Original Article

They see, they learn: Pre-COVID-19 prevalence of refractive errors in school children in suburban areas of North India

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Purpose: India has the largest population of youth in the world, thereby making them important contributors to the "India of Tomorrow". Over 80% of knowledge gained is by the visual sense, thereby making school screening programs a necessity in our country. Data from the pre-COVID era, that is, 2017–18 was collected from close to 19,000 children in Gurugram, Haryana, a tier two city in National Capital Region, India. A similar prospective observational study is planned post COVID-19 (2022–23) for further analysis to depict the impact of COVID-19 in these areas. **Methods:** The program They See, They Learn was set at government schools in the area of operations (district of Gurgaon, Haryana), where the children and their families were unable to afford eye care services. All children who were screened underwent a comprehensive eye examination at the school premises itself. **Results:** A total of 18,939 students were screened over a period of 18 months, covering a total of 39 schools in the Gurugram belt, in the first phase of the program. Eleven point eight percent (n = 2254) of all school students had some form of refractive error. Girl students were found to have a higher refractive error rate (13.3%) compared to boy students (10.1%) across the schools screened. Myopia was the most common type of refractive error. **Conclusion:** School students require perfect vision or else they can be discouraged and may become a major burden to the economy of any developing nation. A school screening program aiming at populations that cannot afford such basic needs like spectacles is a must in all zones of the country.

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India has the largest young population in the world.[1] This population has a great impact on the economy of our country. An estimated 27 lakh blind children, out of a global estimate of 1.9 million blind children, alone reside in our country.[2,3] Uncorrected refractive error is one of the leading causes of blindness in the world; thus a majority of childhood blindness is preventable with timely correction.[4] In India, 20% of the total visually impaired population is accounted by people suffering from uncorrected refractive errors.[5] This affects the development and maturity of children and impairs their learning abilities and academic performance,[6] often leading to their dropping out of school and directly affecting the productivity of the economy.

Refractive errors generally appear in childhood, more so in the school-going age, and continue into adult life.[7] Children generally are not aware of their problem or may adjust to their poor vision; therefore they often do not complain of defective vision. This can cause adverse impact on the learning process, which is more than 80% visual, at the school-going age.[6] This blindness can have a dramatic effect on personality development and career opportunities, thereby draining the potential of the youth. School screening programs, therefore, can be a major boon to reverse this loss by detecting and treating vision loss and preventing blindness.[8]

Owing to the differing socioeconomic status of students across the country, access to regular eye checkups and quality and affordable eyeglasses is a major concern. Therefore, school-based interventions have been proven to be a cost-effective[9,10] approach to prevent childhood blindness. The aim of our program They See, They Learn was to diagnose and treat uncorrected refractive errors and thereby reverse this tide of curable blindness and reduce its detrimental effect on the mental and personality development of these young school-going age groups.

Methods

Our study was a prospective observational study conducted in government schools present in and around the field practice area in the district of Gurugram, Haryana. The program covered a total of 39 schools in the Gurugram belt and screened 10,000 students for refractive error and other ocular

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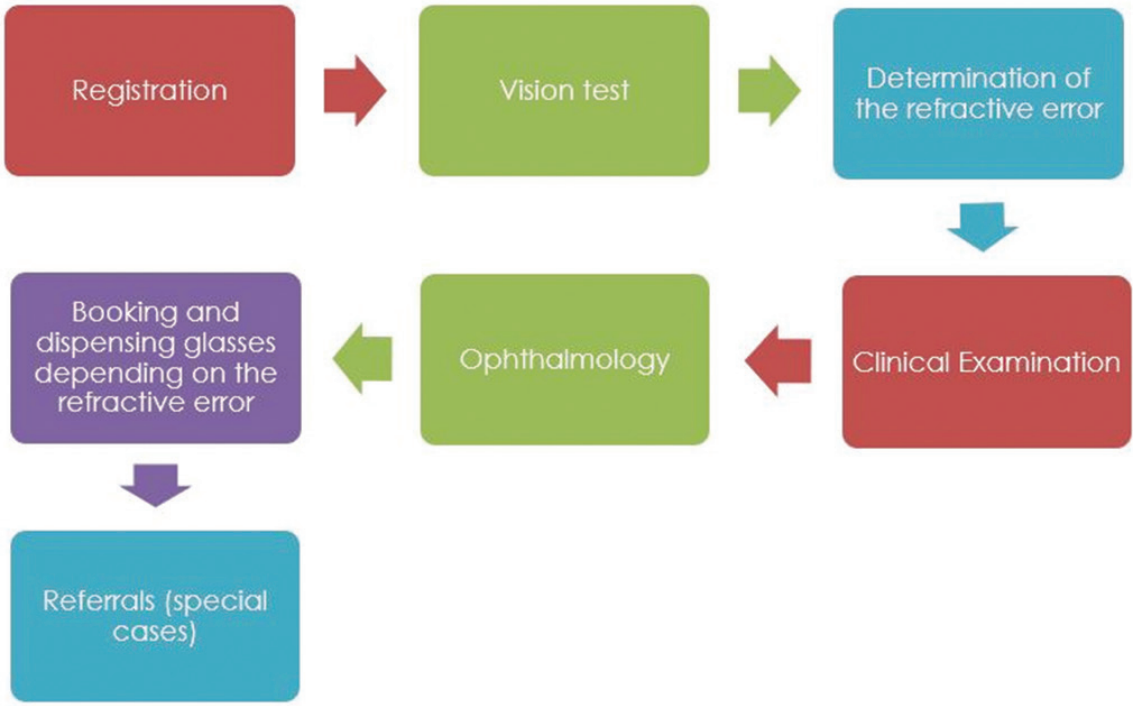

Figure 1: Schematics for methodology of school screening program They See, They Learn

morbidities in its first phase and 8939 students in its second phase. The study was conducted over a period of 18 months, from February 2017 to August 2018. Students from class I to class XII(verbal) were included in the study. Children were accordingly informed regarding the procedure and the need for the eye examination. All children present in the school on the day of screening were included in the study. Very few children were absent or unwilling to participate at the time of their respective school visits and were left out.

This study was approved by the institutional review board and adhered to the Declaration of Helsinki. Consent and required permissions were taken from all students (verbal), their parents, teachers, and authorities before conducting any examination on the wards. Schools chosen to screened were at a 50-km radius from the base hospital and visits were scheduled to achieve maximum attendance and avoid dropouts. School authorities and teachers were informed in good time, and appropriate arrangements were made much prior to the team visit. Teachers were educated in the tumbling E chart and a lecture on "common ocular morbidities and eye care for children" was given in each school prior to the team visit by a health care worker in order to seek cooperation from school authorities and teachers. Basic training with E chart and about sorting referrals was given to interested parties, mainly class teachers.

The team at the site comprised of an ophthalmologist trained in pediatric screening, an optometrist, an optometry trainee, two ophthalmic workers, and a driver. The team was sent in a mobile ophthalmic van equipped with a slit-lamp machine, a photoscreener (PlusOptix) device, an auto-refractometer, visual acuity screen, E charts, both adult and pediatric trial frames, trial sets, and retinoscopes for refraction.

The system of screening was as follows [Fig. 1]:

1. Registration for data collection
2. Visual acuity estimation: unaided, pinhole, and with glasses at a distance of 6 meters
3. Extraocular movements, Hirschberg test, cover test
4. Examination with torch light
5. Examination with slit lamp (mounted or handheld)
6. Photo screener/auto-refractometer refraction
7. Retinoscopy/subjective refraction
8. Referrals/advice as required.

The criteria for diagnosing refractive error in the children were laid prior to the start of the study. That is a VA <6/12 with a refractive error of greater than or equal to 0.5D whether as a diagnosis of myopia, astigmatism or hypermetropia were considered as "Refractive Error" Patient in the population for study. Students who had previously been diagnosed and treated for refractive error via Glasses were included, examined and given new refractive correction appropriate to the requirements. Referrals were only made when necessity of cycloplegia and / or for other suggestive ocular comorbidities like Amblyopia, Strabismus, Night blindness, Vitamin deficiency, Pediatric Cataracts,etc were found.

Results

A total of 18,939 students between the ages of 5 and 16 years were screened in 39 government schools around the district of Gurugram. On an average, there were 946 students in each school, belonging to class VI to class XII and having an average age of 15 years. Out of the 18,939 students screened, a refractive error rate of 11.8% was observed amongst these children, owing to 2254 children with refractive error. This figure included children with all forms of refractive error; that is myopia, hypermetropia and astigmatism, as well as amblyopia and other ophthalmic comorbidities leading to refractive error.

Figs. 2 and 3 depicts graphs showing percentage of students with normal versus those with reftactive error needing correction in each of these 39 schools covered over the time span of one year. Out of a total number of students screened, maximum students were of the age group of 13–15 years

[Fig. 4a]. It was also noted that refractive error rate was the maximum amongst students older than 13 years of age, with the maximum rate observed amongst the age group 16–18 years (17%) [Fig. 4b].

Out of 39 schools chosen for the study, four schools were exclusive girl schools, and out of the total students screened 56% were girls and 44% boys [Fig. 5a]. This was correlated with refractive error rate amongst males and females, and it was found that female students had a slightly higher refractive error incidence than the males [Fig. 5b]. The number of students with myopia (1139) was higher compared to hyperopia and astigmatism, out of the total number suffering from refractive error [Fig. 5b]. Fig. 6 shows the different types of astigmatism prevalent in the population of students with refractive error in this study. It was found that compound myopic astigmatism (694) and simple myopic astigmatism (320) were the two most prevalent types.

Furthermore, there were 15 children who were amblyopic and needed urgent referral for further management. The total number of children referred to the hospital for further evaluation and for other ocular morbidities was 410.

Discussion

This was the first of its kind study done for the suburban population in the pre-COVID era in the Gurugram district region. In our study, 16,274 (85.9%) out of 18,939 students from 39 different schools that were screened had normal vision (emmetropia). 2254 students out of these 18,939 had a significant refractive error and were provided with eyeglasses; that is the mean refractive error rate was 11.8%, which correlates with most of these 39 schools [Fig. 3] and with what previous literature suggests.[2,3,7]

Our study demonstrated that 15.5% of the 18,939 school children assessed had some form of ocular morbidity. Ocular morbidity included refractive error, strabismus, xerophthalmia, congenital cataracts, and other conditions. The demographic studied included school-aged children living in the Gurugram belt in India. A similar study in Mangalore looked at 402 students and found a prevalence of 20.4% of ocular morbidity.[11]

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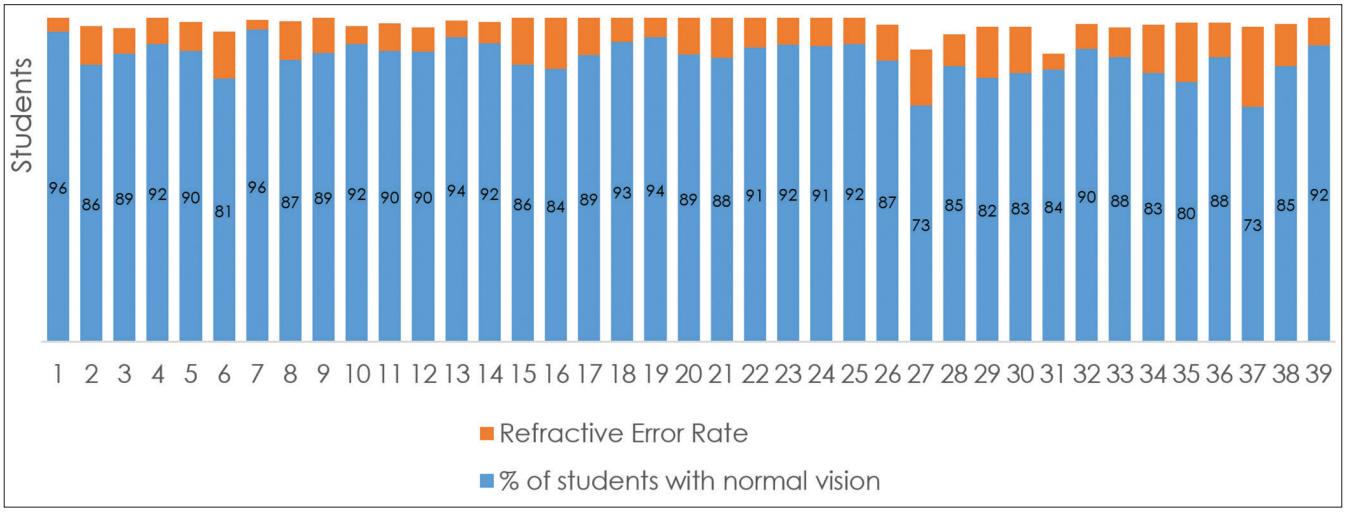

Figure 2: Graph depicting students with emmetropia versus ammetropia

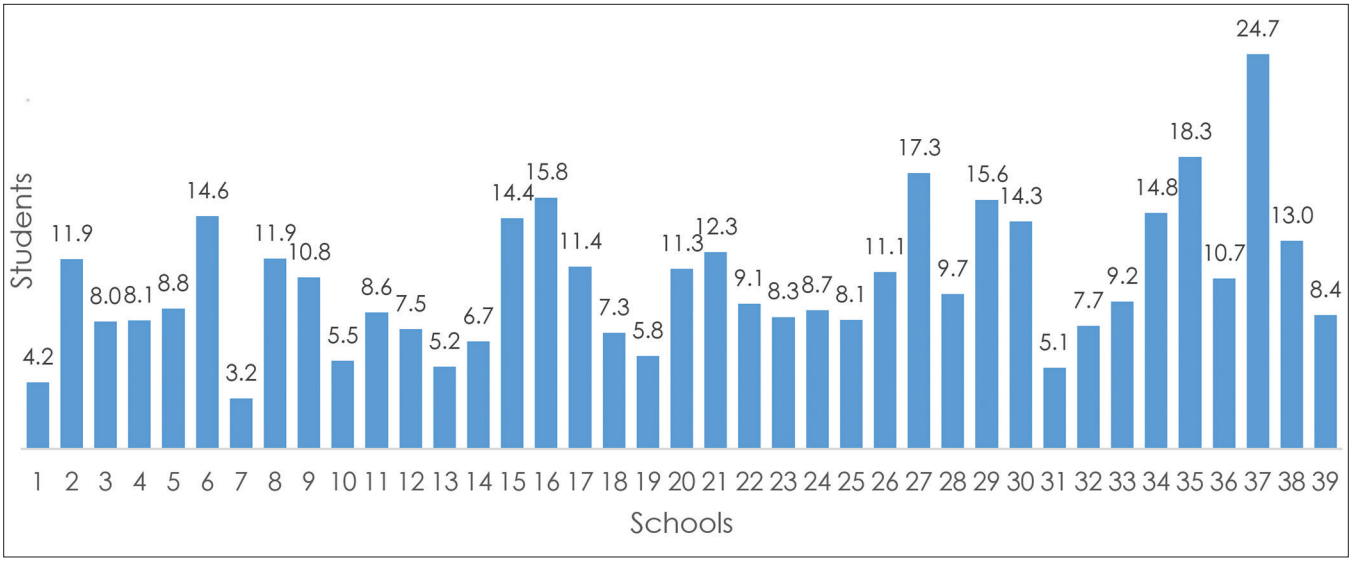

Figure 3: Graph depicting refractive error rate in each of these 39 schools

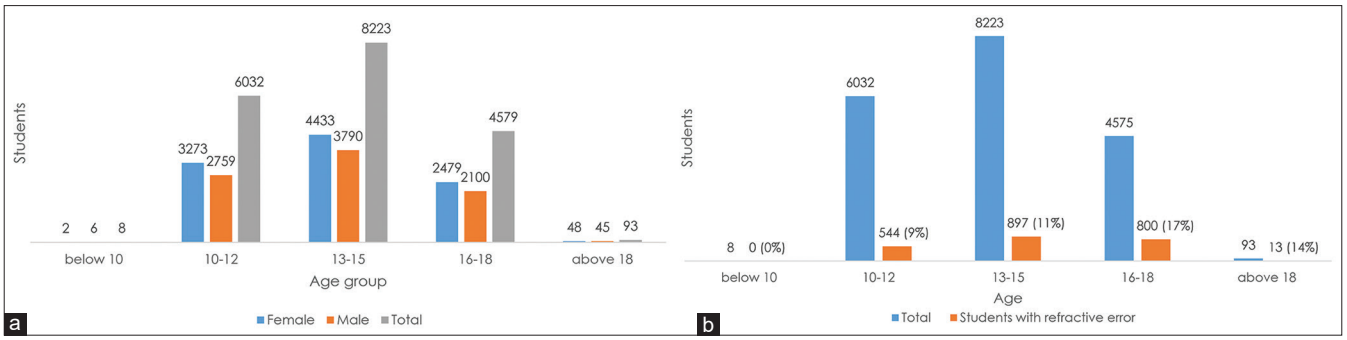

Figure 4: (a) Age distribution of students screened. (b) Age distribution of refractive error rate

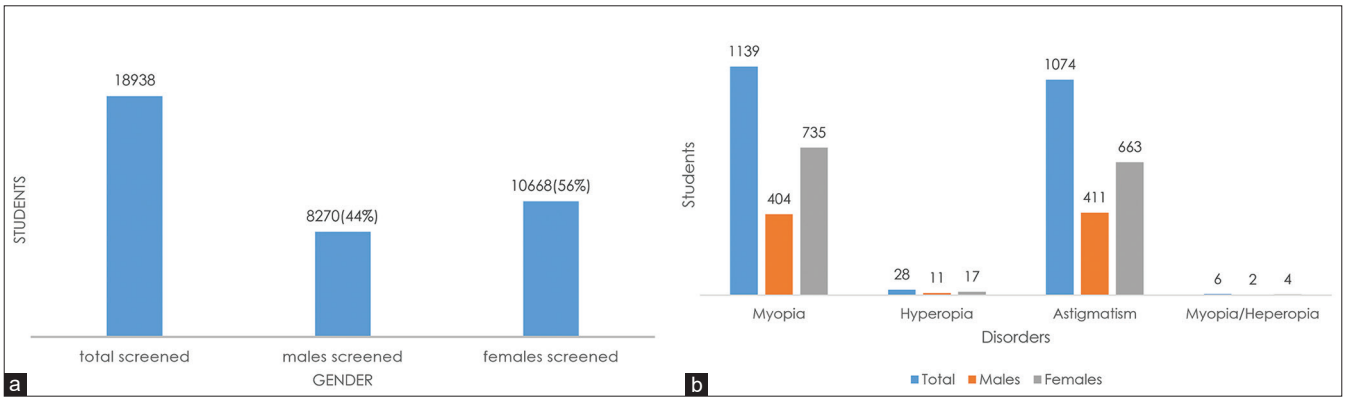

Figure 5: (a) Gender-wise distribution of school screening amongst total students. (b) Gender-wise distribution of refractive error and type of refractive error

A study in Goa looked at 817 students and found a prevalence of 13.22% of ocular morbidity among primary school–aged children, aged 6–10, that were assessed.[12]

Another study in Nigeria looked at 1393 students. It was found that 277 pupils had an ocular morbidity, which equated to a prevalence of 19.9%.[13] Another study in Shimla, Himachal Pradesh looked at 1561 students and found that 31.6% of students studied had an ocular morbidity.[14] Reasons that could have contributed to the range of ocular morbidity include location of the study, access to health care, and genetic predisposition.

Age as a factor

Refractive error rate was noticed to be high amongst students above 13 years of age, peaking in the age group of 16–18 years at 17%. Thus, our study suggests that students in the age group of around 13–18 years need to be targeted more regularly for refractive error testing in order to prevent irreversible vision loss in their adulthood.

Regression analysis of the data suggests that we may consider age as a marginally important determinant of refractive error. The R^2 value (coefficient of determination) was 0.096. Though age is a marginally important factor vis-à-vis refractive error, it becomes vitally important in planning vision-screening camps at school. As adolescents have the highest tendency to have refractive error, they become the single most important target age group whilst planning a school screening program to ensure maximum impact.

Gender as a factor

There were 8270 males (44%) and 10,668 females (56%) in total, out of which 832 (37%) males and 1422 (63%) females were given eyeglasses. The Chi-squared test showed the P value to be 0.525 which accepts null hypothesis. Thereby, our study suggests that gender has no impact on the refractive error and reiterates that there is only a slight difference between the refractive error rate of males (10.1%) and females (13.3%). This means that school screening programs should not be gender agnostic.

Type of refractive error

As reported in literature, our study too showed myopia to be the most common form of refractive error prevalent in school-going children.[15,16] This re-enforces the need for myopia control in all school going population and need to spread awareness regarding the same, which includes awareness of lifestyle modifications, environmental changes, screen time control and availability of latest methods of interventions. Astigmatism and hypermetropia followed myopia in our study as the most common form of refractive error amongst these children.

Our study demonstrated that 11.8% of the 18,939 school children assessed had a refractive error. The demographic studied included school-aged children living in the Gurugram belt in India. A similar study in Mangalore looked at 402 students and found 14.2% of students to have a refractive error.[11] A study in Shimla, Himachal Pradesh looked at 1561 students and found that 22% of students studied had a refractive error.[14] Another study conducted in the Kwabre East District of Ghana looked at 500 students and found that 26.3% of the school children had uncorrected refractive error.[17]

Need for school screening projects

Refractive errors leading to permanent vision loss have become one of the most common causes of blindness in our country.[2,8]

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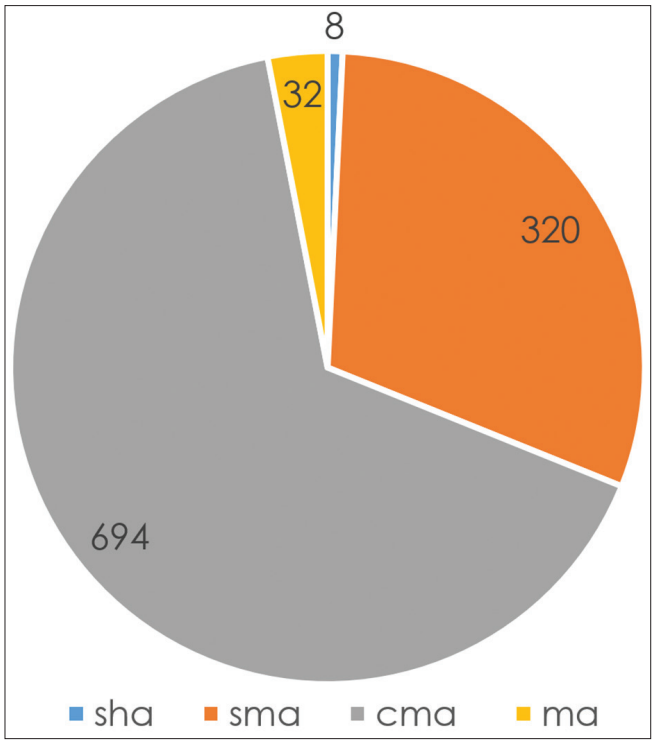

Figure 6: Distribution of types of astigmatism amongst the students diagnosed with refractive error (SHA- simple hypertropic astigmatism, SMA - simple myopic astigmatism, CNA - compound myopic astigmatism, MA - mixed astigmatism)

Avoidable blindness adversely affects a child's achievement in school and ultimately has a severe socioeconomic impact on society and, later, the country. The National Program For Control Of Blindness (NPCB) established in 1976, while having provisions for eye care, still needs major backing in terms of requirements, accessibility, and implementation. Thus, eye screening projects in government schools are of utmost importance to reduce the rate of eye disorders among children and eliminate the negative influence on their future.

Evidence on the impact of academic achievement

Academics and vision go hand in hand, and this directly impacts the future of a country.[18] A random control trial conducted in rural China[19] took 252 schools in western China where 3052 students participated, and it was found that provision of free glasses to those children with refractive error increased academic output significantly.

Conclusion

Impaired vision can a have a direct impact on school children's education, which can burden the economy of any developing nation. For a large majority of the students in our study, this was the first time they had their eyes screened and received a pair of glasses. An eye program with vision screening and free spectacles for underprivileged children is necessary for the well-being, education, and future of a developing nation. Therefore, more such programs should be undertaken to cover as many children as possible.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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