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Vision Impairment and Productivity Among Female Garment Workers in Bangladesh. A Cohort Study

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Setting and Participants

Eye health screenings and service delivery were performed at 4 garment factories during September and October 2019. These included 2 urban factories in Dhaka (Shanin Clothing Ltd and Mac-Tex Industries Ltd), and 2 rural factories located near Mymensingh (Targeted Garments Ltd 1, and Targeted Garments Ltd 2).

The eye health screenings and service delivery included women working in a variety of job categories. Dates were scheduled in consultation with factory owners and participants were recruited based on their availability to attend on the selected days and their consent to participate in the study. Training for future screenings, outside of the study, was provided to mid-level management and nursing staff at the factories so that all workers would eventually have the opportunity to attend an eye health screening.

Vision Screening and Ocular Examination

The eye health screening and service delivery teams each consisted of 1 ophthalmologist, 1 refractionist, 2 ophthalmic assistants, 1 counselor, 2 data recorders, 1 spectacle dispenser, and 1 coordinator. Ocular examinations were carried out according to a standard screening protocol and included:

1. Patient registration
2. Assessment of correctable distance visual acuity separately in each eye using an ocular occluder and Snellen Tumbling E chart at a distance of 3 m in a well-lighted indoor area of the factory
3. Near vision testing with both eyes together using an N-type handheld chart at a distance of 40 cm
4. Examination of the anterior segment by handlight and the posterior pole by direct ophthalmoscopy, both performed by an ophthalmologist
5. Distance refraction by a trained refractionist where presenting distance visual acuity was $<6/12$ in at least 1 eye, and near refraction was performed if near vision was N8 or worse.^{1,10}
6. Free medications (predominantly topical ocular antibiotics, anti-allergy drops and artificial tears) were dispensed as needed. Free presbyopic and myopic spectacles were provided to all those whose vision improved with refraction.
7. Dilation of the pupil in cases of suspected cataract (based on handlight examination), after which a medical officer performed a torchlight examination of the anterior segment and direct ophthalmoscopy to confirm the diagnosis.
8. Those identified needing further investigation or surgical intervention for cataract or epiphora were referred to the National Institute of Ophthalmology and Hospital (NIO&H) for treatment.

Data Collection and Management

A questionnaire was administered to all participants, inquiring about age, marital and educational status, income, job designation and years of seniority, daily hours worked, district of residence, spectacle ownership, and vision complaints. Presenting distance visual acuity as assessed by an ophthalmic assistant, distance refractive power as measured by refractionists using streak retinoscopy, presenting near visual acuity, near refraction tested by using plus lenses, and ocular conditions diagnosed during the examination were recorded separately for each eye.

Patient demographic, clinical, and questionnaire data were entered into Microsoft Excel 365 (Redmond, WA, US) by a trained data entry specialist. A password-protected administrative database containing all respondent contact details and managed by the Orbis Bangladesh office was used for contact purposes and oversight of the data collection process. Paper records of contact sheets, registration documents, questionnaires, and other forms were archived under lock and key. All data for research analysis were provided to the study statistician (JLP) in deidentified format.

Statistical Methods

Data were downloaded from Microsoft Excel 365 and imported into SAS version 9.4 (Cary, NC, US) for statistical analysis. Distance vision impairment was the presence of uncorrected vision of $<6/12$ in either eye, correctable to $\geq 6/7.5$ with distance refraction. Distance refractive error was defined according to recorded clinical diagnosis during the examination and included myopia, hyperopia, and/or astigmatism. Near vision impairment was defined as 1 or more of the following: 1) either eye with presenting near vision $<N8$ at 40 cm with distance visual acuity $>6/12$ in the same eye; 2) having been prescribed near add spectacle power in examination records; and/or 3) clinical diagnosis of presbyopia at the time of screening. Monthly income was self-reported via the survey and converted to US dollars by dividing reported Taka by 83.2.¹¹

Basic frequencies are presented for categorical variables, and means, standard deviations (SD), and medians are given for age and monthly income. Chi-square tests were utilized to compare urban and rural residents with regard to presenting correctable distance visual acuity, distance spherical equivalent refractive power in the better-seeing eye, and near vision impairment. Statistical testing was performed on the entire cohort and stratified by age category (<25 , 25–29, 30–34, 35–39, and 40+ years). Univariate and multivariable linear regression was utilized to assess predictors of monthly income, and parameter estimates (β), standard errors (SE), and *P* values are presented for each. The final multivariate model applied backward stepwise selection to include variables contributing to the model at $P < 0.10$. A sensitivity analysis was performed that included only participants who worked in the operators/sewing section since this job type likely requires near vision activities the most. Similar methods were utilized for univariate and multivariable linear regression models with monthly income as the primary outcome.

RESULTS

A total of 915 participants (100% female) with mean age of 29.8 (SD 8.25 years) were screened. Participants reported a mean monthly income of \$96.90, two-thirds ($n = 609$, 66.6%) had a primary school or lower education, and most (80.9%, $n = 740$) were married. Workers had a mean of 5.04 (SD 4.16) years of seniority in their current jobs and worked for a mean of 10.8 hours/day. A small percentage (9.29%, $n = 85$) of workers owned spectacles at the time of the survey, and one-quarter (28.5%, $n = 261$) reported symptoms of asthenopia (Table 1).

Correctable distance refractive error, defined by the presence of myopia, hyperopia, or astigmatism, was present in 29.2% ($n = 267$) of workers undergoing eye health screenings, with a

Table 1. Demographic and Professional Characteristics and Baseline Ownership of Spectacles Among Garment Workers Participating in the Study

	All Study Participants
Female, n (%)	915 (100%)
Age, y	
Mean (SD)	29.8 (8.25)
Median (IQR)	30.0 (24.0–35.0)
Range	18–70
Age 35 and older	297 (32.5%)
Married, n (%)	740 (80.9%)
Educational status	
No education	150 (16.4%)
Nongraded religious education	41 (4.48%)
Primary school only	418 (45.7%)
Secondary school	287 (31.4%)
Higher secondary/Masters	19 (2.08%)
Monthly income (US\$*) (n = 905)	
Mean (SD)	97.1 (33.1)
Median (IQR)	96.4 (72.3–118)
Range	12.0–301
Job designation	
Helper	91 (9.95%)
Quality control	72 (7.87%)
Operator/Sewing section	626 (68.4%)
Cleaner	42 (4.59%)
Folding woman	78 (8.52%)
Unknown	6 (0.66%)
No. y on the job (n = 910)	
Mean (SD)	5.04 (4.16)
Median (IQR)	4.00 (2.00–8.00)
Range	0–25.0
Daily time working, hr (n = 913)	
Mean (SD)	10.8 (2.10)
Median (IQR)	12.0 (8.00–12.0)
Range	7.00–18.0
District of residence	
Urban	447 (48.9%)
Rural	468 (51.2%)
Baseline ownership of spectacles	85 (9.29%)
Self-reporting symptoms of asthenopia	261 (28.5%)

*1 US\$ = Taka 83.0 on October 31, 2019.

IQR indicates interquartile range; n, number of study participants; SD, standard deviation.

similar prevalence among urban participants (30.4%, n = 136) compared to rural dwellers (28.0%, n = 131). Rural participants in the 40+ age group had significantly better presenting correctable distance visual acuity compared to their urban counterparts ($P = 0.0132$) (Table 2).

Just over one-quarter of screened participants (n = 245, 26.8%) had near vision impairment. Of the 245 participants with near vision impairment (near visual acuity <N8, Snellen equivalent 6/12, in either eye), 30.6% (n = 75) had near visual acuity <N10 in either eye (Snellen equivalent 6/18). Prevalence of near vision impairment was significantly higher among rural residents (34.2%) compared to urban overall (19.0%, $P < 0.0001$) with the largest differences occurring in the 35 to 39 (68.2% vs 44.2%, $P = 0.002$) and 40+ (85.9% vs 48.9%, $P < 0.0001$) year age groups (Fig. 1). Prevalence of near vision impairment was already high among urban (20.4%, n = 20) and rural (23.0%, n = 17) workers at young ages (30 to 34 years).

In simple linear regression models, participants with near vision impairment earned \$13.3 (SE 2.44, $P < 0.0001$) less per month than those without, while urban residents earned \$40.6 (SE 1.74, $P < 0.0001$) more than rural ones (Table 3). In the final multivariable linear model, both near vision impairment (\$6.51 lower monthly earnings, SE 1.84, $P = 0.0004$) and urban residence (\$43.2 higher monthly earnings, SE 2.39, $P < 0.0001$) remained significantly associated with income (Table 3). The sensitivity analysis that included only females in the operator/sewing section job type had similar univariate and multivariable findings for near vision impairment and urban/rural residence. Correctable distance visual impairment was not significantly associated with earnings.

DISCUSSION

This study found high rates of near vision impairment among garment workers, particularly rural study participants. We observed a near vision impairment prevalence of 20% to 23% between the ages of 30 and 34 years, which is consistent with other studies documenting the loss of accommodative reserve before age 40.^{12,13} This was presumably due to the existing high prevalence of hyperopia in this cohort, consistent with the observed higher prevalence of near vision impairment in rural workers; hyperopia has commonly been seen at higher rates in rural populations,^{14–17} due to lack of educational exposure.^{18,19} The presence of near vision impairment was also associated with lower monthly salary, even after adjusting for potential confounding variables such as years on the job, daily working hours, education, job type, and rural versus urban residence. Inexpensive treatment with near glasses, proven effective in the long term,^{20–22} could increase earnings by some \$70 per year, a difference by itself sufficient to guarantee 6 weeks of income above the World Bank's poverty line.²³ Workplace screening and

Table 2. Presenting Correctable Distance Visual Acuity in the Better-Seeing Eye Among Urban and Rural Residents

Age Group	Total	Urban			Rural		
		= 6/6	6/9–6/12	6/18–6/60	= 6/6	6/9–6/12	6/18–6/60
<25	249	106 (98.2%)	0 (0%)	2 (1.85%)	137 (97.2%)	1 (0.71%)	3 (2.13%)
25–29	197	110 (94.0%)	7 (5.98%)	0 (0%)	72 (90.0%)	6 (7.50%)	2 (2.50%)
30–34	172	89 (90.8%)	7 (7.14%)	2 (2.04%)	70 (94.6%)	3 (4.05%)	1 (1.35%)
35–39	165	68 (88.3%)	7 (9.09%)	2 (2.60%)	85 (96.6%)	3 (3.41%)	0 (0%)
40+*	132	37 (78.7%)	3 (6.38%)	7 (14.9%)	71 (83.5%)	12 (14.1%)	2 (2.35%)
Total	915	410 (91.7%)	24 (5.37%)	13 (2.91%)	435 (92.9%)	25 (5.34%)	8 (1.71%)

*Urban and rural significantly different in distribution of presenting correctable distance visual acuity ($P = 0.0132$, chi-square test) for this age group.

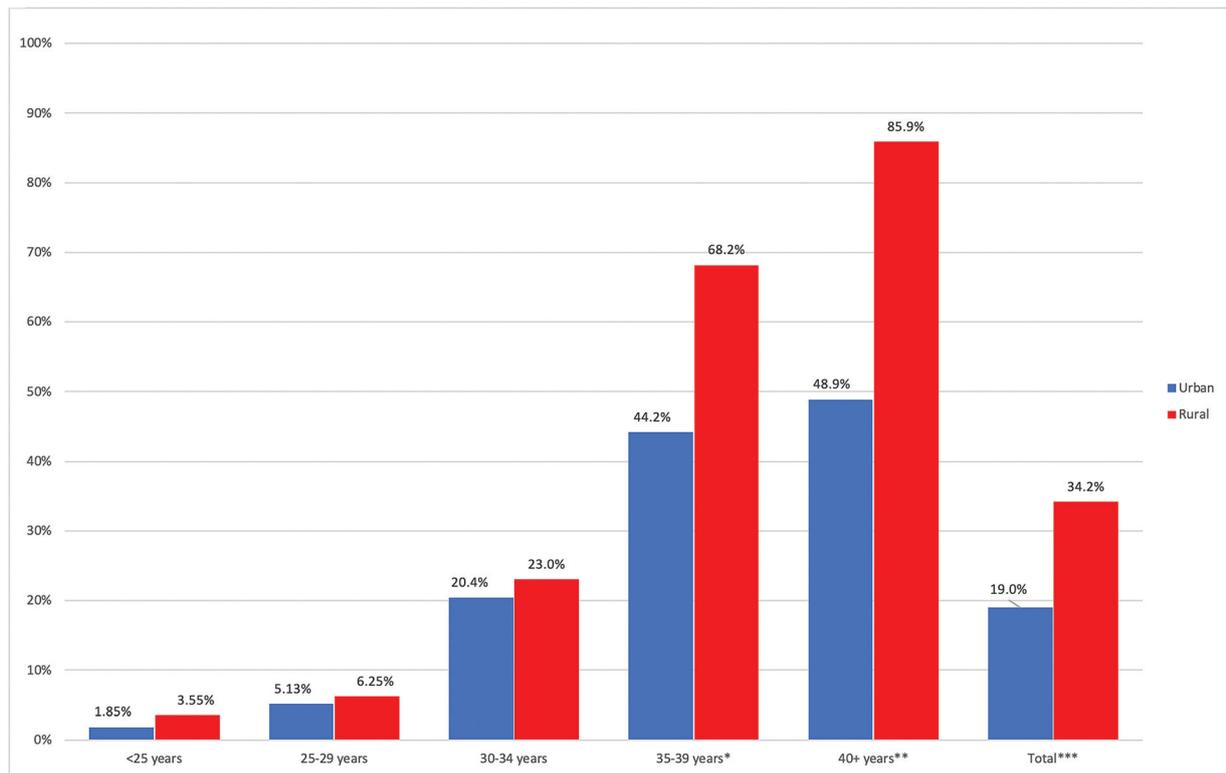


Figure 1. Prevalence of near vision impairment by urban/rural residence and age group.

provision of near glasses similar to this program could serve as a scalable poverty reduction strategy in service of the United Nations Sustainable Development Goal 1—to end poverty in all its forms everywhere.²⁴

While this study did not include productivity measures, the decrease in salary for participants with near vision impairment may have been due to vision-related reduction in quality and/or output among these garment workers, as recruitment and salary increases are tied to productivity tests and annual adjustments

based on performance. Improving near vision with spectacle correction has been shown to increase productivity among textile workers²⁵ and in other sectors, such as agriculture, that depend on good near vision.²⁰ Of the 245 participants with near vision impairment (near visual acuity <N8, Snellen equivalent 6/12, in either eye), 30.6% (n = 75) had near visual acuity <N10 in either eye (Snellen equivalent 6/18). The degree of near vision impairment present in this cohort was thus modest, consistent with other assessments showing the impact of near vision impairment

Table 3. Univariate and Multivariate Regression Models of Potential Predictors of Monthly Salary (US\$, n = 905)

Potential Predictor	Univariate		Multivariate	
	β (SE)	P value	β (SE)	P value
Near vision impairment	-13.3 (2.44)	<0.0001	-6.51 (1.84)	0.0004
Age, y	-0.238 (0.133)	0.074	-	-
Time on the job, y	3.35 (0.240)	<0.0001	2.21 (0.195)	<0.0001
Daily time working, h (n = 903)	-5.56 (0.488)	<0.0001	2.54 (0.551)	<0.0001
Married, n (%)	-1.59 (2.79)	0.568	-	-
Educational status				
No education	Reference	-	Reference	-
Non-graded religious education	17.0 (5.86)	0.004	-4.43 (4.30)	0.304
Primary school only	13.1 (3.12)	<0.0001	1.49 (2.33)	0.520
Secondary school	14.4 (3.30)	<0.0001	4.70 (2.48)	0.058
Higher secondary/Masters	36.4 (7.93)	<0.0001	24.1 (5.78)	<0.0001
Job designation				
Helper	Reference	-	Reference	-
Quality control	28.6 (4.92)	<0.0001	18.0 (3.63)	<0.0001
Operator/Sewing section	31.8 (3.44)	<0.0001	16.7 (2.58)	<0.0001
Cleaner	35.9 (5.87)	<0.0001	13.8 (4.39)	0.002
Folding woman	37.4 (4.79)	<0.0001	9.06 (3.62)	0.0126
Urban residence	40.6 (1.74)	<0.0001	43.2 (2.39)	<0.0001
Baseline ownership of spectacles	14.5 (3.74)	0.0001	-	-

SE indicates standard error.

in the workplace, for example in the PROSPER trial on presbyopic Indian tea pickers,²⁰ less than 20% of participants (who had to have near visual acuity <N8 in both eyes) had near visual acuity <N10. It would appear that even modest degrees of near vision impairment can negatively impact workplace productivity. In view of the very significant global productivity losses associated with near vision impairment among persons of working age,⁴ and the observed high burden among younger workers with many remaining years in the workplace, the financial benefits of near vision correction for this population could be significant. Both workers and factories could benefit from increased productivity, with a synergistic impact on economic growth.

This study included only female garment workers, who constitute the majority of workers in the industry. Women often require near vision correction at an earlier age than men,^{26–28} presumably due to reduced access to education compared to men and higher prevalence of hyperopia. This may have contributed to the high prevalence of near vision impairment in this study. Globally, women carry a larger burden of vision impairment than men,² and women living in LMICs make a significant contribution to the economy in rural settings,²⁹ where we found a higher prevalence of near vision impairment. Therefore, focusing on industries with a high proportion of female workers, such as readymade garments, may be effective in addressing gender disparities in vision impairment and its economic impact.

As previously mentioned, limitations of the study include the lack of productivity measures before and after correction of near vision impairment. More trials on the impact of spectacle correction on productivity in textiles and other vision-intensive sectors are needed, to broaden the evidence base for action. Strengths of the study include presentation of data from both urban and rural locations, the large sample size, and the focus on LMICs, whose populations account for 90% of uncorrected near vision impairment globally,^{1,2} and where the need for practical poverty alleviation strategies is especially acute.

CONCLUSIONS

This study found high rates of near vision impairment among female garment workers in Bangladesh, particularly rural dwellers, and at a younger age than expected. Further, the presence of near vision impairment was associated with significantly decreased income, even after adjusting for a variety of potential confounders. This study suggests that focusing on industries with a high proportion of female workers, such as readymade garments, may be effective in addressing gender disparities in vision impairment, its economic impact, and as a potential poverty alleviation strategy in this setting. Additional studies, and especially trials, addressing near vision impairment in the garment industry would be beneficial in increasing understanding, and quantifying the potential economic impact.

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