18)	(0.27)	(0.31)
Fruit	0.42	0.31	0.44	0.41	0.34
	(0.49)	(0.46)	(0.50)	(0.49)	(0.47)
Vegetables	0.94	0.97	0.97	0.93	0.97
	(0.24)	(0.16)	(0.18)	(0.26)	(0.18)

[8] In contrast to Swindale and Bilinski, Round 2 data did not allow for the distinction between 'Vitamin A-rich plant foods' and 'Other fruits and vegetables', which resulted in the generation of seven food groups instead of the original eight groups, as it would not have been possible to compare dietary diversity between Round 2 and Rounds 3 and 4.

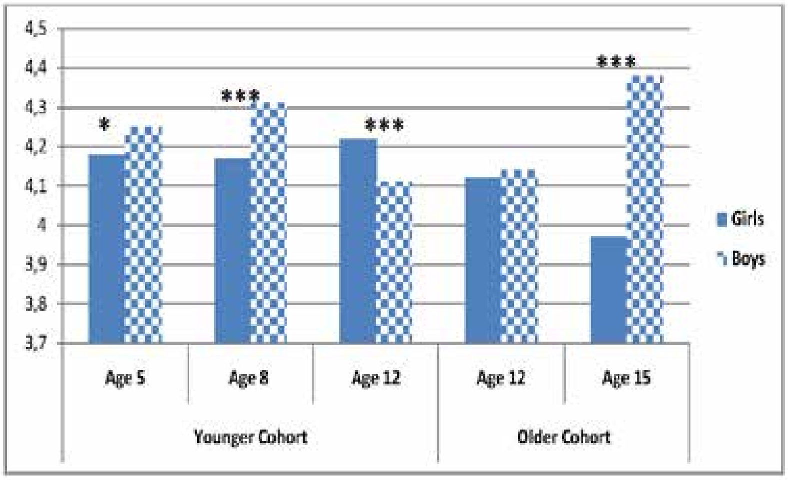
[9] See Steyn et al. (2006) for a review.

3. Results

3.1 Basic result: the emergence of gender-based gaps in dietary diversity during mid-adolescence

Figure 2 presents mean values of the dietary diversity measure disaggregated by child gender and cohort for each round of data.While genderdisparities are statistically significant at all ages except for 12-year-old Older Cohort adolescents, the gap is particularly marked at 15 years old. At this age, the pro-boy difference in dietary diversity accountsfor more than 40 percentage points of a food group.

Figure 2 - Mean of children's dietary diversity by gender, for each cohort and round



*$p<0.1$, ***$p<0.01$

Would the observed gender-based gaps at different ages be significant even after controlling for child- and household-specific factors that are likely to influencedietary quality? To address this question, I rely on a standard multivariate set-up:

$$y_{ij,t} = \beta_0 + \beta_1 M_{ij} + \beta_2 X_{ij,t} + \gamma_j + \varepsilon_{ij,t} (1),$$

where$y_{ij,t}$ relates to dietary diversity of child i, living in cluster[10]$j$and measured at time t;M_{ij} is a dichotomous variable related to child gender, and $X_{ij,t}$relates to contemporaneous observable child, parental and household characteristics. Additionally, γ_j is a vector of time-invariant community characteristics and $\varepsilon_{ij,t}$ is the error term. The vector of child and household covariates$X_{ij,t}$ includesthe following covariates: child caste and birth order; maternal and parental years of schooling;[11]gender of the head of the household; and household's size and the logarithm of consumption per capita in rupees.The set of covariates also includes adichotomous variable related to whether the child wasvegetarian, another to whether an older brother was living in the householdand an interaction term between being a girl and having an older brother. The former controls for the lacto-vegetarian diet pattern, which is common amongst Hindu children (Kehoe et al. 2014), whilethe latter two control for the demographic characteristics of the siblings, which JayachandranandPande

[10] Cluster and community are used as synonyms.

[11] Religious and adult education were recoded as 0 years of education.

Table 2 - Descriptive statistics:Child and household characteristics, by age and cohort (mean withstandard deviations in parentheses)

Variable	Younger Cohort Age 5	Younger Cohort Age 8	Younger Cohort Age 12	Older Cohort Age 12	Older Cohort Age 15
Male	0.53	0.53	0.53	0.49	0.49
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Scheduled Caste[a]	0.18	0.18	0.18	0.20	0.20
	(0.39)	(0.39)	(0.39)	(0.40)	(0.40)
Scheduled Tribe	0.13	0.13	0.13	0.10	0.10
	(0.33)	(0.33)	(0.33)	(0.30)	(0.30)
Backward Caste	0.48	0.48	0.48	0.49	0.49
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Other Caste	0.21	0.21	0.21	0.21	0.21
	(0.41)	(0.41)	(0.41)	(0.40)	(0.40)
Child is Hindu	0.91	0.91	0.91	0.92	0.92
	(0.27)	(0.27)	(0.27)	(0.27)	(0.27)
Vegetarian	0.03	0.05	0.13	0.05	0.06
	(0.17)	(0.23)	(0.34)	(0.22)	(0.23)
Child birth order	2.03	2.03	2.03	2.33	2.33
	(1.12)	(1.12)	(1.12)	(1.38)	(1.38)
Child has male older brother	0.32	0.32	0.32	0.41	0.41
	(0.47)	(0.47)	(0.47)	(0.49)	(0.49)
Girl has elder brother	0.15	0.15	0.15	0.21	0.21
	(0.36)	(0.36)	(0.36)	(0.41)	(0.41)
Mother's years of education	3.50	3.51	3.50	2.54	2.54
	(4.39)	(4.39)	(4.39)	(3.96)	(3.96)
Father's years of education	6.24	6.22	6.24	5.30	5.30
	(6.21)	(6.19)	(6.21)	(6.19)	(6.19)
Household head is female	0.01	0.01	0.01	0.08	0.08
	(0.12)	(0.12)	(0.12)	(0.27)	(0.27)
Logarithm consumption expenditure	6.58	6.66	6.73	6.69	6.81
per capita	(0.53)	(0.53)	(0.60)	(0.55)	(0.55)
Household size	6.5	6.82	6.99	5.85	6.13
	(2.74)	(3.01)	(3.12)	(2.31)	(2.64)
Observations	1915	1915	1915	976	976

[a]Caste in India is divided into four official categories. Scheduled Tribes, Scheduled Castes and Backward Classes are recognised in the Constitution of India as historically disadvantaged, while Other Castes are the more privileged and socially and educationally advantaged castes.

Table 3 presents theempirical results based on the specification outlined above, where the relationship between dietary diversity and child genderfor each cohort and age is estimated through ordinary least square (OLS) regressions with community fixed effects.[12] Communityfixed effects are included in order to control for the set of environmental factors "that are reasonablyconstant over time (e.g. agro-ecological characteristics, cultural preferences around food, etc.), as they may affect the diets of children living in differentcommunities.[13] A potential drawback of the OLS approach is that it may lead to biased estimates of the gender coefficient because ofthe potential correlation between child gender and unobservable child and parental characteristics that may affect the intra-household allocation of good food. While this issue is partially taken into account by the child and household controls included in the model, the present empirical strategy only aims at documenting patterns of associations between child gender, age and diet, and not at claiming causal findings.

12 The use of the OLS model implies treating the dietary diversity variable as continuous, as in Amugsiet al.(2015) or Jones et al.(2014). This choice was motivated by the ease of the interpretation of the linear model as compared to alternatives such as ordered logistic regression. Sensitivity analysis undertaken through ordered logit models confirms that the choice of the linear model does not distort the findings (results available from the author).

13 A similar approach is taken by Derconand Sánchez (2013), who use the terms 'community' and 'cluster' synonymously.The use of this technique however inevitably reduces theR-squared of the regression models. I use Round 2 as the reference sentinel site for the community fixed effects.

As compared to the difference-in-means approach presented in Figure 2, the male coefficient now provides a measure of the magnitude and statistical significance of the gender-based gap after controlling for child- and household-specific characteristics and community heterogeneity. With the exception of 12-year-old children in the Younger Cohort, the male coefficient is always positive, which indicates that boys tend to enjoy better diets at different ages. However, the association between gender and diet is only statistically significant at 15 years old, accounting for about half of a food group.

The coefficients of the childand household covariates reveal other interesting patterns. As expected, child dietary diversity is positively associated withincreases in household consumption levels, while the relation between caste and diet variesby age and cohort. Additionally, while at earlier stages of childhood, factors related to socio-economic status such as household consumption levels and caste seem to be driving most of the variation in children's diets, at 15 years old gender appears to be the most critical factor associated withimproved dietary diversity levels. Other potential explanatory factors such as household size and father's years of education do not seem to contribute strongly to children's dietary diversity, while maternal education appears to be weakly associated withbetter diet only at 12 and 15 years old.A similar lack of association between parental education and children's diets in South India is found in Kehoe et al. (2014). This may be explained by the correlation of parental education with household socio-economic status, which is controlled for by consumption levels, and/or by the widespread recognition amongst caregivers of the importance of nutritious diets for child development, irrespective of their education status (Aurino and Morrow2015). In contrast to Jayachandran and Pande (2015), whofind a strong birth order gradient and disadvantage in anthropometric indicators for second-born young girls who donot have elder brothers, no association with dietary quality is found in this sample.

Table 3 - Dietary diversity, by round and cohort (OLS estimates)

	(1) Age 5 (YC– Round 2)	(2) Age 8 (YC– Round 3)	(3) Age 12 (YC– Round 4)	(4) Age 12 (OC– Round 2)	(5) Age 15 (OC– Round 3)
Male	0.101	0.105	-0.090	0.025	0.436***
	(0.068)	(0.061)	(0.062)	(0.122)	(0.099)
Scheduled Caste	-0.168	-0.155**	-0.109	0.026	0.014
	(0.099)	(0.069)	(0.067)	(0.117)	(0.084)
Scheduled Tribe	-0.206**	-0.002	-0.026	-0.072	0.138
	(0.086)	(0.067)	(0.126)	(0.114)	(0.085)
Backward Caste	-0.097	0.010	-0.063	-0.053	0.048
	(0.065)	(0.056)	(0.055)	(0.091)	(0.064)
Child is Hindu	-0.087	-0.072	0.121	0.012	0.145
	(0.099)	(0.050)	(0.072)	(0.108)	(0.130)
Child is vegetarian	0.169	-0.171	-0.207**	0.167	0.059
	(0.115)	(0.100)	(0.076)	(0.112)	(0.085)
Child birth order	0.023	0.005	0.010	-0.018	-0.006
	(0.020)	(0.025)	(0.028)	(0.023)	(0.025)
Child has older brother	-0.024	-0.110**	0.008	0.037	0.046
	(0.058)	(0.040)	(0.061)	(0.097)	(0.101)
Girl has older brother	0.003	0.011	0.025	-0.047	0.002
	(0.075)	(0.060)	(0.066)	(0.106)	(0.100)
Mother's years of education	0.008	0.004	0.012*	0.027***	0.012*
	(0.006)	(0.005)	(0.006)	(0.009)	(0.006)
Father's years of education	0.001	0.005*	-0.000	-0.003	0.003
	(0.005)	(0.003)	(0.002)	(0.004)	(0.004)
Household head is female	-0.059	-0.024	0.096	0.127	-0.023
	(0.181)	(0.140)	(0.120)	(0.116)	(0.104)

Table 3 segue **- Dietary diversity, by round and cohort (OLS estimates)**

Logarithm consumption expenditure per capita	0.446***	0.287***	0.072	0.234***	0.108**
	(0.090)	(0.053)	(0.051)	(0.065)	(0.047)
Household size	0.021***	0.005	-0.002	0.008	0.012
	(0.007)	(0.005)	(0.007)	(0.015)	(0.010)
Constant	1.198*	2.321***	3.637***	2.480***	2.923***
	(0.608)	(0.368)	(0.380)	(0.457)	(0.383)
Observations	1,829	1,829	1,823	941	939
R-squared	0.093	0.063	0.020	0.038	0.085
Communityfixed effects?	YES	YES	YES	YES	YES
Adj. R- squared	0.09	0.06	0.01	0.02	0.07

*Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

The results presented so far show the emergence of gender-based gaps in dietary diversity during mid-adolescence. Gender- and age-specific gaps in dietary diversity are explored further by pooling data from the Younger and Older cohorts and treating them as repeated cross-sections. Specifically, I estimate the following model:

$$y_{ij,t} = \beta_0 + \beta_1 M_{ij} + \beta_2 X_{ij,t} + \beta_3 M_{ij} * Age_{ij,t} + \beta_4 Cohort_{ij} + \beta_5 Age_{ij,t} + \gamma_j + \varepsilon_{ij,t} \, (2).$$

Dietary diversity is now a function of the male dummy, the set of child and household characteristics introduced above, male–age interactions, and cohort and age dummies. Male–age interactions are included in order to capture gender-specific gaps in the way parents allocate foods at a given age. Cohort- and age-specific dichotomous variablesrespectively relax the assumptions that the relation between age and diet is the same across different stages of child development, and that structural patterns in diets are invariant across the two cohorts. Column 1 in Table 4 presents results from this pooled model, where only the coefficients related to male and the male–age interactions are displayed, as they constitute the parameters of interest of this model. [14] Estimates have been obtained through OLS,including communityfixed effects. In line with the results presented in Table 3, Column 1 shows that there are no statistically significant differences in thedietary diversity indicatorbetween being a boy at 8 and 12 years old as compared to the baseline category of 5-year-old girls. In contrast, the coefficient associated with15-year-old boys is strong and significant, accounting for about 35 percentage points of the dietary diversity measure, which corroborates the finding related to the emergence of gender differences in dietary quality during mid-adolescence.

With regard to the other controls, the key patterns of association between child and household covariates and dietary diversity do not substantially change from the ones shown in Table 3.[15] Specifically, the negative association with marginalised castes (as compared to the omitted category of Other Caste) and the positive association with household consumption levels become stronger. No statistically significant association between dietary diversity and age or cohort is found.

Which foods are driving the observed gender-based variation in dietary diversity during mid-adolescence? Columns 2–7 in Table 4 address this question, where the outcome variables now relate to the consumption of the differentfood items. Results related to the food itemsthat mostly relate to protein and micronutrient intakes are reported[16]. Estimateswere conducted through the use ofthe linear probability model (LPM) with community fixed effects.[17] At 15 years old, girls are systematically less likely to consume protein-rich foods such as legumes, eggs and meat, and vitamin-rich foods such as fruit and roots as compared to when they were aged 5 years old. At 15 years old, the male–age interaction is also positively associated withthe consumption of milk, although the coefficient is not significant. Additional gender–age gaps emerge from the analysis of the interactions at the other ages considered. Five-year-old boys are more likely to consume milk and vegetables, while at 8 years old boys tend to consume more legumes. In contrast, at 12 years old girls tend to eat more eggs. This last pattern is driven by the Younger Cohort sub-sample.

Notably some of the highlighted gender and age gaps relate particularly to the consumption of some 'unitary' food itemssuch as milk, fruit and eggs. In a context such as India, where meals are usually shared from the same pot, parents may be able to discriminate betweensiblings by providingan egg, a piece of fruit or a glass of milk to the preferred child at a given age.

14 Full results are available upon request.

15 Full results are available upon request.

16 No significant result emerged for cereals and oil.

17 Although the variables related to the consumption of each food group are binary, a linear model was preferred, as in the case of dietary diversity. This choice is due to its easier interpretability as compared to non-linear models, and as it usually provides a good approximation of the response probability for common values of the covariates (Wooldridge 2010).

Table 4 - Dietary diversity and consumption of different food items (pooled data, OLS and LPMestimates, main results)

	(1) Dietary diversity	(2) Roots	(3) Legumes	(4) Milk	(5) Eggs	(6) Meat	(7) Fruit
Male	0.078	−0.000	0.002	0.047*	−0.004	-0.004	−0.003
	(0.059)	(0.023)	(0.032)	(0.027)	(0.016)	(0.010)	(0.021)
Male*8 years old	0.043	0.024	0.080**	0.008	0.018	0.032	0.004
	(0.073)	(0.041)	(0.035)	(0.030)	(0.028)	(0.021)	(0.028)
Male*12 years old	−0.130	−0.021	0.028	−0.042	−0.045**	0.003	0.023
	(0.076)	(0.029)	(0.029)	(0.035)	(0.019)	(0.020)	(0.034)
Male*15 years old	0.359***	0.141***	0.251***	0.025	0.087*	0.045*	0.080**
	(0.091)	(0.039)	(0.058)	(0.045)	(0.045)	(0.026)	(0.037)
Constant	2.389***	−0.136	0.338*	−0.237**	−0.169*	-0.087	- 0.397***
	(0.311)	(0.108)	(0.168)	(0.106)	(0.083)	(0.061)	(0.115)
Observations	7,361	7,360	7,359	7,360	7,361	7,348	7,361
Child and household covariates?	YES	YES	YES	YES	YES	YES	YES
Community fixed effects?	YES	YES	YES	YES	YES	YES	YES
Adj. R-squared	0.04	0.02	0.04	0.08	0.02	0.03	0.04

*Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

These findings echo a body of literature in the social sciences that reports gender- and age- based differences in the allocation of higher-quality food in South-Asian households (Gittelsohn 1991; DasGupta 1991; 1997, Harriss 1991; Palriwala 1993). In particular, Harriss (1991) and Gittelsohn (1991), in India and Nepal respectively, report no preferentialtreatment of young children based on gender with regard to nutrition inputs, and the emergence of gender-based disparities during adolescence. This may relate to adolescence being a stage in whichgender norms – including those about food - may become more pronounced. In particular, Gittelsohn's description is rather suggestive:

- While differences were never as severe as for older household women, adolescent girls were disfavored in food allocation. It is at this stage of their lives that they begin to assume many household domestic responsibilities, such as water-fetching, wood collection and food preparation. No longer children, they were served later in the meal, often in the same eating group as the mother. ...On the other hand, adolescent boys were automatically served and frequently offered second helpings ...They were also given moderate-level preference in terms of substitution and channeling, occasionally receiving special foods, and they tended to receive a great amount of food proportionate to body size.
(Gittelsohn 1991: 1152)

3.2 Is the gap explained by puberty, time use and dietary behaviours?

The results from the previous section highlighted the emergence of gendergaps in diet during mid-adolescence, after controlling for a variety of observable child- and household-specific characteristics that can influence dietary quality. Nevertheless, mid-adolescent boys and girls may differ systematically insome dimensions, which may represent potential explanations for the emergence of the gap at 15 years old.

Differencesbetweenthe timing of the pubertal growth spurt ofgirls and boys, which under optimal growth conditions usually occurs at 11 years old in girls and 13 years in boys (Rogolet al. 2000), can be one of those factors. Puberty is a phase of radical physical changes, including significant height and weight gain, and increased nutritional requirements. It may therefore beplausible that parents, by witnessing the rapid growth of the adolescent during this stage, would provide him/her with a more varied diet and with foods of higher nutritional quality. Following this line of reasoning, the pro-boy gap at 15years old would arise due to the lateronset of puberty for boys as compared to girls.

Similarly, the gendergap may be driven by systematic differences in time-use patterns between boys and girls that get more pronounced in adolescence, which may in turn influence how parents allocate foods within the household. Time use is highly gendered in India, with girls spending more time on unpaid domestic work and boys being more likely to be engaged in paid work and education (Beamanet al.2012). As genderinequalities in time use tend to widen after puberty (Pells 2011), the emergence of the gap at 15yearsold may be explained by parental bias in the intra-household distribution of food towards the adolescent that contributes most to the family budget through farm or off-farm employment, or that spends more time at school or studying, which in both cases is usually the male (Harriss 1991; Pells 2011; Derconand Singh 2013).

By the same token, adolescent boys and girls may differ significantly with regard to their dietary behaviours, as research from both advanced economies and middle-income countries shows that genderdifferentials along this dimension tend to appear during adolescence. Compared to boys, adolescent girls – even in middle-income countries such India -generally display higher levels of dissatisfaction with regard to their body weight, which in turn is associated withgreater prevalence of restrictive dietary practices among females (CardamoneCusatisand Shannon 1996; Mallicket al. 2014; Stuparet al. 2012). Accordingly, the observed gender-based gap at 15 years old may be the result of adolescent girls' deliberate choicestocontrol their dietary behaviours in order to curb body weight gain, instead of skewed parental allocation of food towards boys of the same age.

The presence of systematic gender differentials between adolescent boys and girls in these three dimensions seems to be corroborated by the data. Table 5 presents gender-based differences between boys and girls in terms of puberty onset, time-use patterns, and dietary behaviours at 15 years old.Puberty is proxied by an indicator of height differences between 15 and 12 years old, as one of the distinguishing features of puberty is the growth spurt, where girls peak height velocity at 12 years and boys two years later (Rogolet al. 2000). On average, Older Cohort boys gained about 15 cm between Rounds 3 and 2, while girls gained 9 cm. As hypothesised, significant gender-based differences can be noted in the time-use indicators. In particular, girls reported that they tended to spend almost twomorehours than boys on household chores or caring for other family members. By contrast, boys tended to spend an additional hour per day in school or studying compared to girls. Surprisingly, there wereno gender differences in the time spent on work on the family farm or for pay.Lastly, gender differences were noticeable with regard to two indicators ofdietary behaviour:(i) number of meals(including snacks) they reported having consumedin the previous day and (ii) days per week in which the adolescent had been engaged in at least one hour of intense physical activity such as running, cycling, etc. The patterns emerging from the data are consistent with the hypothesis that adolescent girls are more likely to adopt weight-control strategies such as skipping meals orundertakingintense physical activitymore frequently than boys (CardamoneCusatisand Shannon 1996; Mallick et al. 2014).

Table 5 - Gender differences in puberty onset, time use and dietary behaviours

	Girls	Boys	Difference (Girls – Boys)
Difference in height (cm), 15–12 years old	8.69	15.20	−6.51***
Hours spent at school or studying	7.92	8.90	−0.98***
Hours spent on leisure activities	3.96	4.26	−0.30**
Hours spent on household care/chores activities	2.47	0.94	1.54***
Hours spent on family farm or business	0.45	0.54	−0.09
Hours spent on work for pay	1.03	1.05	−0.02
Number of meals on the previous day	4.49	4.69	−0.20***
Days featuringintense physical activity over last week	4.18	3.79	0.39**

*** p<0.01, ** p<0.05, * p<0.1

In order to investigate whether these factors explain the emergence of the gap in dietary qualityat mid-adolescence, two different approaches were adopted. With regard to puberty and time use, the basic cross-sectional model of Equation 1 was augmented by the relevantindicators in two separate modelsfor the sample of 15-year-olds. If puberty and/or time use are correlated withthegender-based gap, both a statistically significant association of these indicators withdietary diversity, and a change in the size and statistical significance of the male coefficient would be expected. Column 1 of Table 6presentsthe estimates for the baseline model for the reader's convenience, while Columns 2 and 3 present theresultsof the models that incorporate puberty and time use respectively. F-tests and Chow tests of equality of male coefficients in the different models (as compared to the estimate of the male coefficient from the baseline model) are also presented. Neither the puberty nor the time-use variablesare statistically associated withdietary diversity. Despitethe fact that the size of the male coefficient decreased slightly after the indicator of puberty was included, the Chow testconfirmedthe null hypothesis of the absence of statistical differences between the male coefficient from the augmented model and the baseline model. Similar results emerge when a different indicator of puberty (related to the age at which it occurs) was included, which are not shown here.

With regard to the hypothesis related to systematic gender differences in dietary behaviours, Columns 4 and 5 present the result of two models in which the two indicators of dietary behaviours were used as dependent variables in the multivariate model ofEquation 1. Once child and household characteristics are controlled for, no significant gender-based differences in dietary behaviours arenoticeable. Taken together, these results suggest that potential systematic differences between adolescent boys and girls in terms of pubertal growth spurt, time use and dietary behaviours are not able to explain the emergence of the gender gap in dietary diversity at 15 years old.

Table 6 - Dietary diversity and dietary behaviours among 15-year-olds (OLS estimates, main results)

	(1) Dietary diversity (baseline)	(2) Dietary diversity (puberty)	(3) Dietary diversity (time use)	(4) Number of meals	(5) Physical activity
Male	0.436***	0.374***	0.407***	0.129	−0.656
	(0.099)	(0.103)	(0.105)	(0.111)	(0.527)
Difference in height (cm)		0.009			
		(0.006)			
Hours spent at school or studying			0.006		
			(0.017)		
Hours spent on leisure activities			0.000		
			(0.021)		
Hours spent on household care/chores activities			−0.014		
			(0.026)		
Hours spent on family farm or business			0.017		
			(0.017)		
Hours spent on work for pay			0.004		
			(0.018)		
Constant	2.923***	3.021***	2.903***	2.828***	4.395***
	(0.383)	(0.421)	(0.514)	(0.574)	(1.030)
Observations	939	895	939	940	939
Child and household covariates?	YES	YES	YES	YES	YES
Communityfixed effects?	YES	YES	YES	YES	YES
F-test	0.000	0.000	0.000	0.000	0.000
Chow test (equality male coefficients from baseline and augmented models, p-value)		0.24	0.34		
Adj. R-squared	0.07	0.07	0.07	0.05	0.02

*Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

3.3. Extension: is the gap moderated by maternal education, poverty,locationor parental attitudes towards girls?

So far, the appearance ofa pro-boy gap in mid-adolescence has been documented across the whole sample. This section explores whether gender-based differentials in diet would differ across population sub-groups, as the question of whether gender inequalities in diet are exacerbated or mitigated by specific factors, such as maternal education or poverty status, has important policy implications. To this end, the modelling approach allows for gender to vary by maternal education, poverty, place of residence and parental educational aspirations. Following Dercon and Singh (2013), this is achieved in practice by augmenting the basic cross-sectional model usingan interaction variable between the gender dummy and each of those factors. A significance of the interaction term and a change in the gender coefficient would suggest thatthat specific factor magnified or mitigated gender inequalities in diet. Table 6 presentsthe coefficients for childgender and the interactions for the sample of 15-year-olds, after controlling for the set of child and household characteristics,[18] as well as F- and Chow tests. The latter compares the male coefficient from the baseline specification to the augmented models.

This analysis starts by examining the role of maternal education, as this factor emerges as critical in reducing gender inequalities in diet for young children (Borooah2004). This does not seem to be the case for adolescents, where the male coefficient is unchanged and the interaction variable is not significant. The next two models examine whether the gap varies for adolescents in the poorest tercile in terms of consumption per capita (as compared to the second and least-poor terciles)and for those living in urban areas, as povertyandplace of residencehave been shown to exacerbate discriminationagainst girls in India (Pells 2011; Derconand Singh 2013; Mukhopadhyay 2015).The empirical results show that neither financial constraintsnor place of residence contributes tointensifying the gender gap in dietary quality. Similar results are found when there is an interaction with caste is included (not shown here).

Finally, Column 5 reports the results from testing whether parental attitudes and aspirationsfor childrencan constitute a moderating factor for the gender differential in diet.For instance, Derconand Singh (2013) showed that caregivers' educational aspirations predicted both child educational aspirations and cognition, leading to increasing female disadvantage in education during adolescence in India, while Favara (2016) presented similar findings for Ethiopia. In the absence of a specific indicator related to parental attitudes towards the adolescent's health, these are proxied bya measure of the caregiver's aspirations for the adolescent's completed educational level. As in Beamanet al. (2012), the indicator assumes a value of 1 if the caregiver would like the adolescent to at least graduate from secondary school (Grade 12). This indicator is considered a good measure of parentalaspirations for the adolescent, as it is future-oriented and predictive of current behaviour (ibid.). Caregivers' aspirationswere onlyrecorded in Round 2for the Older Cohort, but this should not constitute a concern as parental aspirations and attitudestowards education are usually assumed as relatively time-invariant[19] (Rampinoand Taylor 2013). After the inclusion of the interaction between male and high parental educational aspirations, the advantage in dietary diversityis particularly marked for boys living with 'academically aspiring' parents, as compared to girls whose parents have equally high levels of educational aspirations, while the size and statistical significance of the male coefficient is less pronounced in the case of adolescents with parents with low aspirations. This result persists even after controlling for the adolescent's school enrolment status(Column 5) and time-use indicators (not shown here), as caregivers' preferences for educational achievements may be reflected in differences in those outcomes.

While this empirical framework only provides estimates of associations and not full causality, this evidence can be suggestive that, beyond educational outcomes, caregivers' educational aspirations may exacerbate gender inequalities in other dimensions, such as the intra-household distribution of food.

4. Conclusions

By using three rounds of data from the two cohorts in the Young Lives study, this paper provides original evidence on gender gaps in dietary diversity at different stages of childhood and adolescence in India. The empirical results showthat gender-based differentials in dietary quality are absent at 5, 8 and 12 years old, but that wide pro-boy gaps emerge at 15 years old. Disparities between mid-adolescent boys and girls are driven by the increased likelihood of boys to consume protein- and vitamin-rich foods. This result is robust to genderdifferentials in timing of puberty, in time use and in dietary behaviours. Moderation analysis shows that the magnitude of the gap does not vary by maternal education, poverty or rural/urban location. By contrast, once parental attitudes towards education are interacted with gender, there are smaller differences in dietary quality between boys and girls whose caregivers have low educational aspirations, and the pro-boy bias is mostly manifest amongst adolescents with 'aspirational'caregivers.

The documented variation in the intra-household distribution of highly nutritious (and generally higher-cost) foods underscores the advantages of adopting a longitudinal approach in the analysis of gender inequalities in dietary outcomes.This in turn can enhance the design and targeting of policiesaimed atimproving the nutritional status of groups at particular risk of malnutrition, such as adolescent girls in India.

18 Full results are available from author.

19 This is quite a standard hypothesis in the literature, although Beamanet al. (2012) showed that in certain conditions caregivers' aspirations can actually change.

Table 7 - Coefficient on male dummy and interaction of dietary diversity among 15-year-olds with key variables (OLS estimates, main results)

	(1) Dietary diversity (Maternal education)	(2) Dietary diversity (Poverty)	(3) Dietary diversity (Rural/urban location)	(4) Dietary diversity (Caregiver aspirations)	(5) Dietary diversity (Caregiver aspirations + school enrolment)
Male	0.468***	0.491***	0.376***	0.202*	0.201*
	(0.093)	(0.102)	(0.121)	(0.115)	(0.115)
Male* Mother is illiterate	−0.053				
	(0.128)				
Male* Poorest tercile		−0.224			
		(0.141)			
Male * Urban			0.216		
			(0.187)		
Male * High caregiver aspirations				0.300***	0.302***
				(0.104)	(0.103)
Currently enrolled					0.014
					(0.064)
Constant	2.824***	3.219***	2.971***	3.012***	3.006***
	(0.359)	(0.495)	(0.389)	(0.396)	(0.400)
Observations	939	939	939	939	938
Child and household covariates?	YES	YES	YES	YES	YES
Communityfixed effects?	YES	YES	YES	YES	YES
F test	0.000	0.000	0.000	0.000	0.000
Chow test (equality male coefficients from baseline and augmented models, p-value)	0.69	0.14	0.37	0.002	0.002
Adj. R-squared	0.07	0.07	0.07	0.08	0.08

*Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

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