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WHAT CAN CHILD ANTHROPOMETRY REVEAL ABOUT LIVING STANDARDS AND PUBLIC POLICY? AN ILLUSTRATION FROM CENTRAL ASIA

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The paper considers the case for the use of data on weight and height of children to assess living standards and public policy, contrasting them with monetized measures of welfare based on household incomes or expenditures. Data on child anthropometry are then used from Uzbekistan, the most populous of the Central Asian republics of the former Soviet Union, to investigate rural–urban differences in living standards, the impact of kindergartens on nutritional status, and the targeting of means-tested social assistance. Conclusions are drawn for the use of information on child anthropometry in the design of public policy.

1. INTRODUCTION

Economists' measurements of household welfare and analyses of the incidence of public policy focus on monetized indicators of well-being—income or expenditure. This paper takes a different route to the measurement of welfare and the targeting of policy, by using information on child anthropometry—measurement of children's body sizes.

The paper has two purposes. The first is to make more widely known to economists some attractions and limitations of child anthropometry as a welfare measure. Evidence of the attractions comes from the increasing use of anthropometric data by economic historians and development economists (e.g. Thomas, Strauss, and Henriques, 1991; Komlos, 1994; Steckel, 1995; Thomas, Lavy, and Strauss, 1996). But this form of information also has limitations. Section 2 reviews the informational content of data on children's weight and height, viewed from the standpoint of economic analysis.

Our second purpose is to use child anthropometry to investigate living standards and public policy in Uzbekistan, the most populous former Soviet Central Asian republic. The mixture of Soviet and Asian influences makes for a somewhat confusing picture of the level of development in the region, and the circumstances

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of transition further compound the problems of welfare measurement and the targeting of policy (Falkingham *et al.*, 1997). Analysis of child anthropometry offers one possible route forward.

The issues on which anthropometry can provide insight are illustrated in section 3 using data on 1,298 pre-school children from a 1995 household survey. First, we investigate whether anthropometric status is higher in rural than in urban areas when controlling for differences in cash income. A common view of living standards in less developed transition economies is that rural households gain such substantial support from non-monetized agricultural activity that the picture of rural–urban welfare differences is badly distorted by a focus on cash income or expenditure. Second, we test whether attendance at kindergartens has a positive net impact on nutrition. Transition has seen sharp falls in pre-school attendance in Central Asia and there has been speculation as to the effect on nutritional status. Third, we ask whether a new means-tested social assistance scheme is well-targeted in terms of anthropometric status. This scheme, which has attracted attention outside Uzbekistan, is characterized by considerable flexibility and a lack of clear conditions for award of benefit. Section 4 concludes.

2. What Can be Learned from Child Anthropometry?

Anthropometry holds three main attractions for the measurement of living standards. First, anthropometry is one way of measuring "net" nutritional status—input of nutrients minus claims made by body maintenance, physical activity (including work), and disease. Malnutrition reduces energy and mental concentration, and increases mortality and morbidity risk. Nutritional status is particularly relevant to child well-being since childhood malnutrition adversely affects individual development, including school achievement, and hence health and productivity in later life (Alderman *et al.*, 1997; UNICEF, 1998). Better nutrition improves "capabilities" in the Sen sense (e.g. Sen, 1985) and hence nutritional status is a good candidate for inclusion in an ideal vector of welfare measures.

Second, if anthropometric status reflects household income or consumption, data on body size may proxy measures of the latter, which are subject to errors of construction and interpretation. Problems in measuring income or consumption are aggravated in transition economies by growing self-employment, especially activity of an informal type that is not monetized, e.g. income in kind from food produced and consumed at home. Measurement of home production and imputation of its monetary value is far from straightforward (Casley and Lury, 1987). Anthropometric data are largely free of analogous problems—it is not as if a significant part of body weight or height is hard to observe (although care is certainly needed if precise measurements are to be obtained).[1] And unlike monetary data, anthropometric status can be compared directly across different countries.

Third, anthropometry provides information on individuals. By contrast, use of household incomes or expenditures to infer individual welfare requires an

[1]Procedures for obtaining accurate data are described in Kostermans (1994). Anthropometric measurements in the survey used in section 3 were made by persons trained by a team from the London School of Hygiene and Tropical Medicine.

assumption that household members share resources, with the common pooling assumption increasingly questioned (Alderman *et al.*, 1995).

These attractions of anthropometric data may appear strong to the economist used to struggling with monetized measures of household welfare. However, the novice to anthropometry needs to be aware of their principal drawback.

Body size is strongly influenced by genetic inheritance as well as by the "environmental" factors of interest—family income, health and housing conditions. Indeed, genes explain *most* of the variance in individuals' heights (Tanner, 1994, p. 1). Moreover, gene–environment interaction is complex and far from fully understood. For example, Eveleth and Tanner note that "two genotypes which produce the same adult heights under optimal environmental circumstances may produce different heights under circumstances of privation" (1976, p. 222). This casts doubt on the often unstated assumption that genetic factors can be absorbed into an unobserved additive error term in regression equations explaining anthropometric status.

On one view, the genetic factor is no constraint to the use of anthropometric data to measure human welfare. At the outset of his survey article on "Stature and the Standard of Living", Steckel urges that

> newcomers to the idea that stature measures important aspects of living standards should not be side-tracked by genetic issues. Genes are important determinants of individual height, but genetic differences approximately cancel in comparisons of averages across most populations. (1995, p. 1903).

The averaging out of genetic influence is particularly true of young child populations—differences in the impact of genes on growth that are associated with ethnic group manifest themselves in adolescence (WHO, 1995). Measurements of child height and weight are therefore matched for age and sex with a set of National Centre for Health Statistics/World Health Organization (NCHS/WHO) reference standards based on a large sample of healthy US children. The most common indices calculated are height for age and weight for height. A child is classified "stunted" if height for age is beneath two standard deviations of the median in the reference population and "wasted" if the same condition applies to weight for height.[2]

The use of international standards facilitates cross-country comparisons but there are limitations to such an exercise. Wasting is rare, even in countries at low levels of development unless they are undergoing an exceptional crisis. The same levels of stunting or wasting in two different settings may be associated with different risks of mortality and morbidity on account of a variety of intermediating factors between malnutrition and outcome, including "epidemiology of certain diseases, access to health care facilities ... and behavioural differences in relation to household management of infection" (Tomkins, 1994, p. 113). Classification of stunting and wasting is not therefore analogous to calculation of poverty on the basis of purchasing power parity (PPP) dollars, a given sum of

[2]The terminology is unfortunate, implying that the conditions should always be seen in a negative light, whereas the importance of genetic influences means that there may not necessarily be cause for concern.

which in principle provides the same command over resources in all countries. On the other hand, the same amount of PPP dollars may be associated with different living standards in different countries due to varying levels of public provision of social services and other non-cash benefits.

Do genetic influences mean that little notice should be taken of within-group differences in anthropometric status? Those using height data to study historical changes in living standards emphasize the between-group variation.[3] On the other hand, some aid programs in the developing world do use individual anthropometric status as a basis for targeting interventions (UN, 1990, p. 16). Unlike the economic historian, the emergency aid worker often has access to data on weight. Low weight (relative to height) provides a good measure of mortality risk at the individual level in situations of famine and is used as one basis for screening and intervention in the provision of food relief.

In general, however, "deviant" anthropometry clearly provides imperfect information on individual living standards. A child with weight or height below two standard deviations of the reference standard for his or her age is more likely to be living in a household where conditions are not conducive to development than is a child with values at the median. But targeting of, say, cash social assistance on the basis of this classification would be subject to both Type I and Type II error.[4] (The errors would be reduced if information on parental height were used to partly control for genetic inheritance—ideally data on parents should be collected in anthropometric surveys as well as data on children.) Anthropometric status clearly does not provide a welfare ranking in the same sense as would an adequately measured full income variable. Nor would an anthropometric index provide a monotonically increasing measure of welfare, even if it were free of genetic noise—excessive weight brings increased health risk.

Genetically determined variation in height is also present among siblings (except for identical twins), exerting, in general, "much more force than environmental ones, unless one or more [of the siblings] has been for some reason subject to real starvation" (Tanner, 1994, p. 2). This imposes severe limits on the ability of anthropometry to measure intra-household differences in welfare. In our Uzbek data, 902 of the 1,298 measured children lived in households with more than one measured child. Over 40 percent of the variance in both height for age and weight for height (relative to the reference median) among these children was *within* households. It would clearly be wrong to associate all this within-household variation with differences in individual welfare.[5] However, this does not

[3]Addressing the issue of genetically-induced "noise", Tanner argues firmly that "we are talking about the *mean heights of populations* or sub-populations . . . we are not talking about the height of any individual" (1994, p. 1, emphasis in the original).

[4]Nor does a focus on change over time solve the problem since the genetic impact cannot be treated satisfactorily as an additive error to be differenced out. That said, problems are less than with one-off assessment and "growth monitoring" is a standard technique in measurement of child welfare in both the developed and developing worlds. (Ulijaszek (1994) discusses individual variation in the growth process and consequent problems of interpretation.)

[5]Our data certainly do reveal some correlation between anthropometric measures for children of the same household. Where the first child in a successive pair within the household (when children are ranked by age) is stunted, 38 percent of the second children are also stunted, compared to only 12 percent if the first child has height for age that is normal.

mean that anthropometric data can reveal nothing about intra-household differences in welfare. The between-group variation by gender or between children of different birth order can still shed light on average patterns within households.

Does child anthropometry convey information about current living standards or those over a long period? Low weight for height can develop rapidly and at any age—wasting reflects current household and individual circumstances, including seasonality in food supply or the impact of recent sickness. Stunting, on the other hand, develops more slowly, with deficits in height increasing throughout a child's growth period if conditions remain unfavorable. However, the impact is most marked during the first two years of life when the rate of growth is at its peak. Hence height principally reflects failure to grow in very young children and having failed to grow in older children (UN, 1990, p. 7).[6]

The greater is the extent of income mobility (in the sense of true income fully measured), the more noisy will be the information on current living standards conveyed by height data among older children.[7] Cross national comparisons of stunting among all children under six, the usual age group taken for comparison, therefore tell something about living standards in different countries averaged over several years, rather than those for just the year in which the data were collected—something that is important to note in the context of rapid economic change.

Weight for height and height for age may therefore convey different information about current living standards and the correlation between the two is often not strong. The correlation of Z-scores in our Uzbek data was only 0.06 among all measured children (aged 6 to 72 months) and even among very young children (age up to 24 months) was only 0.09. Indeed, the nutritional factors associated with stunting and wasting may be quite different; while wasting may be due to a deficit in energy, stunting may be affected by the quality of the diet (including micronutrients such as calcium) once the demand for energy has been satisfied (e.g. Victora, 1992).

Mortality data have been argued by Sen (1998, p. 22) to have "intrinsic importance" (a longer life being valued in its own right), "enabling significance" (life is a necessary condition for the individual to function), and "associative relevance" (mortality has links to other aspects of welfare). Nutritional status, measured by child anthropometry, has the second and third of these attributes, and, like mortality, has the additional merit of indicating individual rather than household well-being. In some circumstances anthropometric data are even the best tool in the welfare measurement tool bag, as in assessment of those most in

[6]Wasting is highest during the weaning period and then decreases as the child gets older; stunting, on the other hand, is less common among infants (<12 months) but then rises. The weaning age is a period of high nutritional risk: breastmilk nutrients become insufficient to support good growth and the child is at exposure to higher risk of disease.

[7]There is considerable debate about the extent to which "catch-up" growth of height can occur if conditions improve. (It goes without saying that catch-up of weight is possible.) Intervention at an early age appears to have the greatest positive impact (UN, 1990), although studies of later interventions are sparse (Dasgupta, 1993, p. 85). The interpretation of stunting among older children as reflecting past circumstances clearly assumes that relatively little catch-up is possible after the first two or three years of life. Steckel (1985) argues that height data on American slaves of the early nineteenth century suggest a high capacity to recover from nutritional deprivation during childhood under conditions of good nutrition during adolescence.

need of emergency food aid in famine conditions. In other circumstances they provide additional information, complementing tools traditionally present in the economist's toolkit.

3. Investigating Living Standards and Public Policy in Uzbekistan

Our investigation uses the EUI/Essex Survey in Uzbekistan (EESU), conducted in Summer 1995.[8] The survey collected data on about 500 households in each of three regions—the capital city of Tashkent, the populous area of Fergana in the south-east, and the autonomous republic of Karakalpakstan in the north-west. The three regions contrast considerably in terms of average living standards (Coudouel *et al.*, 1997). Tashkent, with over two million people and much the largest city in Central Asia, is well ahead of the rest of the country. Karakalpakstan is at the other end of the range and has suffered substantially from environmental degradation associated with the retreat of the Aral Sea. Fergana is an agricultural area with some big urban centres—it scores relatively highly on several indicators based on information derived from official sources, although EESU income data do not show much clear water between this region and Karakalpakstan.

Basic anthropometric results for the 1,298 children aged 7–83 months who were measured in the EESU are given in Table 1 (unfortunately no anthropometric measurements were taken from parents). There is very little wasting. Only 3 percent of children are more than two standard deviations below the

TABLE 1

Anthropometric Status of Children Aged 7–71 Months in Three Regions of Uzbekistan, Summer 1995

	Tashkent City %	Fergana %	Karakalpakstan %	Total %
Height for age (Z score)				
≥+1 SD	9.9	2.3	2.8	4.6
−1 to +1 SD	57.7	41.7	49.3	48.3
−2 to −1 SD	25.3	36.2	33.7	32.4
≤−2 SD	7.1	19.8	14.2	14.7
Total	100.0	100.0	100.0	100.0
Weight for height (Z score)				
≥+1 SD	10.7	4.8	8.9	7.6
−1 to +1 SD	74.7	73.8	73.0	73.9
−2 to −1 SD	12.6	17.6	15.1	15.5
≤−2 SD	2.0	3.8	3.0	3.0
Total	100.0	100.0	100.0	100.0
Number of children	253	469	576	1298

Notes: SD = standard deviation from median of NCHS/WHO reference standard. Weights are applied to the data from Fergana and Karakalpakstan to adjust for oversampling of urban areas and to all data to produce a sample in which the proportion of households in each region corresponds to that in the population. In the weighted data, the shares of children in each region are 29% in Tashkent, 44% in Fergana and 27% in Karakalpakstan. (The last row gives the unweighted numbers.)

[8]Details of the survey are given in Ismail and Micklewright (1997) and Coudouel (1998).

reference median—barely more than in the NCHS reference population. Stunting is notably more common, occurring in 15 percent of cases. Substantial differences between the regions exist in height for age. Only 7 percent of children in the capital are stunted, but 20 percent are stunted in Fergana. Karakalpakstan lies between the two but the hypothesis that the grouped Z-score distributions are the same in Karakalpakstan and Fergana cannot be rejected, and it is Tashkent city that stands out as being different from the other two regions. Weight for height shows little regional variation—the grouped Z-score distributions are similar in the capital and in Karakalpakstan, the two regions that on many welfare indicators are at opposite ends of the observed range.

The combination of moderate stunting and little wasting found in Uzbekistan is typical of the situation in more developed Latin American countries in the mid-1980s (Carlson and Wardlaw, 1990; De Onis *et al.*, 1993). For example, 9.6 percent of children (aged 0–71 months) were stunted in Chile in 1986 and only 0.5 percent wasted; stunting prevalence was 15.9 percent in Uruguay in 1987 (children aged 0–59 months) and 15.4 percent in Brazil in 1989 (with wasting at 2.0 percent), a country at a lower level of development. The figures for Uzbekistan are far better than those for other poorer South American countries as well as for many countries in Africa and in South Asia where the highest levels of both stunting and wasting are recorded.

Living Standards in Rural and Urban Areas

There has been considerable debate about differences in living standards between rural and urban areas in the former Soviet Union, during both the communist period and transition (Matthews, 1986; Braithwaite, 1997)—much of it relating to uncertainty about the extent and valuation of agricultural income in kind. Official budget survey data from pre-reform Uzbekistan show calorie and protein intake (imputed from recorded consumption) to be higher in collective farm households than in worker–employee households, holding cash income constant (Marnie and Micklewright, 1994). But *net* nutritional status, as revealed by anthropometry, may not follow this pattern if there are other factors in rural areas, such as sanitation and other living conditions, that place more demand on nutrients entering the body.

Unconditional on income (or anything else), the probability of stunting among children in the EESU is much higher in rural areas—20 percent, compared to only 7 percent in all cities (Tashkent and other urban areas of over 100,000 persons). Interestingly, towns (urban areas of less than 100,000 people) also have a much higher stunting prevalence—19 percent. A focus on a simple "urban/rural" split, grouping the towns with the cities, would not be appropriate.

Table 2 investigates whether incomes (and other factors) mediate these differences, reporting the results of regressions for height for age and weight for height (as percentages of the reference medians) in which location dummies are included among the explanatory variables, with Tashkent the excluded category. The equations are estimated by GLS, allowing for a household level random effect (in addition to an individual-specific error) assumed constant across children in the

TABLE 2

LOCATION EFFECTS AND ANTHROPOMETRY: GLS REGRESSIONS

	Height for Age (as % of reference median) mean = 96.3, SD = 4.4			Weight for Height (as % of reference median) mean = 98.7, SD = 8.4		
	1	2	3	4	5	6
City Fergana	–1.53	–1.44	–1.20	–1.93	–1.99	–1.90
	(2.9)	(2.7)	(2.2)	(1.8)	(1.9)	(1.7)
City Karakalpakstan	–1.88	–2.03	–1.49	0.54	0.59	–0.28
	(2.8)	(3.1)	(2.2)	(0.4)	(0.4)	(0.2)
Town	–2.70	–2.47	–2.06	–1.70	–1.81	–1.39
	(6.4)	(5.9)	(4.0)	(2.1)	(2.2)	(1.4)
Rural Fergana	–3.28	–3.25	–2.50	–3.27	–3.34	–2.06
	(8.3)	(8.3)	(4.3)	(4.2)	(4.2)	(1.8)
Rural Karakalpakstan	–1.97	–1.65	–0.85	–1.54	–1.72	–0.49
	(4.8)	(3.9)	(1.4)	(1.9)	(2.0)	(0.4)
Household cash income (log)		0.07	0.08		–0.17	–0.02
		(0.5)	(0.7)		(0.6)	(0.1)
Household size (log)		–1.36	–1.31		0.52	0.45
		(4.0)	(3.7)		(0.8)	(0.6)
1 year old			–2.15			0.88
			(4.3)			(0.9)
2 years old			–2.47			4.67
			(4.9)			(4.9)
3 years old			–3.35			6.53
			(6.8)			(7.1)
4 years old			–3.53			5.64
			(7.0)			(5.9)
5 years old			–3.61			6.37
			(7.1)			(6.7)
6 years old			–2.90			5.68
			(5.6)			(5.8)
Mother did not complete lower secondary school			–0.08			–0.56
			(0.2)			(0.7)
Slav head of household			2.26			–1.89
			(2.7)			(1.2)
Running water in house			0.51			1.61
			(1.3)			(2.0)
Drainage in house			0.10			–0.63
			(0.2)			(0.7)
Agricultural plot			0.51			–0.36
			(1.2)			(0.4)
Agricultural produce sold last month			–0.76			–1.00
			(1.9)			(1.2)
Constant	98.4	100.4	101.8	100.2	100.5	94.3
	(330.2)	(100.7)	(80.4)	(170.3)	(50.4)	(37.8)

Note: t-statistics in brackets; sample size is 1,298 children. The base for the location dummies is the city of Tashkent.

same household (and assumed uncorrelated with observable factors included in the regression).[9]

Columns 1 and 4 contain only location variables. Mean height for age in rural Fergana is over 3 percent points lower than in the capital (but still less than one standard deviation), nearly 3 points less in the towns, and 2 points less in rural Karakalpakstan. The deficit in other cities relative to Tashkent is between 1.5 and 2 percent (stunting prevalence shows no differences, which underlines the danger of an exclusive focus on the lower tail of the distribution). The variation across location in weight for height is similar in its pattern (although much smaller in relation to the standard deviation), with the noted exception of Karakalpak cities (of which there is only one) where there is no difference from the capital.

Columns 2 and 5 include measured cash income in the previous month and household size, both in logs (wages or cash benefits due in that month but not paid are included in the income variable). Information on cash incomes in the EESU was collected in considerable detail, with each adult separately questioned about a wide range of different possible sources. The inclusion of the household size variable allows for an unspecified adjustment to household income for differences in household needs (that are related to size) as well as a further impact besides that through the needs adjustment.[10]

The inclusion of income and household size has little impact on the location coefficients. Cash income turns out to be completely insignificant in explaining either height for age or weight for height. (Even the simple correlation between income and individual nutritional status is very low.) There is certainly no evidence that rural areas have higher nutritional status when current cash income is held constant. The lack of an income effect may be interpreted in various ways. On the one hand, the relationship between income and nutritional status has been the subject of debate (Alderman, 1993; Deaton, 1997). On the other, cash income over one month may just be a very poor proxy for permanent or full income (or even annual cash income, especially for agricultural households), although this problem might be expected to affect the results for height for age, the more long-term measure of nutritional status, much more than weight for height.

Columns 3 and 6 include further controls: the age of the child (infants aged less than 12 months are the base), mother's education, whether the household head is of Slav ethnicity, ownership of an agricultural plot, whether agricultural produce is sold, and the presence of running water and drainage in the household. Height deficits build up with age while wasting becomes less likely—reflected in the pattern of the age coefficients. A higher level of maternal education should

[9]The hypothesis of no random effects was firmly rejected by an LM test. The household error proxies unobserved influences such as common "environmental" factors and any shared genetic inheritance. However, our earlier discussion indicates that most genetic inheritance enters via the individual rather than the household specific error, and implies that our treatment of genetic influences (whether shared or individual) as additive is unsatisfactory.

[10]Let $A_i = \alpha + \beta \ln [Y/(H^{\theta})]_i + \gamma \ln H_i + \varepsilon_i$, where A is anthropometric status, Y is total income, H is household size, and θ is the (unknown and unspecified) elasticity of household needs with respect to size (the location dummies are omitted for the purposes of exposition). The equation is re-written in the form in which it is estimated as $A_i = \alpha + \beta \ln Y_i + \delta \ln H_i + \varepsilon_i$, where $\delta = (\gamma - \beta . \theta)$.

result in better child nutrition, reflecting various factors including better knowledge of health and sanitation and higher use of health services (Thomas *et al.*, 1991). However, no evidence is found of lower height for age or weight for height (*ceteris paribus*) when mothers did not complete lower secondary education. Running water in the household has a positive effect on weight for height, presumably reflecting better cleanliness and less disease.

There is no particular reason to expect Slav ethnicity to have any impact, controlling for income, location and education (genetic differences associated with race that determine final height should manifest themselves in adolescence and not at the pre-school age). But children in Slav households have height for age that is some 2 percent higher than other children. For whatever reason, these children have better long-term nutritional status (there is no significant difference in weight for height although it is interesting to see that here the association is negative). (1 in 8 children in Tashkent are in Slav households but very few elsewhere.)

The last two variables refer to the household's agricultural activity. Possession of an agricultural plot provides the opportunity to grow food, but there is no significant association with either measure of nutritional status (most households have plots, even in Tashkent). Children in households that sold produce (from crops or livestock) in the previous month (1 in 5 rural households) have lower height and weight, although the relationship is not very well determined. (Interviews were in the early summer when fruit and vegetable production is high.) Cash derived from this activity is included in the household income variable—the dummy variable is intended rather to pick up households with sufficient involvement in private agriculture to engage in selling to others.

We experimented with other variables measuring agricultural assets (e.g. size of land and ownership of livestock). None had strong association with the children's anthropometry but the general pattern was for the relationship to be negative. Households with greater involvement in agriculture tend to have children with lower nutritional status, controlling for other factors. A variety of reasons may explain this: agriculture requires more work of women, resulting in lower birth weights and lower quality of child care; and households that sell food may do so to buy manufactured goods at the expense of household consumption.

The mean values of all the variables included in columns 3 and 6 differ across location and their inclusion in the equations reduces the coefficients on the location dummies, some of them quite appreciably, providing some insight into why the associations of location with nutritional status arise.

Our conclusion is that anthropometric status *is* lower in rural areas when controlling for current cash income (which itself has very little effect), thus casting severe doubt on one stylized view of the relative living standards of different household types.

The Impact of Kindergartens on Nutritional Status

Kindergartens can raise household welfare in several ways. These include child care for mothers, which allows them to work and thus earn income, and pre-school education and social interaction for children. One function of kindergartens believed important in the former Soviet Union is the impact on nutritional status through provision of food that would not otherwise be eaten—kindergartens are typically full-day with one or more meals provided. On the other hand, both quality and quantity of food consumed in kindergartens is unclear (we have no information on this in our survey data), as is consumption in the counterfactual of non-attendance. And interaction with other children in kindergartens may increase risk of infectious diseases that lower net nutritional status.

As elsewhere in Central Asia (Klugman *et al.*, 1997; UNICEF, 2000) kindergarten enrolment has fallen significantly in Uzbekistan during transition, from 37 percent of the relevant age-group in 1991 to 16 percent in 1998. This results from both demand and supply factors, the latter including closure of many enterprise facilities. Whatever the explanation, the issue is whether falling enrolment is a cause for concern for public policy—and the net impact of kindergarten attendance on nutritional status is one factor to be taken into account.

We investigate the net impact of kindergartens by inserting a dummy variable for attendance in the regressions described above. Table 3 reports the coefficient on the kindergarten dummy in regressions of height for age and weight for height under two different treatments of unobservables (29 percent of measured EESU children are in kindergartens). Column 1 gives GLS results in which the control variables are as in columns 3 and 6 of Table 2. This assumes unobservables to be uncorrelated with observables. However, unobserved factors may indeed be correlated with kindergarten attendance. For example, "good" mothers may provide their children with more food and better living conditions but may also be more likely to send their children to kindergarten so as to take advantage of the benefits offered. In this case a positive impact of the kindergarten dummy in a GLS regression of anthropometric status could merely be proxying the unobservable factor of having a "good" mother.

The column 2 results try to allow for this problem through use of a fixed-effects estimator, exploiting the fact that we often observe more than one child per household. With a two-child household this technique is equivalent to

TABLE 3

KINDERGARTEN ATTENDANCE AND ANTHROPOMETRY

	Coefficient on Kindergarten Dummy	
Dependent Variable	1 GLS	2 Fixed-Effects
Height for age as % of reference median	–0.20 (t = 0.64)	–0.03 (t = 0.05)
Weight for height as % of reference median	1.18 (t = 2.00)	1.68 (t = 1.53)
Sample size	1,298	765

Note: Results in column 1 are obtained by GLS regression on the full sample of 1,298 children in an equation containing all the control variables in columns 3 and 6 of Table 2. Results in column 2 are obtained by OLS on a transformed equation in which the dependent and independent variables are adjusted by subtracting their household-specific mean values and is estimated on the 902 children in multi-child households (controls showing within-household variation that remain in the equations are the child's age and maternal education).

regressing the difference in nutritional status between the two children on the difference in their kindergarten attendance. Unobserved factors such as a "good" mother that are common to the children drop out of the equation, leaving an estimated kindergarten effect that should be uncontaminated. The disadvantage is that the kindergarten impact is estimated only from the within-household variation in attendance. The amount of such variation is low—in only 72 households is there at least one child under seven attending kindergarten and one who is not. We cannot therefore hope for well-determined estimates.

With neither treatment of unobservables is there any association of kindergarten status with height for age. However, weight for height, the short-term nutritional indicator, does seem to be positively related to kindergarten attendance. The GLS results show weight for height over 1 percent higher where the child is in a kindergarten, controlling for other observables factors (including the age of the child—correlated with both kindergarten attendance and anthropometric status), a difference which is significant at the 5 percent level. The fixed effect estimator yields a slightly larger estimate, but as expected the impact is less well determined and significant at only the 10 percent level. (Like the GLS results, this estimate is obtained controlling for differences in the children's ages.) The results are suggestive, but a considerably larger sample size would be needed to estimate any kindergarten effect with more precision.[11]

Targeting of Social Assistance

As part of its moves towards a targeted safety net, the Uzbek government introduced a new means-tested social assistance scheme in 1994. A key feature is that the scheme is administered by the "Mahallas", a pre-Soviet traditional community organization that has been revived under the government's auspices. Some 1 in 5 households were granted benefit in 1995 (for renewable periods of three months).

The scheme combines firm rules regarding applications and procedures for assessing them with a large element of discretion for the Mahallas. Guidelines lay down indicators to be taken into account when assessing need, including household composition, labour force status, cash incomes, durable good ownership and agricultural plot size and use. They also indicate types of households expected to benefit from the scheme, among which those with large numbers of children head the list. However, there are neither necessary nor sufficient conditions for benefit and decisions are not subject to appeal. The Mahallas are expected to tailor decisions to the local situation and any available information on the circumstances of applicants.

The strong discretionary element brings the risk of targeting errors—discretion may be inappropriately applied to exclude the needy and to include those not genuinely in need. And ignorance of the scheme or a reluctance to publicly

[11]Ideally one would also use panel data to look at changes in anthropometric status as children enter or leave kindergartens. Kindergarten closures would provide an attractive source of exogenous variation in attendance.

TABLE 4

ANTHROPOMETRIC STATUS AND RECEIPT OF SOCIAL ASSISTANCE FROM THE MAHALLA

	Height for Age (as % of the reference median)		Weight for Height (as % of the reference median)	
	Benefit	No benefit	Benefit	No benefit
Tashkent	96.64	98.04	95.56	98.60
	(t = 1.31)		(t = 1.55)	
Fergana	93.45	94.89	94.11	95.18
	(t = 2.45)		(t = 0.99)	
Karakalpakstan	94.24	95.13	95.90	96.39
	(t = 1.64)		(t = 0.47)	
All households	94.29	95.70	95.19	96.43
	(t = 3.62)		(t = 1.75)	

Note: The results refer to the average values across households with and without social assistance benefit of the minimum value within each household of height for age and weight for height among all measured children. The total number of households is 765 (159 in Tashkent, 289 in Fergana and 317 in Karakalpakstan). The t-test in brackets is of the hypothesis that the means are equal.

display need (Mahalla recommendations are voted on in a monthly public meeting) will reduce take-up. The degree of targeting achieved in practice is hence an open question.

We conduct a simple test of targeting, comparing mean height for age and weight for height (as a percent of the reference median) in households with and without support from the Mahallas (Table 4). We focus on the minimum values among measured children in each household. Among households with children for whom anthropometric data were collected, 16 percent received assistance from the Mahallas in Tashkent, 24 percent in Fergana, and 28 percent in Karakalpakstan.

Taking all households, those receiving benefit have a minimum measured height for age which is 1.4 percent lower than that in households with no benefit. The difference is quite strongly significant. Weight for height is also lower, by 1.2 percent, but the difference is only significant at the 10 percent level. On average, benefit goes to households with children of lower anthropometric status. The results for each region provide mixed support to this finding. The means in every case are lower for households receiving benefit but the differences are often not significant, although the much smaller sample sizes at this level need to be recognized.[12]

In the case of weight for height, the more short-term measure, the possibility cannot be ruled out that receipt of benefit has allowed weight to improve due to the household having a greater ability to purchase food, although the lack of income effects found earlier in the paper imply the impact must be small. Arguably, the lower weight for height in households receiving benefit is quite a strong result since it will have emerged despite any positive effect of benefit on nutritional status.

[12]For example, the Tashkent sample is less than a quarter of the size of the overall sample, so standard errors that are over twice as large are to be expected.

How does the picture of targeting based on anthropometry compare with that obtained from cash income? Thirty percent of households receive benefit in the bottom two quintiles of households with pre-school children when ranked by cash income (paid or due last month, excluding that from the Mahalla scheme, and equivalized by the square root of household size). A figure of 17 percent is found in the top two quintiles. Similar proportions of households receiving assistance are found in the bottom two and top two quintiles when ranking households by children's height for age or by weight for height—28 percent and 17 percent and 26 percent and 19 percent respectively. (The measures are defined as in Table 4.) This similarity cannot be explained by the association between anthropometric status and income since the correlation between the two is very low. The results for anthropometry therefore re-enforce those for cash income and are reasonably encouraging: assistance is more likely to go to households that are classified as having low living standards in either of these two dimensions of household welfare.

4. Conclusions

Quantifying individual and household welfare and investigating the impact and targeting of public policy requires various sorts of data that measure living standards. Child anthropometry is one candidate. We have given some reasons for using such data, which can usefully complement monetized measures of welfare, together with some of the problems of interpretation that arise. And we have illustrated their use for a transition economy where information on living standards is at a premium.

Although anthropometry may help the researcher, can it play a direct role in the design of safety net policy, putting aside the extreme case of targeting food intervention in a situation of famine? The issue of targeting in the Uzbek social assistance scheme provides a good example of the issues involved. Could anthropometric status of children be one criterion for paying benefit to households? The genetic source of variation in body size implies that this would result in substantial errors of both inclusion and exclusion (although the same is true with other imperfect welfare measures). A better use of anthropometry would be to help determine average living standards in each Mahalla so as to guide the allocation of funds from central government to be used for benefit—a key element in efficient and equitable targeting. This is a classic problem in the design of a decentralized social assistance scheme, something that many transition countries wish to move towards. (The current method of allocating funds in Uzbekistan is obscure.)

Routine measurement of height and weight of all children at entry to elementary school would provide a complete picture across the country each year of one dimension of average living standards by locality. This may be particularly appropriate for Central Asia, where elementary enrolment remains universal and where the overall degree of, in particular, stunting is high enough to ensure some substantial variation in nutritional status across different localities. Basic training (and periodic re-training) of teachers, or use of mobile teams of health personnel, together with investment in good equipment, would provide the data quite easily.

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