RESEARCH REPORT

Effect of work related variables on growth among working boys in Jordan

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Objective: To study the effect of work related variables on the height, weight, and body mass index (BMI) of working boys aged 10–16 years.

Design: Cross sectional survey.

Setting: Irbid, Jarash, and North Jordan Valley in Jordan.

Participants: 135 working boys aged 10–16 years and their mothers.

Outcome measures: Height for age z score; weight for age z score; BMI for age z score.

Results: In bivariate analysis, child's duration of work ($r=-0.20$), maternal height ($r=0.26$), and household per capita income ($r=0.23$) were significantly correlated with height for age z score and duration of work ($r=-0.24$), maternal height ($r=0.24$), and household per capita income ($r=0.19$) with weight for age z score. Duration of work ($p<0.001$), child's monthly income ($p=0.044$), maternal height ($p=0.002$), and household per capita income ($p=0.005$) were retained in the regression model fitted on height z score that explained 20.1% of the variance. The regression model fitted on weight z score explained 20.1% of the variance and duration of work ($p<0.001$), child's monthly income ($p=0.022$), household per capita income ($p=0.017$), and maternal height ($p=0.004$) were retained. Only duration of work ($p=0.001$) was retained in the model fitted on BMI for age z score.

Conclusion: The results of this study suggest that the length of time children have been working and low monthly income have a detrimental effect on growth of working boys independent of the effects of low household per capita income and small maternal stature. Relevance of these findings for social policy and health care of working boys in Jordan and elsewhere is discussed.

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Child labour is an important global issue¹ associated with poverty, inadequate educational opportunities, and failure to enforce existing laws and standards. The effects of child labour on growth and health have been reported but distinguishing the effects of work from those of poverty has been problematic. Previous studies that have reported on the association of child labour with growth are summarised in table 1. A Japanese study showed a 4 cm difference in height between those who started work before the age of 14 years and those starting after the age of 18 years.² A longitudinal study in Hyderabad, India³ followed up 410 boys, characterised by their height for age at entry into normal, moderate, and severely malnourished, up to the age of 17 years. Significant differences in height and weight attained by 17 years were demonstrated in each nutrition group. However, no attempt was made to control for socioeconomic factors within the groups. Height, weight, and signs of malnutrition were significantly more common among 110 children working in carpet weaving factories compared with 290 school children matched for age in Jaipur, India.⁴ Adjustment for socioeconomic status or parental height was not undertaken. Although some of the studies shown in table 1 used matched controls, the potential for residual confounding of the relation between work related variables and stunting by socioeconomic status is high in some studies^{4–6} because matching was by area of residence. Others matched on individual level measures of SES^{7,8} but only one study⁹ adjusted for family SES in regression models. None of the studies adjusted for parental height.

Very few papers have analysed the relation between growth and work related variables such as age of starting, type of work, and duration of employment. Joshi and Sharma⁴ reported that the differences in growth between working and non-working children only became established after 8 years of age suggesting that longer duration of work may be associated

with poorer growth. A further study¹⁰ suggests that weight slowdown occurs in working boys after the age of 12 and height slowdown after the age of 14. Body mass index (BMI) also decreased with increasing duration of employment.

This paper, based on the results of a cross sectional survey, reports the relation between growth and work related variables such as length of working week and duration of work among working boys in Jordan adjusted for the effects of family per capita income and maternal height.

METHODS

The study was conducted in three Jordanian areas, Irbid, Jarash, and North Jordan Valley, with a combined population of 1 million (20% of the total population). They contain a wide social range and are broadly representative of economic activity in Jordan from industry in Irbid to agriculture in North Jordan Valley. Jordan is a country in transition; its annual growth rate between 1960 and 1985 was 5.8% but between 1985 and 1995 there has been a negative annual rate of growth (–4.5%).¹¹ The GNP/capita was \$1510 in 1995. Between 1960 and 1995 the under 5 mortality rate fell from 139/1000 to 29/1000.¹¹ Child labour may have increased as a result of the economic difficulties accompanying the declining growth rate.

Definition of working child

Waged and unwaged boys aged 10–16 years employed in economic activity in the study areas and not attending school. Working girls were excluded because of small numbers among working children in Jordan and the cultural constraints that made it more difficult for the male researcher (HH) to approach them at their place of work.

Sample selection

Key local informants were interviewed to identify the sites and type of occupations undertaken by children in the study

Table 1 Cohort and case-control studies examining the relation of child labour with growth

Author/year	Study design	Setting	Exposure	Outcome	Control for SES and parental height	Conclusion
Japanese study reported in Shah 1984 ²	Case-control	Japan	Children starting work at 14 v those starting work at 18	Height	No attempt to adjust for SES or parental height	4 cm difference in height between cases and controls
Satyanarayana <i>et al</i> 1985 ³	Cohort (17 year follow up)	Hyderabad, India	Child farmers in families; waged farm workers; non-farm workers; students	Height and weight	No attempt to adjust for SES or parental height	Height and weight lower in workers compared with students; deficit in height and weight greater in waged than children working in family.
Singh <i>et al</i> 1980 ⁵	Case-control	Bombay, India	Working v non-working children in slums	Height	No attempt to adjust for SES or parental height	Height of working children lower than non-working controls; children starting to work before 9 years more stunted than those starting at age 11.
Gross <i>et al</i> 1996 ⁶	Case-control	Jakarta, Indonesia	Working street children v non-working slum children	Height for age; weight for age; weight for height	No attempt to adjust for SES or parental height	52% of street children <3rd centile for height by NCHS reference standards; 7% <3rd centile for weight. Height and weight of street children > slum children
Joshi and Sharma 1996 ⁴	Case-control	Jaipur City, India	110 working children v 290 school children matched for age and area	Height; weight	No adjustment for SES or parental height	Height and weight controlled by age < in working children except among 6–8 year olds in whom no difference noted
Lee ¹⁸	Case-control	Republic of Korea	593 female factory workers <18 years v 109 girls applying for work	Height; weight	No attempt to adjust for SES or parental height	Working girls taller and heavier than controls
Mahathevan ⁷	Case-control	Malaysia	210 working children (7–15 y) v 210 age, sex, ethnic group and SES matched school children	Weight	No adjustment for parental height	48% of working children “underweight” but no figures given for controls
Sampa 1993 ⁸	Case-control	Calcutta, India	40 boys (7–14 y) working in leather workshops v 40 age, area and SES matched controls	Height; weight	No adjustment for parental height	No height or weight differences between cases and controls
De La Pas 1990 ⁹	Case-control	Philippines	113 working v 109 non-working boys matched for age and area	Height; weight; sitting height	Adjustment for SES but not for parental height	Height and weight differences between cases and controls disappeared on adjustment for SES; working hours and number of working days not correlated with growth parameters measured
Ambadekar <i>et al</i> 1999 ¹⁰	Case-control	Maharashtra, India	223 working children (8–15 y) v 223 age and gender matched non-working controls	Height; weight; BMI	No adjustment for SES or parental height	Mean height and weight of working boys increased less than non-working boys—for weight slowdown occurred in working boys after 12 years and after 14 yrs for ht. Girls showed no significant differences. BMI decreased with increasing duration of employment.

areas. Each study area was then systematically mapped to children's workplaces. The researcher (HH) then carried out detailed observation of each study area during daytime and evening hours recording frequency of different types of child labour. Three broad categories of child labour were identified: industrial (mainly in Irbid); service and commercial (mainly in Jarash); agricultural (mainly in North Jordan Valley). Sampling was stratified so that each category of child labour was represented in the study sample in proportion to its size in the three study areas. The stratified study sample of 135 working children included 75 in Irbid (60 in the industrial and 15 in the service sectors), 35 in Jarash (25 in the service and 10 in the industrial sectors), and 25 in the North Jordan Valley (all in the agricultural sector). After an approach to the employer, working boys, who were present at the workplace during sampling recruitment visits, were enrolled into the study. There were few study refusers once employers had given their consent. Parental consent was obtained after full explanation of the purpose of the study. Difficulties had been experienced in obtaining consent during the pilot study, which proved to be related to parental concern that the information might be passed to government officials. In the main study, parents

were reassured that the information was confidential and that the data would not be shared with government departments.

Data collection

Working boys were interviewed in the home with their parents using a structured interview schedule pre-tested in a pilot study. Data on the following exposures were collected: length of working week in hours; monthly income earned by the child in Jordanian dinars (JDs); duration of work in years; age in years of starting work; type of work (industrial, service, or agricultural); child's smoking status (≥ 5 cigarettes/day—yes/no); family per capita monthly income in JDs. Maternal height, as a proxy for mid-parental height, was measured at the end of the interview. Data were not available on height of fathers and fathers were rarely present at the time of the interview. Although child's income is part of family income, there is evidence from a study in Indonesia suggesting that child's income may be used to purchase food for their own consumption and not always pooled with family income. For this reason, it was decided to enter child's income as an independent variable into the analysis. Outcome variables collected were height (cm), measured using a portable tape,

Table 2 Family sociodemographic characteristics of working boys

Family characteristics	Working boys (n=135)
Family size:	
≤4	5 (3.7%)
5–7	31 (23.0%)
8–10	57 (42.2%)
>10	42 (31.1%)
mean (95% CI)	9.7 (9.07 to 10.33)
range	4–30
Household per capita income (JD/month):	
≤20	31 (23.0%)
21–41	68 (50.3%)
42–60	21 (15.6%)
>60	15 (11.1%)
mean (95% CI)	36.4 (32.9 to 39.9)
range	10–150
House m ² per capita:	
≤20	104 (77.0%)
>20	31 (23.0%)
mean (95% CI)	15.6 (14.4 to 16.8)
range	0–35
Household durable expenditure (JD):	
0–14	87 (64.4%)
15–36	33 (24.4%)
>36	15 (11.2%)
mean (95% CI)	24.5 (20.1 to 28.9)
range	0–108
Occupation of head of household:	
Unskilled	77 (57%)
Semiskilled	51 (37.8%)
Skilled	7 (5.2%)
Father's education level:	
Illiterate	12 (8.9%)
Lower education	113 (83.7%)
Higher education	10 (7.4%)
Mother's education level:	
Illiterate	36 (26.7%)
Lower education	89 (65.9%)
Higher education	10 (7.4%)

expressed as a z score using LMS software based on UK standards¹² and weight (kg), measured using Detecto adult scales, expressed as a z score using LMS software based on UK standards.¹² BMI (weight (kg)/height (m²)) was expressed as a z score using the same software.¹²

Data analysis

Simple correlation coefficients of exposure on outcome variables were estimated. Linear regression models were fitted on height, weight, and BMI z scores using SPSS v.8.0.¹³ All exposure variables, whether or not they achieved conventional levels of statistical significance on bivariate analysis, were entered into the regression analysis. The r^2 (the proportion of the variance explained by the model) and the regression coefficient β (change in the outcome associated with a change of

one unit in the exposure variable) for each exposure were estimated for the models fitted on both outcomes. Only variables achieving a significance level of <0.05 were retained in the final model. Residuals were plotted for the regression models.

RESULTS

Permission to enrol their employees into the study was denied by 3 of 64 (4.7%) employers. Two mothers refused to be measured. These missing maternal height data were given values equivalent to the mean for the whole sample according to the method described by Katz.¹⁴ Data on 135 working boys were available for analysis. The family, work, and socioeconomic characteristics of the sample are shown in table 2 and are reported in detail in a related paper.¹⁵

Correlation coefficients of exposure variables on outcomes are shown in table 3. Duration of work in years, maternal height, and household per capita income showed a statistically significant correlation with height for age z score. Duration of work, age of starting work, maternal height, and household per capita income were also significantly correlated with weight for age z score. Only duration of work and age of starting work were correlated with BMI for age z score.

To explore the association between age of starting work and low household income, the correlation between age of starting work and total household monthly income minus child's monthly income was estimated. There was no significant correlation ($r=-0.08$).

The regression model fitted on height z score (table 4) explains 20.1% of the variance ($r^2=0.201$); duration of work in years explains 9.1% and each year of work is associated with a z score reduction of 0.31; maternal height explains 6.0% of the variance and 1 cm increase is associated with an increase in z score of 0.07; family per capita income explains 5.0% of the variance with an increase of 1 JD/month associated with a z score increase of 0.01; monthly income of the child explains 2.5% of the variance and for each 1 JD rise there is an associated z score increase of 0.01.

For weight z score (table 5), the regression model explains 20.1% of the variance ($r^2=0.201$); 11.3% of the variance was explained by duration of work with 0.33 reduction in z score for each additional year worked; 5.3% of the variance was explained by maternal height with 0.06 increase in z score for each additional cm of maternal height; the child's monthly income explains a further 3.4% of the variance with 0.01 increase in z score for each additional JD earned; the family per capita income accounts for 4.6% of the variance with a 0.01 increase in weight z score for each additional JD.

Only duration of work was retained in the final model for BMI for age z score. The model explained 9% of the variance ($r^2=0.09$) with 0.24 reduction in z score with each additional year worked.

The plots of residuals in the models were close to normal distribution.

Table 3 Bivariate correlation (Pearson coefficients) of exposure on outcome variables

Exposure	Height for age z score	Weight for age z score	BMI for age z score
Type of job (industrial/service/agricultural)	-0.03	-0.10	-0.13
Duration of work (y)	-0.20*	-0.24**	-0.23*
Age at starting work	0.05	0.18*	0.24**
Working hours per week	0.03	0.06	0.03
Child's monthly income	0.07	0.07	0.02
Household per capita income	0.23*	0.19*	0.09
Smoking (>5 cigarettes/day)	-0.02	0.02	0.03
Maternal height (cm)	0.26*	0.24*	0.11

**Correlation is significant at the 0.01 level (two tailed). *Correlation is significant at the 0.05 level (two tailed).

Table 4 Final regression model fitted on height z score

Independent variables in final model	Unstandardised coefficient β (95% CI)	t Statistic	p Value	r ² (% of variance explained by each independent variable)
(Constant)	-11.02 (-17.75 to -4.28)	-3.24	0.002	
Duration of work (y)	-0.31 (-0.48 to -0.15)	-3.85	<0.001	0.090 (9.0)
Child's monthly income (JDs)	0.01 (0.00 to 0.02)	2.03	0.044	0.025 (2.5)
Maternal height (cm)	0.07 (0.02 to 0.11)	3.11	0.002	0.060 (6.0)
Household income/capita (JDs)	0.01 (0.00 to 0.02)	2.86	0.005	0.050 (5.0)
Final model				0.201 (20.1)

Table 5 Final regression model fitted on weight z score

Independent variables in final model	Unstandardised coefficient β (95% CI)	t Statistic	p Value	r ² (% of variance explained by each independent variable)
(Constant)	-9.35 (-15.65 to -3.05)	-2.94	0.004	
Duration of work (y)	-0.33 (-0.48 to -0.18)	-4.29	<0.001	0.113 (11.3)
Child's monthly income (JDs)	0.02 (0.00 to 0.02)	2.32	0.022	0.034 (3.4)
Maternal height (cm)	0.06 (0.02 to 0.10)	2.93	0.004	0.053 (5.3)
Household income/capita (JDs)	0.01 (0.00 to 0.02)	2.42	0.002	0.046 (4.6)
Final model				0.201 (20.1)

Key points

- Growth impairment is associated with duration of work and low monthly child income independent of household per capita income or maternal height.
- Laws protecting children from exploitation through work exist in most countries but are not enforced.
- Protection of working children may need initiatives aimed at nutritional and educational outreach alongside more effective law enforcement.

DISCUSSION

The results of this study suggest that, independent of maternal height and family income per capita, work related variables, such as duration of work and child's monthly income, have an effect on growth in height and weight. BMI is affected only by duration of work. Another plausible explanation of these findings is that the poorest children who are likely to be the most growth retarded before starting work have the greatest economic pressure to work. As this is a cross sectional survey, it is not possible to completely refute this alternative explanation. If this alternative explanation were true, as a result of the need for the poorest children to work as early as possible, a correlation would be expected between age of starting work and the family income excluding the child's income. No such correlation was found. In addition, as we have reported elsewhere from the same study,¹⁶ working boys have significantly lower height for age and weight for age z scores than their non-working male siblings. The findings are also consistent with those of the few studies reporting the relation between growth and duration of working in childhood.⁴⁻¹⁰

There is a plausible physiological explanation for these findings. The higher physical activity associated with work requires additional nutrients to compensate for additional calorie consumption especially during periods of increased growth such as puberty. If the child's income is required to supplement household income, it is probable that insufficient compensatory calories will be available for normal growth. The finding that growth differences between working and

non-working children did not become established until after 8 years of age⁴ lends support to this explanation. Further support comes from a study of street children in Jakarta⁶ whose growth was better than non-working children from the same poor neighbourhoods; the authors suggest that the street children were able to use their incomes entirely for the purchase of additional calories rather than sharing them with other household members.

While there is an extensive literature on the characteristics of work among children and the general health hazards of work,^{3-4,6,8-17} a comprehensive literature review has failed to identify any reports of studies examining the relation of duration of work and child's income with child growth.

Limitations of the study

Child labour is illegal in many countries including Jordan although the law is not enforced. As a consequence, children's work is frequently hidden making the selection of a representative sample difficult. Despite the systematic sampling method used in this study, it is probable that some types of child labour are under-represented. It is probable that child labour within the family is under-represented. Impairment of growth may be less likely in the comparatively protected family environment. However, more hidden forms of child labour outside the family in less protected environments are also likely to be under-represented and these forms of labour may carry an increased risk of growth impairment.

Stage of puberty was not assessed. It is possible, though unlikely, that this introduced a systematic bias among working boys such that those with shorter work histories were more likely to enter puberty early thus confounding the relation between work duration and height z score.

The regression models for height and weight z scores account for only 20.1% of the variance and 9% for BMI. Other factors not measured in this study exert an influence on growth among working children. Some of these unknown variables may be confounding the apparent independent effect of work related variables on growth. For example, it is possible, although unlikely, that children sent to work at an early age are victimised within the family leading to growth impairment. Residual confounding by socioeconomic status

may also account for some of the apparent independent effect of work related exposures.

As considered above, this is a cross sectional survey and we cannot rule out alternative explanations for the relation between growth and work related variables found in this study. Longitudinal study design would be necessary to resolve these conflicting explanations.

Conclusions

Despite these limitations, the results of this study suggest that, within a group of working children, duration of work is associated with growth impairment and higher monthly income protects against some of the detrimental effects of work on growth. These effects seem to be independent of family per capita income and maternal height.

These findings have social policy implications for Jordan and probably for other countries with high levels of child labour. Despite strict laws prohibiting child labour, it remains a common problem globally flourishing among poverty and low levels of education. To minimise the intergenerational cycle of child labour leading to illiteracy, social policies aimed at reducing poverty and ensuring basic levels of literacy and educational and nutritional outreach to child workers are likely to be more effective than simply attempting to enforce laws.

Contributors

HH and NS jointly designed the study which forms the basis of HH's PhD. HH collected the data. HH analysed the data with guidance from NS. HH and NS jointly wrote the paper. NS is the guarantor.

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