

Eye screening can be used to perform anemia screening and treatment in adolescent girls using TouchHb

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Purpose: Anemia is common in adolescent girls. Apprehension while drawing blood to estimate hemoglobin concentration is a barrier for confirming anemia. TouchHb, a noninvasive instrument that estimates the hemoglobin by taking an image of the exposed conjunctiva, was used during eye screening to help diagnose and treat anemia. **Methods:** TouchHb was used during secondary school eye screening and during house-to-house eye screening to estimate the hemoglobin concentration in the body. Each of the girls was distributed a packet of 60 tablets of ferrous and folate and a tablet of albendazole. They were followed up after 3 months. **Results:** Exactly 1511 municipal school girls aged 10-19 years (mean 12.9; standard deviation [SD] 1.64) were examined. Of them, 949 (62.8%) had hemoglobin of ≤ 9 mg%. Among those girls with hemoglobin ≤ 9 mg%, the mean (SD) during the initial and follow-up examinations was 6.1 (1.4) and 9.6 (1.03), respectively, by paired *t*-test ($P < 0.001$). Another 588 girls (average age 14.4 years, SD 1.2) had their eyes examined and hemoglobin estimated during a house-to-house eye screening. Of them, 116 (19.7%) had hemoglobin level of ≤ 9 mg%. Their pre-Hb was 7.9 (SD 1.05) on average and after 3 months, it was 9.6 (SD 1.02). Among those girls with hemoglobin ≤ 9 mg%, the mean (SD) during the initial and follow-up examinations was 6.2 (1.4) and 7.9 (1.1), respectively, by paired *t*-test ($P < 0.001$). **Conclusion:** TouchHb was useful to diagnose anemia while doing eye screening and to ensure its treatment. Anemia diagnosis and management would enhance the health of adolescent girls.

Key words: Adolescent Girls, anemia, hemoglobinometer, school eye screening

Anemia is common among prepubescent and pubescent girls in India.^[1] While there are numerous programs for mother and child care, there are few of them for girls in 12-18 years age group, which are the crucial years for their growth and development.^[2] Due to "sarva siksha abhiyaan" and the national program for control of blindness, school eye screening activity has been carried out extensively for the past two decades.^[3] The enrollment of girl children aged 12-16 years is 97% in schools of Maharashtra, and schooling is free for girls till graduation.^[4] School eye screening mainly aims to identify and treat refractive errors.

TouchHb is an instrument designed to measure the hemoglobin level in the body by looking at the color of the capillaries in the conjunctiva.^[5] The International Longevity Centre-India was privileged to present the "Anjani Mashelkar Inclusive Innovation Award" to TouchHb.

One of the barriers for checking anemia in girls is the fear of a needle prick. Schools teachers are reluctant to do anything invasive with the children, especially girls, as it needs parental consent, which may be difficult to obtain. This series reports measuring hemoglobin levels of adolescent girls while doing eye examination using TouchHb.

Methods

TouchHb is a noninvasive anemia screening device that works by illuminating and taking an image of the exposed conjunctiva of an individual with visible light. It quantifies the pallor to give a semi-quantitative estimate of hemoglobin by the principles of reflectance photometry. TouchHb is intended for screening purpose in primary health care settings. Its manufacturer insist that it is not designed to be used for diagnostic or emergency application. It may not be used for determining hemoglobin of potential donors for blood donation purposes. The instrument was calibrated and validated in four institutes: Blood Bank of Civil Hospital, Thane; by Civil Surgeon, Central Hospital, Ulhasnagar, Maharashtra; at the L. V. Prasad Eye Institute, Hyderabad; and the Seth GS Medical College & King Edward VII Memorial Hospital, Parel, Mumbai. It has won the Anjani Mashelkar Innovation Award for 2018. Ethics committee clearance was obtained from the ethics committee of XXX.

The hemoglobin test results were displayed in about 1 min. The instrument is a lightweight and portable handheld device weighing <300 g. It has a simple three-step testing process. There are no recurrent costs. An instrument could perform

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30 tests per hour. It had been correlated with the standard method of estimating hemoglobin across multiple centers in India earlier.^[6]

TouchHb quantifies the pallor in the eye to estimate hemoglobin in grams per deciliter of blood. According to the World Health Organization (WHO), anemia is defined as a hemoglobin value of <12 g/dL in females and <13 g/dL in males.^[7] TouchHb can estimate hemoglobin ranging from 5 g/dL to 15 mg/dL. TouchHb was found to be accurate with 95% of the readings within ± 1.8 g/dL as that of reference hemoglobin values.^[6] Inpatient reproducibility for similar selection criteria was ± 0.5 g/dL.

Permission was sought and obtained from principals of the respective schools. A consent form was read out and the students and their parents were asked to sign in it. The same consent form was used in house-to-house screening too. Parental consent and concurrence was considered a must for all girls below 18 years of age. Each girl had her vision examined by a community health worker followed by an optometrist. Refraction was performed in the mobile eye clinic. The community health workers, both females with secondary school education, had been trained to use the TouchHb instrument. Girls from 6th to 10th standard in municipal schools were included in the study. Each of the girls was distributed a packet of 60 tablets of iron (ferrous) and multivitamin (folate) and a tablet of albendazole, an anti-helminthic drug, and given advice about proper diet. They were followed up after 3 months to measure their hemoglobin again. For house-to-house screening, the initial examination (visual acuity and hemoglobin estimation) was done in the girls' homes, while refraction was done in the vision center in the vicinity. They too were dispensed with the tablets and advice regarding proper diet.

Both the cohorts were followed up after 3 months for a repeat hemoglobin examination.

Data was entered in Microsoft Excel software, and paired *t*-test was used to calculate the significance between pre- and post-intervention hemoglobin values.

Results

One thousand five hundred and eleven girl students from five municipal schools were examined for ocular problems and for anemia in 2018-2019. The school girls were aged 10-19 years (standard deviation [SD] 1.64). Of these, 949 (62.8%) had hemoglobin of 9 mg% or less. The average age of school girls was 12.9 years (SD 1.64). They were studying in classes from 5 to 10: 306 (20.3%) in class 5, 395 (26.1%) in class 6, 178 (11.8%) in class 7, 384 (25.4%) in class 8, 105 (6.9%) in class 9, and 143 (9.5%) in class 10. Their average hemoglobin was 9.3 (SD 1.4) during the initial examination. On follow-up, their average hemoglobin was 9.9 (SD 2.1) with a difference of 0.6. Among those girls with hemoglobin ≤ 9 mg%, the mean (SD) during the initial and follow-up examinations was 6.1 (1.4) and 9.6 (1.03), respectively, by paired *t*-test ($P < 0.001$).

During the house-to-house eye screening around the vision center, 588 adolescent girls of the Phulenagar area also underwent anemia screening. Their average age was 14.4 years (SD 1.2). Their mean hemoglobin level was 10.4 (SD 2.5). Of the 588 girls, 116 (19.7%) had a hemoglobin level of 9 or less. Their pre-Hb was 7.9 (SD 1.05) on average and

after 3 months, it was 9.6 (SD 1.02). Among those girls with hemoglobin ≤ 9 mg%, the mean (SD) during the initial and follow-up examinations was 6.2 (1.4) and 7.9 (1.1), respectively, by paired *t*-test ($P < 0.001$).

Distribution of ferrous and folate tablets and anti-helminthic drug had helped improve their hemoglobin levels.

Discussion

School eye screening can be done relatively easily as it is noninvasive, and it offers an immediate benefit to the affected students by dispensing of spectacles.^[8] Most schools, their students, teachers, and principals, are familiar with this activity. This activity can be used to screen for anemia, which is highly prevalent in this age group. Girls in this age group are particularly vulnerable to anemia. Many are conscious of their figure and weight and may skimp on their diet.^[9] Many associate their weakness and giddiness as a normal part of menarche.^[10] A simple noninvasive examination would help screen these vulnerable girls, and simple supplementation and dietary advice would help them have better health and well-being. Ophthalmic paramedical staff could easily contribute to this. Earlier, school teachers had been recruited and trained to estimate their students' vision.^[11] Even older children and volunteers were used to examine vision of younger children.^[12,13] The same may be applied to measure hemoglobin by this noninvasive method. As it does away with the pinprick, with all its attendant risks and fear, and gives almost immediate result, it is eminently suited for anemia screening in schools and other eye care programs. An instrument may be kept in school nurse or principal's office. It would go a long way to highlight and treat the common health problem of anemia among adolescent girls and ensure their health, as it helps them overcome the challenges they would face as young adults.

The limitation of this study was a relatively short duration of follow-up at 3 months.

Conclusion

TouchHb was useful to diagnose anemia while doing eye screening and to ensure its treatment. Anemia diagnosis and management would enhance the health of adolescent girls.

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Conflicts of interest

There are no conflicts of interest.

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