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Analysis of The Appropriateness of Refractive Error Correction in Students of Madrasah Aliyah Negeri 1 Soppeng

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ABSTRACT

Introduction: Refractive errors, causing many visual impairments and cases of blindness globally, impose a significant economic and academic burden, especially in children. Myopia, which often co-occurs with astigmatism, poses a challenge to vision correction and can cause symptoms such as asthenopia. While full vision correction reduces asthenopia. This study aimed to explore the appropriateness of vision correction in Madrasah Aliyah Negeri 1 Soppeng students. **Method**: This *cross-sectional* study was conducted at Madrasah Aliyah Negeri 1 Soppeng from March to July 2024, involving 243 students selected through total sampling. Vision was measured using the Snellen chart, and the need for spectacle use (*met-need, undermet-need*, and *unmet-need*) was evaluated. Data were analyzed based on the impact of refractive error on need for correction, focusing on e-REC, REC and REC-Gap. **Result**: The study included 243 students, of whom 25.1% had significant refractive errors. Only 12.8% wore glasses, while 50.8% met the need for corrective lenses (REC). The *unmet-need* rate was 49.2%, and e-REC was 42.6%, indicating that a large proportion of the population was either not wearing glasses or using inappropriate correction. Conclusion: This study found that despite relatively low levels of *met-need, undermet-need* and *unmet-need*, REC and REC-gap values remained high. Effective eyewear fulfillment among MAN 1 Soppeng students needs to be improved.

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INTRODUCTION

Patients with refractive errors in the world continue to increase every year. Refractive errors account for 43% of visual impairment and cause blindness in 6.8 million people worldwide (Hashemi et al., 2018). Other complications of refractive disorders cause economic burden due to work, therapy and use of glasses (Martiningsih, Swasty, Novitasari, & Kurniati, 2024). The epidemiologic increase in refractive error leads to

various complications of visual impairment depending on the severity of refractive error including the combination of refractive errors (Razaan, Sangging, & Himayani, 2023).

The most common refractive error is myopia and is often found together with refractive errors due to corneal curvature in the form of astigmatism. This condition makes vision correction more difficult than with single myopia. Macular complications increase in the presence of astigmatic comorbid conditions in myopia (Haves Ashan, Afrina, Dian Ayu Hamama Pitra, & Seres Triola, 2022).

Patients with refractive error are generally children and have an impact on reducing the quality of learning and achievement as well as the ability to capture lessons (Siregar, Sridhamayani, & Suryanto, 2024). This impact brings major changes to the quality of school graduates. This refractive error is still often experienced by children due to the lack of awareness of parents to conduct routine examinations. In addition, the level of awareness and understanding of parents about refractive errors in children and the use of glasses is still low (Doringin, Simarmata, Dika, & others, 2021).

Refractive errors are often not fully corrected and cause fatigue in the eye as an accommodation compensation mechanism and have a spectrum of symptoms up to headache (Yandi, 2017). Full correction allows the patient to see without accommodation while partial correction causes refractive load and increases the risk of macular complications.

The difference between refractive error correction and correction shows the burden of refractive error therapy (Pratama, Setiawan, & Purnomo, 2021). This condition also causes various complications in patients such as asthenopia and macular degeneration of myopia as a long-term impact (Pramesti, 2022). The difference scale and the description of the suitability of refractive errors with their correction are measured by *met-need, undermet-need* and *unmet-need* so as to provide an overview of the success of correction with refractive errors. Coverage with these scales also provides information related to refractive error *screening*.

Distributive coverage of spectacle needs is derived from the *Effective Refractive Error Coverage* (e-REC), *Refractive Error Coverage* (REC) and *Refractive Error Coverage Quality Service Gap* (REC-Gap) values (Marmamula et al., 2022). This coverage assesses the quantity (*met-needs*) and quality (*met-needs*) of eye health services for refractive error. The WHO threshold for mild distance vision impairment is 6/12 in the better eye and is used to determine need and to establish effective correction (Wulandari, 2024). Globally, the median e-REC is 35.7% at a visual acuity threshold of 6/12. The average global relative quality gap between "coverage" and "effective coverage" was 7.3%

Coverage of the fulfillment of spectacle needs in people with *refractive* errors in the form of *Effective Refractive Error Coverage* (e-REC) and *Refractive Error Coverage Quality Service Gap* (REC-Gap) values can be the basis for regular monitoring and has a major impact on the world of education because it involves student vision which has an impact on student learning achievement (Marmamula et al., 2022). Research related to *Effective Refractive Error Coverage* (e-REC) and *Refractive Error Coverage Quality Service Gap* (REC-Gap) data in Indonesia does not yet exist, but countries such as India show *Effective Refractive Error Coverage* (e-REC) of 37.4%, Colombia with *Refractive Error Coverage* (REC) of 50.9% and the United Arab Emirates around almost 70% which shows differences between various countries in the world (Brandt et al., 2021). There is no specific standardization regarding the values of these parameters.

Based on the description above, it can be concluded that there is a clinical impact on suboptimal refractive error correction. Therefore, the researcher wants to describe and explore the suitability of refractive error correction in Madrasah Aliyah Negeri 1 Soppeng

students. This research is expected to help focus on the factors that influence the unsuitability of refractive error correction.

LITERATURE REVIEW

Refractive error is an eye condition that results in the inability to focus clearly on objects located at a certain distance (Harb & Wildsoet, 2019). It is caused by an imbalance between the length of the eye and the refracting power of the lens within the eye (Chuck et al., 2018). There are several common types of refractive error (Sheeladevi et al., 2019). One common type of refractive error is myopia (Abdillah, Nugraha, Supandi, & others, 2023). In the case of myopia, the eye has a longer length than normal or the cornea and lens of the eye are too strong (Q. Yang et al., 2021). As a result, light entering the eye is focused in front of the retina rather than on its surface, causing distant objects to look blurry. People with myopia usually have problems seeing objects in the distance, but can still see close objects clearly

Another refractive error is hypermetropia. In hypermetropia, the eye has a shorter length than normal or the cornea and lens of the eye are too weak. As a result, light entering the eye is focused behind the retina rather than on its surface, causing close objects to look blurry. People with hypermetropia often have difficulty in seeing close objects and may also experience eyestrain when reading or doing prolonged close work. In addition, astigmatism is another type of refractive error. In astigmatism, the surface of the cornea or lens of the eye does not have a perfect shape. As a result, light entering the eye is focused at more than one point behind the retina, causing blurred and indistinct images of both distant and near objects. People with astigmatism may experience problems with blurry vision, double vision, or difficulty in distinguishing fine details (Rozema, Dankert, Iribarren, Lanca, & Saw, 2019).

e-REC and REC

e-REC refers to the percentage of individuals in the population who have access to adequate spectacles to correct their refractive needs. It reflects the extent to which an individual's refractive needs are met with appropriate eyewear. *Refractive Error Coverage* (REC) is the combined *met-need* and *undermet-need* of the total need for spectacles. To calculate e-REC and REC, it can be used the following formula:

e-REC = (*Met-need* / Total *need*) x 100

REC = ((*Met-need* + *Undermet-need*) / Total *need*) x 100

Visual impairment is usually reported at the person level rather than each eye separately, so e-REC is calculated using the visual acuity in the better eye of each individual and reported at the person level (Cottrell, North, Sheen, & Ryan, 2022). The higher the percentage of e-REC, the higher the level of fulfillment of refractive needs. However, it should be noted that e-REC does not provide a snapshot of the quality of services provided or whether the glasses provided accurately match the individual's needs

REC-Gap

Refractive Error Coverage Quality Service Gap (REC-Gap) evaluates the quality of service in meeting the refractive needs of individuals by looking at the extent to which the spectacles provided match the actual needs (Muhit et al., 2018). It identifies the gap between the service that should have been provided and the service received by the individual. REC-Gap can be calculated using the formula :

REC-Gap = 1-(e-REC/REC) X 100

A higher REC-Gap percentage indicates better quality of service in accurately addressing refractive needs, as it reflects the extent to which prescribed spectacles meet individual visual requirements. The REC-Gap helps identify potential issues such as errors in refractive measurements, inappropriate spectacle dispensing, or insufficient follow-up on spectacle use outcomes. When used together, the e-REC and REC-Gap provide a more comprehensive overview of refractive care needs, encompassing both access to and the quality of eye health services.

However, the fulfillment of the need for spectacles is also influenced by other factors, including hereditary conditions, environmental influences, and non-refractive eye disorders. For instance, individuals with high myopia are at greater risk of rhegmatogenous retinal detachment, while prolonged use of computers and digital devices can exacerbate refractive issues. Additionally, other ocular pathologies unrelated to refractive errors may complicate accurate diagnosis and treatment. These conditions highlight the importance of thorough clinical examinations beyond simple refraction assessments.

A situation in which REC and e-REC percentages are low but the REC-Gap is high suggests a failure in adequately addressing refractive error correction needs within a given region or country. Ideally, programs should aim to increase REC levels to closely match e-REC while minimizing the REC-Gap, thereby reducing the overall economic burden of uncorrected vision. Although no official benchmark values for REC, e-REC, or REC-Gap currently exist, the World Health Organization has set a global target for e-REC to reach 40% by 2030. This absence of standardized benchmarks underscores the need for further research to evaluate the effectiveness and appropriateness of current correction strategies. Persistently low REC and e-REC values contribute to widespread unmet vision correction needs, negatively affecting economic productivity—especially in occupations that require optimal visual performance (Ramke, Rogers, & Logan, 2022).

Refractive error can also be influenced by the economic level of the person with refractive error due to access to health care, quality of life and employment. This condition relates to people with disorders with higher economic levels having access to better treatment so that they can have appropriate glasses (Z. Yang et al., 2021). The quality of life of patients with higher economic status is also better because they can control and adjust their spectacles. The work of patients with refractive errors is also not interrupted and can provide better work efficiency (Li et al., 2021).

Refractive errors can be influenced by the parents' level of education. Parents with higher education can recognize the signs and symptoms of refractive errors better than parents with lower education. Patients with highly educated parents can seek better treatment and access to glasses (Pan, Wu, Wang, Li, & Zhong, 2018).

METHOD

This study employed a descriptive observational design with a cross-sectional approach and was conducted at Madrasah Aliyah Negeri 1 Soppeng, located in Soppeng Regency, South Sulawesi, Indonesia, from July 15 to August 6, 2024. The study population comprised all students enrolled at Madrasah Aliyah Negeri 1 Soppeng. Using a quota sampling technique, the research involved 243 students, with 81 participants each from grades X, XI, and XII.

The tools and materials used included a Snellen chart, informed consent forms, personal data collection sheets, a pen, and a laptop. The research process was divided into three key stages: preparation, implementation, and data analysis. During the preparation

stage, the researchers selected an appropriate population, determined a representative sample size, and set a timeline for data collection to ensure effective study execution.

In the implementation phase, the research began with the submission of a research proposal and the acquisition of ethical approval. Informed consent was then obtained from all participants to ensure voluntary involvement. Eligibility criteria—both inclusion and exclusion—were applied to screen suitable participants. A visual examination was conducted to detect potential refractive errors.

Following data collection, data tabulation and cleansing were performed to ensure accuracy and readiness for analysis. In the final stage, univariate analysis was used to determine the distribution of met and unmet needs, categorized as met-need, undermet-need, and unmet-need. Bivariate analysis was also conducted to explore the relationship between refractive errors, the need for spectacles, and the fulfillment of eye health service needs.

RESULTS AND DISCUSSION

Based on the research, 243 research subjects were obtained with the detail of characteristics can be seen on Table 1.

Table 1. Characteristics of Research Subjects

Variables	Frequency	Percentage (%)
Age	Mean±SD = 16.25±0.89	
Gender		
Male	52	21.4
Female	191	78.6
Class		
X	81	33.3
XI	81	33.3
XII	81	33.3
Father's education		
Bachelor	59	24.3
High school and below	184	75.7
Mother's education		
Bachelor	82	33.7
High school and below	161	66.3
Father's income		
>5 million/month	81	33.3
<5 million/month	162	66.7
Mother's income		
>5 million/month	78	32.1
<5 million/month	165	67.9
Wearing glasses		
Use	31	12.8
No use	212	87.2

Based on the results of 248 people, the average age of the subjects was 16.25±0.89, most of the parents had a high school education and below and earned less than 5 million per month. And most importantly there were 31 (12.8%) spectacle users even though there were 61 (25.1%) people with significant refractive errors as seen from table 1 which shows the characteristics of the study subjects. Of the 61 people who need glasses, the largest *unmet-need* value is 42.9% or as many as 30 people and the appropriate use of glasses is only 42.6%, as can be seen from table 2 which shows the distribution of the coverage of

the need to use glasses. It can be seen in table 4.3 that although the REC of the need for glasses is met by more than half, namely 50.8%, there is a REC-Gap value of 16.1% which indicates that there is still a population using glasses that are not suitable or not using glasses from the entire population that needs glasses.

Table 2: Distribution of the Need for Eyeglasses Use (Total Need = 61)

Necessity of Eyeglasses Use	Percentage (%)
Met-need *(Met-need* / total *need)* x 100 = (26/61) x 100	42.6
Undermet-need *(Undermet-need* / total *need)* x 100 = (5/61) x 100	8.2
Unmet-need *(Unmet-need* / total *need)* x 100 = (30/61) x 100	49.2

Table 3. Distribution of Coverage of the Need for Eyeglasses Use

Coverage of the Need for Eyeglasses Use	Percentage (%)
REC (*Met-need* + *undermet-need*) / total *need* x 100 = (26 + 5) / 61 x 100	50.8
e-REC (*Met-need* / total *need*) x 100 = (26/61) x 100	42.6
REC-Gap 1-[(e-REC)/REC] x 100 = 1-[(42.6)/50.8] x 100	16.1

Met-need

Based on the research, the *met-need* value was 42.6% (26 people) in MAN 1 Soppeng students. Fulfilling the need for glasses in adolescents with refractive errors is an important issue that has a significant impact on eye health and quality of life. Studies show that the provision of free eyeglasses, especially when combined with educational interventions, can increase adolescents' compliance in using glasses by 53.11%. Factors such as cost, discomfort, and social perceptions of spectacles are also significant barriers to spectacle wearing by adolescents. In addition, the need for renewal of spectacle prescriptions is also higher among adolescents who already wear spectacles, given the more severe degree of refractive error compared to those who do not wear spectacles. Lack of understanding of the importance of regular eye examinations also worsens adolescents' access to adequate eye health services (Hashemi et al., 2017). Efforts to raise awareness of the importance of eye examinations and the use of spectacles need to be increased, especially among adolescents and their parents. Based on this description, the *met-need* value of MAN 1 Soppeng students is lower than the world average.

Undermet-need

Based on the results of the study, it was found that *undermet-need* was 8.2% (5 people) in MAN 1 Soppeng students . *Undermet-need* in the fulfillment of spectacle needs for adolescents with refractive errors is a significant problem in various countries. For example, a study in the United Arab Emirates found that the prevalence of *undermet-need* reached 26.8% among adolescents, with factors such as socioeconomic status, parental education level, and location of residence strongly influencing access to eye health services. In Iran, a study found that of 7-year-old children who needed glasses, about 33.3% had an unmet need , with economic inequality being a major factor. Meanwhile,

research in Kenya showed that unmet refractive correction among adolescents led to a significant reduction in quality of life, which could be addressed with timely correction interventions (Joseph et al., 2021). These studies show the importance of greater efforts in ensuring better access to eye health services, especially among vulnerable populations who often have unmet vision correction needs. Based on this description, the percentage level of *undermet-need* at MAN 1 Soppeng is already lower than the world average.

Eyeglass correction is necessary when a person has a refractive error that affects vision and quality of life. The requirements for spectacle correction include the presence of refractive errors that affect one's visual acuity and quality of life. *Undermet-need* rates show that more than 30% of people with refractive errors do not receive adequate correction, resulting in decreased visual function. The use of *autorefractors* in determining spectacle prescription has almost the same accuracy as conventional subjective refraction examinations, and can be an alternative in resource-limited areas (Killeen et al., 2023). Meanwhile, external factors such as cost and access to eye care services are major barriers for low-income individuals in meeting their spectacle correction needs (Joseph et al., 2021).

Unmet-need

Based on the results of the study there was an *unmet-need of* 49.2% (30 people) in MAN 1 Soppeng students. Meeting the need for spectacles in adolescents with refractive errors remains a significant challenge, as seen in several studies highlighting *unmet* need. Research in India showed that 10.8% of the population in rural areas still had an unmet need for spectacles, despite efforts to distribute subsidized spectacles (Malhotra et al., 2019). In Kenya, another study found that unmet refractive correction in adolescents had a significant effect on their quality of life, despite public health interventions designed to address this issue (Joseph et al., 2021) . Furthermore, in the United States, inequities in eye examinations among adolescents contribute to high rates of unmet need for spectacles, especially among families with low socioeconomic status (Jiang et al., 2019). This suggests that despite efforts to provide spectacles, there are still significant challenges in ensuring that all adolescents in need have adequate access to vision correction services. Awareness and access to eye health services must be increased more equitably to reduce this high *unmet need*. This shows that the *unmet-need* rate at MAN 1 Soppeng is higher than the world average.

Parental education is strongly associated with children's use of spectacles, with parents with higher levels of education more likely to understand the importance of vision correction and ensure their children comply with spectacle use. This is due to the fact that educated parents usually have better access to health information and resources, allowing them to make better decisions regarding their children's health. Studies in India found that parental education directly influenced adherence to spectacle use, where children of educated parents showed higher adherence to treatment (Jiang et al., 2019). Another study from China revealed that paternal education significantly influenced spectacle ownership among children with visual impairment (Bro & Brautaset, 2023). Higher parental education was strongly associated with better compliance and use of spectacles among children.

The relationship between parents' economic status and occupation is linked to their children's use of eyeglasses. Parents with better economic resources are more likely to be able to afford vision aids, such as glasses, for their children. This is because families with higher incomes can prioritize spending on health care, including purchasing glasses if needed. Studies in Cambodia found that parents with higher incomes and stable

employment were more willing to pay for their children's glasses, showing a clear link between economic capacity and access to vision care (Burnett et al., 2022). In addition, research in China shows that parents' employment status directly affects their ability to provide eyeglasses for their children (Bro & Brautaset, 2023). Parents' employment and economic status significantly influence whether children receive necessary vision aids.

REC

Meeting the spectacle needs of adolescents with refractive errors is still an important health issue, especially when the REC effectiveness rate only reaches 50.8%, indicating that the fulfillment of the spectacle needs of MAN 1 Soppeng students is higher than the world average. Studies in India show that effective spectacle coverage is still low, with a coverage rate of only 33.3% in rural areas, reflecting *an unmet-need of* 10.8% (Malhotra et al., 2019). In Kenya, it was found that unmet refractive correction had a negative impact on adolescents' quality of life, despite efforts to distribute free spectacles (Joseph et al., 2021). Another study in Delhi, India, showed that despite an intervention providing subsidized spectacles, spectacle coverage only increased from 29.3% to 65.9% after one year, suggesting challenges in achieving consistent spectacle wear (Jiang et al., 2019). On the other hand, a study in Bogota, Colombia, revealed that only about 50.9% of the population who needed glasses for distance vision actually had glasses, while economic factors were the main barrier to obtaining the necessary glasses (Luque et al., 2019). This confirms that despite various efforts, there are still many challenges in meeting the need for glasses for adolescents with refractive errors.

e-REC

Based on the results of the study, an e-REC of 42.6% was obtained, indicating that there are still many adolescents with refractive errors who do not receive adequate vision correction in MAN 1 Soppeng students. Although this value is higher than the world median of 35.7% for *threshold* 6/12 (Jiang et al., 2019) . In India, a study found that effective spectacle coverage among school children increased after an intervention, but many children still did not wear the provided spectacles, suggesting challenges in meeting vision correction needs (Jiang et al., 2019) . In Kenya, unmet refractive correction negatively impacts adolescents' quality of life, despite spectacle distribution programs (Joseph et al., 2021) . Research in Germany revealed that approximately 58.7% of children had refractive error, but not all received adequate correction, especially in children with uncorrected amblyopia.[23]In Sweden, although the prevalence of myopia is increasing, effective correction coverage is still low, especially among older girls (Bro & Brautaset, 2023) . Another study in Russia showed that effective refractive correction coverage could be increased through more intensive and structured eye examination programs in schools. This suggests the importance of more strategic and focused interventions to improve e-REC among adolescents with refractive errors (Bikbov et al., 2024)

REC-Gap

The Refractive Error Correction Gap (REC-Gap) level of 16.1% indicates that the difference between the fulfillment of spectacle needs has been quite good in MAN 1 Soppeng students. Research in Kenya revealed that unmet refractive correction greatly affects adolescents' quality of life, especially in aspects of daily visual function (Joseph et al., 2021) . Meanwhile, a study in Russia showed that a high prevalence of myopia among children was not fully corrected, resulting in continued visual impairment in adolescence (Bikbov et al., 2024) . Another study in Nigeria identified that despite vision screening programs in schools, many children who need glasses are still not getting them, leading to

increased rates of learning disabilities (Kaiti, Shyangbo, Sharma, & Dahal, 2021) . In Sweden, studies show that although the prevalence of myopia has remained stable, many children still do not receive adequate refractive correction, especially in older adolescent girls (Bro & Brautaset, 2023) . This study shows the importance of increasing access to and awareness of eye health services to reduce the high REC-Gap among adolescents with refractive errors. Although some other parameters are good, the REC-gap of MAN 1 Soppeng students is still quite high compared to the world average due to the high *unmet-need* rate. It is even very far from the Southeast Asian average of 3.2%.

This study offers several strengths, particularly in its comprehensive approach to assessing spectacle needs among students with refractive errors. It incorporates detailed classifications, including met-need, undermet-need, and unmet-need, allowing for a nuanced understanding of visual health status. Additionally, the study highlights the relationship between socioeconomic factors—specifically parental income and education levels—and the likelihood of spectacle use among students. These findings provide valuable insights for developing targeted eye health policies in school settings.

Despite these strengths, the study also has certain limitations. Its scope is confined to a single madrasah, which may limit the generalizability of the results to broader student populations. Furthermore, the absence of follow-up or longitudinal data restricts the ability to assess long-term adherence to spectacle use and the sustained impact of the intervention over time.

CONCLUSION

Based on the research, although the *met-need* and *undermet-need* values are low, the REC and REC-Gap values are still high, so it is necessary to increase the fulfillment of the need for glasses in the population who have not yet received glasses.

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