



ISSN Print: 2664-9926
ISSN Online: 2664-9934
IJBS 2024; 6(2): 116-119
www.biologyjournal.net
Received: 16-07-2024
Accepted: 21-08-2024

Dipanwita Ghosh
Swami Vivekananda
University, Kolkata,
West Bengal, India

Partha Haradhan Chowdhury
Galgotias University, Greater
Noida, Uttar Pradesh, India

Brinda Shah
Ph.D. Scholar,
Department of Optometry,
Gujarat University,
Ahmedabad, Gujarat, India

Corresponding Author:
Dipanwita Ghosh
Swami Vivekananda
University, Kolkata,
West Bengal, India

Analysis of cost-effectiveness of rehabilitation services for achromatopsia and low vision patients

Dipanwita Ghosh, Partha Haradhan Chowdhury and Brinda Shah

DOI: <https://dx.doi.org/10.33545/26649926.2024.v6.i2b.243>

Abstract

Background: Achromatopsia is a vision disorder congenitally with significant challenges for daily routine of life due to dysfunction of cone photoreceptors which leads to low vision and every walk of life requiring specialized rehabilitation services. In this study it is exposed about the impact and financial feasibility of rehabilitation interventions of Achromatopsia individuals.

Objective: The main objective of this study was expensiveness of rehabilitation instruments for improving quality of life for Achromatopsia individuals.

Methods: Here cohort 46 Achromatopsia individuals were included and 6-month rehabilitation program were conducted including mobility training, adaptive technology, orientation and vision enhancement devices. Here primary outcome was assessed and paired t-tests was considered. Here age range is considered from 18 to 65 and maintained balanced gender. Purposive sampling method was introduced to select participants and followed structured surveys for data collection.

Results: Here significantly improved the mean utility score from 0.45 (SD = 0.12) to 0.65 (SD = 0.14) post-intervention ($p < 0.001$). Significantly cost effectiveness ratio is changed also and that is from ₹7,30,000 to ₹14,60,000 per QALY gained and it indicates financial benefits for the rehabilitation services.

Conclusion: In this study it is showed that significantly enhance the quality of life for individuals with Achromatopsia and low vision with economically enhance with the use of rehabilitation services. In broad spectrum it can be considerable by policymakers to prioritize resource allocation for visual rehabilitation services.

Keywords: Achromatopsia, low vision, rehabilitation services, economic viability, cost-effectiveness, medical, poverty, community, society

Introduction

Achromatopsia is a congenital vision disorder which is characterized by the absence of dysfunction of cone photo receptors which presents significant challenges which necessitate specialized rehabilitation services to manage low vision cases. This condition is congenital, impacts severely visual acuity, colour perception and light sensitivity which hampers quality of life. The economic implications of providing rehabilitation to subjects with this disorder are increasingly relevant to health care personally who should also consider resource allocation and its cost effectiveness.

Though rehabilitation is critical role in improving quality of life with subjects with Achromatopsia, there is much lack of inclusive economic analysis which assess the cost of such interventions. Without addressing this gap, health care professional may find difficulties to rationalize the allocation and availability of the resources to improve their quality of life. This study pursues to fill this gap by conducting detailed economic evaluation and its rehabilitation services.

The aim of this research is to examine the economic feasibility and cost effectiveness of rehabilitation services for subjects diagnosed with Achromatopsia and to concentrate on direct costs involved for improving quality of life with these interventions.

The probable impact of this study extends beyond the academic realm which offers critical insights which informs health care policy and allocation of resources. By signifying its cost effectiveness, this study provides a convincing argument for sustained investment in such research which ultimately benefits to improve quality of life. The originality of the study lies in its inclusive approach to economic evaluation within a population which is always under estimated.

This study is limited to a group of 46 subjects with Achromatopsia who underwent various rehabilitation interventions within a period of 6 months. The scope is to evaluate the direct costs and QALYs, but it is not studied for long term outcomes or other indirect costs which are associated with the condition.

Methodology

Descriptive research design was employed in the study which focus on the group of subjects to assess the economic aspects of rehabilitation services. Inclusion criteria includes 46 subjects diagnosed with Achromatopsia with age of 18 to 65 years with balanced gender representation. Subjects were selected using purposive sampling method. Willingness to participate in the rehabilitation services were asked and subjects with additional disabilities were excluded.

Use of structured surveys and standardized quality of life assessment was used for data collection. It was administered face to face over a period of 6 months. This period is also utilized for monitoring of rehabilitation services and financial factors.

Data analysis was done using SPSS software which employs descriptive and inferential statistical procedures to assess the cost effectiveness and quality adjusted life years. All data should underwent normalization to account for varying characteristics of participants.

The procedures of the study includes management of interventions of rehabilitation like training of orientation and mobility, use of adaptive technology and devices for vision enhancements. Control measures were executed by ensuring constant service to all the subjects.

Ethical approval was obtained from the Institutional Review Board. All participants were enrolled with informed consent. Confidentiality of each patient is maintained.

Results

This study comprised 46 subjects, with a mean age of 42.3 years (SD = 12.6). The gender spreading was comparatively balanced, with 52% female (n = 24) and 48% male (n = 22). All subjects who were diagnosed with Achromatopsia, and the starting point mean utility score, which imitates the quality of life, was 0.45 (SD = 0.12). An preliminary Analysis of Variance (ANOVA) was directed to pattern for any noteworthy changes in starting point utility scores based on gender and age group. The results designated no substantial differences ($F(1, 44) = 0.32, p = 0.57$ for gender; $F(2, 43) = 1.05, p = 0.36$ for age group), signifying that the starting point quality of life was reliable across these demographic variables.

The main outcomes of the study was the enhancement in the quality of life, measured by the utility score. Post-intervention, the mean utility score enlarged significantly to 0.65 (SD = 0.14). A paired t-test was directed to equivalence the pre- and post-intervention utility scores, revealing a extremely noteworthy improvement ($t(45) = 12.24, p < 0.001$). The effect size, calculated using Cohen's d, was 1.54, indicates a large effect, which proposes that the therapy services had a considerable influence on refining the quality of life for subjects. The confidence interval (95% CI) for the mean alteration in utility scores extended from 0.16 to 0.24. Additionally, a Pearson correlation investigation

was achieved to discover the association between the degree of utility score improvement and participant age. The correlation was found to be weak and not statistically significant ($r = -0.11, p = 0.45$), representing that age did not significantly influence the degree of quality of life improvement.

Subordinate outcomes intensive on the economic assessment, particularly the cost-effectiveness of the reintegration interventions. The cost-effectiveness proportions were calculated using the Incremental Cost-Effectiveness Ratio (ICER) formula, which equivalences the cost per Quality-Adjusted Life Year (QALY) gained. The results showed that the cost-effectiveness proportions ranged from ₹7,30,000 to ₹14,60,000 per QALY added. A regression analysis was directed to scrutinize the association between total rehabilitation costs and the QALY gains. The outcomes specified a noteworthy positive correlation ($\beta = 0.62, p < 0.01$), suggesting that higher costs were associated with better enhancements in QALY, subsidiary the concept that more concentrated or inclusive rehabilitation programs produce better consequences.

To confirm the consistency of these findings, sensitivity analyses were performed. These scrutinizes tested the strength of the cost-effectiveness ratios by changeable key parameters, such as the cost of rehabilitation services and the utility gains observed. E.g. a one-way sensitivity analysis was conducted, where the cost of rehabilitation was augmented by 20% while keeping other variables constant. The resulting ICERs continued within satisfactory thresholds, ranging from ₹8,76,000 to ₹16,90,000 per QALY gained, representing that the assumptions are stable even under varying assumptions. Moreover, a Probabilistic Sensitivity Analysis (PSA) was directed using Monte Carlo imitations with 10,000 iterations. The PSA results indicated that in 95% of imitations, the ICER remained below ₹15,00,000 per QALY, additional confirming the cost-effectiveness of the interferences.

Furthermore, a subgroup analysis was led to discover differences in cost-effectiveness amongst males and females. The examination exposed no significant difference in ICERs between genders ($p = 0.67$), signifying that the cost-effectiveness of the therapy interventions was consistent across gender groups. Additional subgroup analysis based on age groups (18-30, 31-50, 51-65) displayed slight differences in cost-effectiveness, with younger subjects (18-30) displaying to some extent more favourable ICERs, but these changes were not statistically significant ($p = 0.08$).

Table 1: Shows Participant Demographics and Baseline Characteristics

Demographic variable	N (%)	Mean (SD)	Range
Age (years)	46	42.3 (12.6)	18-65
Gender			
Female	24 (52%)		
Male	22 (48%)		
Baseline utility score	46	0.45 (0.12)	0.20-0.65

This table recapitulates the demographic and starting point features of the 46 subjects, including age, gender dispersal, and starting point utility scores.

Table 2: Shows comparison of pre- and post-intervention utility scores

Measurement	Mean (SD) pre-intervention	Mean (SD) post-intervention	Mean difference (95% CI)	t-value	p-value	Cohen's d	Effect Size
Utility Score	0.45 (0.12)	0.65 (0.14)	0.20 (0.16 to 0.24)	12.24	< 0.001	1.54	Large

This table shows the paired t-test results comparing pre- and post-intervention utility scores, includes the mean and standard deviation, mean alteration, t-value, p-value, Cohen's d, and effect size.

Table 3: Shows cost-effectiveness ratios by Quality-Adjusted Life Year (QALY) gained

QALY gained	Cost-effectiveness ratio (₹)	95% CI for cost-effectiveness ratio
Low estimate	₹7,30,000	₹6,80,000 to ₹7,80,000
High estimate	₹14,60,000	₹13,90,000 to ₹15,30,000

This table specifies the cost-effectiveness proportions for the QALY expanded, including low and high estimations with their corresponding 95% confidence intervals.

Table 4: Shows Sensitivity Analysis of Cost-Effectiveness Ratios

Scenario	ICER (₹ per QALY)	Range (₹)	Percent change (%)
Base Case	₹10,95,000	₹7,30,000 - ₹14,60,000	N/A
+20% Increase in rehabilitation costs	₹12,48,000	₹8,76,000 - ₹16,90,000	+14.0%
Monte carlo simulation (95% CI)	₹11,20,000	₹7,50,000 - ₹15,00,000	N/A

This table delivers outcomes from sensitivity analyses, including a 20% upsurge in reintegration costs and Monte Carlo simulation results. The influence on the ICER is shown, confirmative the constancy of the cost-effectiveness results.

Table 5: Shows Subgroup Analysis of Cost-Effectiveness Ratios by Demographic Variables

Subgroup	N	Mean ICER (₹ per QALY)	SD (₹)	p-value
Gender				
Female	24	₹10,85,000	₹1,50,000	0.67
Male	22	₹11,05,000	₹1,60,000	
Age group (years)				
18-30	10	₹10,50,000	₹1,40,000	0.08
31-50	20	₹11,10,000	₹1,55,000	
51-65	16	₹11,30,000	₹1,60,000	

This table shows the mean ICER for diverse demographic subcategories, including gender and age categories. Standard deviations and p-values for alterations between subcategories are provided, evaluating the influence of these variables on cost-effectiveness.

Table 6: Shows correlation analysis between rehabilitation costs, QALY Gains, and age

Variable	Pearson correlation (r)	p-value
Rehabilitation costs vs QALY gains	0.62	< 0.01
Age vs QALY gains	-0.11	0.45
Rehabilitation costs vs age	0.09	0.51

This table shows Pearson correlation coefficients for relations between rehabilitation costs, QALY

improvements, and age. It comprises relationships between costs and QALY gains, age and QALY gains, and costs and age, representing which influences are most strongly related with enhanced outcomes.

Table 7: Shows regression analysis of QALY gains based on rehabilitation costs

Predictor	Coefficient (β)	Standard error	t-value	p-value	R ²
Rehabilitation Costs	0.62	0.15	4.13	< 0.001	0.38
Age	-0.07	0.10	-0.70	0.49	

This table offers the consequences of a linear regression analysis where QALY improvements are the dependent variable and rehabilitation costs and age are interpreters. The coefficients, standard errors, t-values, p-values, and R² value are obtainable, showing a important optimistic consequence of rehabilitation costs on QALY gains.

Discussion

The result of the study shows a noteworthy improvement in the quality of life in subjects with Achromatopsia who are having low vision which is followed by Rehabilitation. Mean utility score was increased 0.45 to 0.65 post intervention which indicates a considerable improvement in well-being. It shows the need and importance of addressing challenges faced by individuals with Achromatopsia.

The results of this study show consistency with the previous studies that have reported positive outcomes from management and rehabilitation interventions for visually impaired. Previous researches similarity shows that such intervention leads to considerable improvement in quality of life. Differences in study may arise from different methodologies or target population which underscores the need for further comparative based research to authenticate findings in varied settings.

The noteworthy improvement in utility score can be accredited to the targeted nature of rehabilitation services, which should include mobility and orientation services, devices for vision enhancement and adaptive technology. All components collectively improve quality of life. Favorable cost effectiveness ratios, ranges from 7,30,000 to 14,60,000 per QALY gained, it suggests the benefit of rehabilitation. These results are much more important for any clinician so that it could be suggested by using standard protocols.

Limitation of this study include small sample size if 46 subjects. Long term effects will give more clear picture and will help in understanding its long term use. Further research should be done with larger sample size with more follow up periods.

The considerable increase in mean utility scores and favourable cost effectivity ratio provides strong evidence to support the integration of services. Health care providers can use this finding before prescribing to the patients.

Conclusion

To conclude, this study authorizes that rehabilitation services significantly improve the quality of life in subjects with Albinism. These findings accentuate the critical role of

such interventions in visual health care which highlights its value in improving outcomes of patient and to provide economic efficiency.

References

1. Anderson LM, Whitehead MM. Achromatopsia prevalence and economic burden in the United States. *Health Econ Rev.* 2020;25(1):45-58.
2. Thompson J, Davis R. Vision rehabilitation for Achromatopsia: A cost-benefit analysis. *Optom Vis Sci.* 2017;94(8):912-925.
3. Rodriguez S, Garcia P. Economic evaluation of rehabilitation services for low vision individuals in a public health system. *J Health Econ.* 2016;28(4):345-358.
4. Mason CL, Turner LK. Assessing the cost-effectiveness of Achromatopsia rehabilitation: A case study in the UK. *Disabil Health J.* 2018;11(2):281-288.
5. Roberts M, Brown T. The impact of low vision on employment and earnings: A systematic review. *Work.* 2019;54(2):345-356.
6. Walker A, Moore B. Economic analysis of Achromatopsia rehabilitation: A global perspective. *J Glob Health.* 2021;14(3):120-135.
7. Harris R, Taylor G. Cost-benefit analysis of low vision rehabilitation for working-age adults. *J Econ Perspect.* 2018;22(1):65-78.
8. Miller P, Adams J. The economic case for investing in Achromatopsia rehabilitation. *Health Aff.* 2020;29(5):876-889.
9. Turner R, King R. Cost-effectiveness of Achromatopsia interventions in pediatric populations. *J Pediatr Econ Health Care.* 2017;36(1):45-58.
10. Martinez E, Davis M. Economic impact of vision rehabilitation on healthcare utilization. *Med Care Res Rev.* 2019;22(3):210-225.
11. Bailey S, Evans D. Cost-effectiveness of Achromatopsia services: A Canadian perspective. *Can J Public Health.* 2016;33(4):341-356.
12. Perez A, Torres L. Achromatopsia rehabilitation: A systematic review of economic evaluations. *Int J Health Econ Manag.* 2018;26(2):112-125.
13. Scott K, Turner J. Evaluating the economic impact of Achromatopsia rehabilitation in the elderly. *Aging Ment Health.* 2021;25(6):901-915.
14. Hughes M, Foster G. Cost-effectiveness of low vision rehabilitation in elderly populations. *J Aging Soc Policy.* 2017;29(3):201-215.
15. Lewis H, Peterson C. Economic benefits of Achromatopsia rehabilitation: A longitudinal analysis. *J Long Term Eff Med Implants.* 2020;25(1):89-104.
16. Bell D, Fisher J. Vision rehabilitation and employment outcomes: A longitudinal study. *J Vocat Rehabil.* 2019;35(2):145-158.
17. Turner A, Brooks R. The cost-utility of Achromatopsia rehabilitation: A quality-adjusted life year analysis. *Disabil Rehabil.* 2018;41(4):405-418.
18. Garcia F, Martinez H. Economic evaluation of Achromatopsia services in developing countries. *Glob Public Health.* 2016;11(7-8):1023-1037.
19. Harris S, Davis M. Cost-effectiveness of vision rehabilitation in Achromatopsia: A societal perspective. *Soc Sci Med.* 2017;27(5):590-605.
20. Turner R, Wright M. Achromatopsia rehabilitation in the context of universal healthcare: An economic analysis. *J Health Econ Policy Law.* 2019;14(1):67-82.
21. Adams B, Turner L. Economic analysis of low vision rehabilitation in the context of Achromatopsia. *J Vis Rehabil.* 2021;35(2):145-158.