

SOCIO-ECONOMIC STATUS AND HEALTH OUTCOMES AMONG SCHOOL-GOING CHILDREN IN DELHI: A META-ANALYSIS

Prashant Kumar¹, Anil k Vinayak², Sarita Tyagi³, Pooja Rexwal⁴,
Deepika Yadav⁵, Rishabh Sharma⁶

^{1,2,3,4,5,6}Department of Physical Education and Sports Sciences, University of Delhi, Delhi, India

*Corresponding Author: Prashant Kumar. Email: pershi.17@gmail.com

Abstract

Background: Extreme socio-economic inequalities exist within the city of Delhi resulting into health inequities across different social strata for school going children. Despite the high proportion (> 35%) of the urban population of India that resides in slums like conditions, there is no systematic synthesis of the evidence regarding its effect on health outcome. **Objective:** Quantify the association between socio economic status (SES) and health outcomes in school going children (age range: 6–18yrs) of Delhi through a meta-analysis. **Methods:** A systematic review of all eligible articles retrieved from PubMed, Scopus, Web of Science, Google Scholar, IndMED, IMSEAR, and ProQuest Dissertations databases (through June 2024) was conducted. A random-effects meta-analysis approach was adopted using Review Manager v5.4 software to pool the study results as ORs along with respective CIs and p values. Subgroup analyses were also performed alongside appropriate meta regression techniques to assess source(s) of heterogeneity. **Results:** Children belonging to the lowest socio-economic status (SES) group had an increased risk of adverse health outcomes [OR = 2.45, 95%CI: 1.89 - 3.18; P <0.001]. Of these nutritional outcomes recorded the highest OR at (OR = 2.89, 95%CI: 2.34 - 3.57), whereas mental health parameters had OR = 2.67 (95%CI: 2.01 – 3.54). This study demonstrated the presence of 'double burden' of nutrition problems where both under nutrition (OR=2.89) and overweight /obesity (OR=3.51) existed amongst low and high SES children respectively. Finally, age proved to be significant moderator of effect sizes (P = 0.012). **Conclusion:** In summary our findings suggest that SES has a considerable impact upon health of school going children in Delhi which includes major problems of under nutrition, mental health issue, and obesity. Therefore, targeted intervention should be designed focusing simultaneously on alleviating problem of undernutrition among lower SES group while targeting prevention of obesity among higher SES. School Health Programme must address socio-economic concerns during designing and implementing.

Keywords: Socio-economic status, child health, Delhi, meta-analysis, school children, health disparities, mental health.

Introduction

The health and wellbeing of school-going children are key indicators of a country's progress towards achieving sustainable development and human capital formation. It reflects the overall health profile

of a given population and their ability to contribute positively to future generations [1]. With over two-fifths of India's total population comprising school-going children, the nation grapples with myriad challenges in delivering optimum health outcomes on a spectrum of socio-economic statuses [2]. This scenario has

been compounded by rapid urbanisation, disparity of economic means, and inequitable distribution of healthcare and educational facilities which together result in divergent health statuses of children from varied socio-economic backgrounds [3]. The National Capital Territory of Delhi, besides being India's political nerve centre, also represents a microcosm of such differences marked by extreme inequality in terms of earnings, wide variations in lifestyle and cultural practices and disparities in accessibility to basic facilities [4]. Socio-Economic Status (SES), an all-encompassing concept that includes both economic parameters (i.e., income) and non-pecuniary factors such as level of parental education, nature of occupation, standard of housing and availability of basic amenities forms the backbone for understanding health inequity among children [5]. Numerous studies indicate that socio-economic status acts as a pivotal factor affecting health status and nutritional state amongst children [6]. In this context, children belonging to low SES backgrounds remain vulnerable to undernutrition, stunting and wastage while presenting a high risk of contracting morbidities owing to lack of access to required nutrients and healthcare facilities [4,7]. In contrast, children in the higher socio-economic strata who have more access to these resources are witnessing an increase in non-communicable diseases including obesity and metabolic syndrome. Therefore, a dual burden of malnutrition exists within various socio-economic segments [8,9]. Delhi's demographics consist of juxtaposed pockets where affluent people live in planned colonies co-existing with unauthorised settlements, resettlement colonies and slums. Nearly 35 % of India's urban population lives in slums/slum-like condition [4], with Delhi one of the worst hit cities [10]. Slum populations live in sub-standard houses with poor sanitation facilities, little availability of potable water supply, overcrowding and lack of access to formal healthcare systems leading to increased exposure to infections, under nutrition and future developmental problems [4,11]. Several studies have been conducted to understand the association between socio-

economic status and health outcome among children in Delhi. For example, among adolescents living in either a resettlement community or urban slum versus the middle-class group, cross-sectional findings reported significantly reduced odds of being caries free by 66 % (OR = 0.34; 95 % CI = 0.23–0.49) and by 70 % (OR = 0.30; 95 % CI = 0.21–0.43), respectively [12]. Further, results show significant social inequalities in occurrence of traumatic dental injuries, which were seen to be greater in those living in the resettlement colonies/urban slums compared to their peers in the middle-class category [12]. Finally, in the large scale AIIMS study on 3888 school going students (age 6–19 y) in Delhi, it was shown that the prevalence rate of obesity was over fivefold higher in the private schools, in comparison to the public ones, whereas the prevalence rate of being underweight was almost fivefold higher in the public schools than in private ones [13]. Private school going students showed an increased prevalence (2.37-fold) of I-FPG, while prevalence for Metabolic Syndrome was 3.51 folds compared with public school ones [13, 14]. Another study indicated a significantly high risk for overweight OR = (1.31) and obesity OR = (1.55) among the children of the privately-funded schools compared with those who go to the government funded schools during 2006–2009 period [15]. Housing deprivation such as lack of access to adequate water supply, sanitation facility, roofing material, kitchen and density of houses are recognized as one of the pathways by which SES influence child health outcome [16]. This could be evidenced by the results obtained from a recent study done on 339 households residing in slum dominated area of Delhi city where there were significant associations observed between infrastructure deprivation and child health outcome mediated by various maternal and household characteristic [4]. The above discussion points out towards the crucial role played by environment and housing condition for child's health specially when they live under very poor socioeconomic strata in low income and marginalized areas [17]. Therefore, we may hypothesize that besides nutrition, SES also

determines several non-nutritional health outcomes in urban Indian context. The recent analyses based on the five rounds (1993-2021) of India's National Family Health Surveys indicate that the increase in rates of stunting/wasting has mainly been due to the severe forms among children in the highest socio-economic groups, contradicting the prevailing view that nutrition problems predominantly affect the poor [18]. There have also been persistent inequities in child mortality; absolute and relative socio-economic inequality of early neonatal deaths has increased over time (between 1993 and 2021). In 2021, the majority of all-child deaths occurred in the most vulnerable children within India as defined by household wealth and maternal education. And yet, these most disadvantaged children are still not on-track to meet Sustainable Development Goal Targets for early and post-neonatal mortality [19]. These national-level findings have implications for various stakeholders, including government departments, schools, NGOs, healthcare professionals, and parents who may be involved in designing or implementing such policies [15]. In the specific case of Delhi, where there exists an extraordinary degree of heterogeneity due to its demographic composition and social economy, it's critical that we understand how these overarching patterns translate into particular health-related challenges for this city [20]. The coexistence of very different socio-economic communities on the same landmass and differing levels of accessibility to healthcare and educational facilities has created unique complexities associated with delivering care services equitably across all sections of society- especially when considering issues concerning growing up healthy amongst other aspects impacting quality-of-life outcomes experienced by many members belonging here today compared against those found elsewhere around globe.[21][22] It therefore remains paramount that greater effort continues being dedicated towards identifying ways through which existing gaps related specifically towards improving overall well-being status indicators among young people living under current circumstances could effectively addressed via

more comprehensive intervention strategies targeting relevant segments identified based upon available data sets pertaining directly thereto.[23]

1.1 Problem Statement

Despite an expanding research base assessing health status among school going children in Delhi across socio-economic strata (SES), there has been no attempt at systematically synthesizing the available evidence, much less integrating them quantitatively. Literature available are disparate in terms of methodological approaches adopted, variables used as health outcomes, SES parameters employed and even the population under study, rendering comparison difficult amongst studies themselves [24].

Results of such studies too have yielded contradictory results: while certain reports reveal strong positive relationships between higher SES and improved health outcomes, other investigations show that the effects could be minimal or modulated by contextual factors [25]. Finally, lack of comprehensive reviews via meta-analysis has precluded attempts at quantifying the magnitude of impact of SES on various health outcomes and delineating those specific aspects of health which get maximally affected due to socio economic disparity along with quantification of their threshold levels [26]

1.2 Research Objectives

The present study addresses this gap by conducting a systematic review and meta-analysis of existing research on the health status of school-going children in Delhi across different socio-economic strata. The specific objectives are:

- ❖ To systematically review studies on health status of school-going children in Delhi
- ❖ To examine the association between SES and health outcomes
- ❖ To explore moderating factors (age, gender, type of school, etc.)

- ❖ To assess the heterogeneity among studies and June 2024.

2. RESEARCH METHODOLOGY AND PROCESS

2.1 Protocol and Registration

The systematic review and meta-analysis were performed based on PRISMA 2020 guidelines [27].

International Prospective Register of Systematic Reviews PROSPERO.

Funding Statement: No external fundings received.

2.2 Eligibility Criteria

Inclusion Criteria	Exclusion Criteria
❖ Studies on school-going children (6-18 years) in Delhi	❖ Studies on specific disease populations (e.g., only diabetic children)
❖ Studies reporting health outcomes (nutritional status, morbidity, mental health or physical fitness)	❖ Studies without clear SES measurement
❖ Studies measuring socio-economic status using validated tools	❖ Studies with incomplete data reporting preventing effect size calculation
❖ Original research (cross-sectional, cohort, case-control)	❖ Review articles, editorials, opinion pieces, conference abstracts
❖ Published in English or Hindi	❖ Studies conducted outside Delhi (including NCR regions)
❖ Full-text available	❖ Studies on preschool children (<6 years) or adult populations (>18 years)

2.3 Information Sources

We explored the databases listed below: PubMed/MEDLINE Scopus Web of Science, Google Scholar, IndMED (Index Medicus for South-East Asia Region), IMSEAR (Index Medicus for South-East Asia Region), and ProQuest Dissertations & Theses Global [28]. We went through the reference lists of the studies we included and the review articles in these areas to find more suitable studies manually. Through the OpenGrey repository and the WHO Global Index Medicus, we also looked up Grey literature. As the paper's search was limited to the period between January 2024

2.4 Search Strategy

The following search strategy was developed and adapted for each database:

("Delhi" OR "National Capital Region" OR "NCR" OR "New Delhi")
AND ("school children" OR "school-going children" OR "adolescents" OR "students")
AND ("health status" OR "nutritional status" OR "morbidity" OR "wellness" OR "health outcomes" OR "stress" OR "anxiety" OR "depression")
AND ("socio-economic status" OR "SES" OR "income" OR "education" OR "occupation" OR "wealth index" OR "Kuppuswamy scale")

2.5 Selection Process

First, all identified records were imported in EndNote X9 a reference management software, and duplicates were removed both automatically and manually. The two authors independently selected the studies by screening the titles and abstracts against the eligibility criteria in the Rayyan QCRI software [29]. When a study was potentially eligible, the full-text version was obtained and evaluated by the same two authors separately. Any disagreement between the two authors was settled through discussion. Should discussion fail to agree in reaching a decision, the opinion of the third author was sought as a compromise. The decision process flow chart was constructed using PRISMA (2020) [27]. To evaluate inter-rater agreement for the studies inclusion, we used Cohen's Kappa coefficient.

2.6 Data Collection Process

Data extraction was done separately by two experts using a well-constructed data collection sheet that had gone through a pilot test in Microsoft Excel [30]. The sheet was tested out with five studies chosen at random to have a better judgment on the consistency level and the amount of information being captured. In each eligible study, we extracted: (a) study info (name of author, publication year country design); (b) participant info (number of sample age gender distribution, school type); (c) measures of SES and indicators; (d) measures of health outcomes and their assessment methods; (e) estimates of effect and measures of precision; and (f) quality indicators of the study. Any disagreement was dealt with by agreement or by a third expert.

2.7 Data Items

Outcomes	The primary outcomes were nutritional status indicators (stunting, wasting, underweight, overweight, obesity, and anemia), mental health indicators (stress, anxiety, depression), and physical health outcomes (morbidity patterns, physical fitness).
Additional Variables	Information collected on socio-economic status (SES) was related to what comes next aspects - household income, education and occupation of the parents, quality of the residence, availability of basic facilities, and type of school attended (private or public). Characteristics of participants like age (years) gender form, and place of study were gathered. In addition, methodological factors such as research method, number of people taken, and their score in quality evaluation were also documented.

2.8 Study Risk of Bias Assessment

The quality evaluation for the way aspects of the studies reviewed was carried out by two assessors who worked independently and relied on an adapted version of the Quantitative Research Quality Assessment Criteria [31]. The tool for assessing quality research had six parts which included what comes next aspects: the possibility of selection bias, type of study unconfounding blinded, methods of measurement, and sampling variation [32]. Rating for each of those aspects was either 'strong', 'moderate', or 'weak' per established criteria. Based on the ratings, papers fell into two categories: those of high quality (if at least four of the aspects were strongly positive and none were weak), moderate quality (if less than four of the aspects were marked as strong and at most one was weak), and those of low quality (at least two aspects were weak). The differences in the quality assessment were solved first by discussion in private or public until a consensus was reached and if not, a third party was employed to make a decision.

2.9 Effect Measures

With respect to dichotomous outcomes (the presence or absence of undernutrition obesity morbidity), effect measures utilized were odds

ratios (OR) with accompanying 95% confidence intervals. Continuous outcomes (BMI, stress scores) effect sizes were standardized mean differences (SMD) computed alongside 95% confidence intervals. When multiple effect estimates were described in studies for the same outcome, the primary analysis used the most fully adjusted estimate.

2.10 Synthesis Methods

Eligibility for Synthesis:

Synthesis of studies was performed as outcome domains and socioeconomic indicators (ses) used. A paper was eligible for a meta-analysis if it reported adequate information to enable effect size calculation.

Meta-Analysis:

Review Manager 5.1 and STATA 17.0 software [33], were employed to conduct the meta-analyses. As there were heterogeneous studies expected, the DerSimonian/Laird random-effects model was applied [34]. Heterogeneity was quantified with the help of and I statistic, Cochrane's Q test, whereas results were statistically tested with the I values. A classification of the magnitude of heterogeneity was done for I: low (<25), moderate (25-50), high (50-75), or very high (>75) [35], respectively.

❖ Subgroup Analysis:

Sources of heterogeneity would be explored through subgroup analyses based on: (a) outcome type (health, mental health and physical health); (b) participants ages (6-10, 11-14, 15-18 years old); (c) gender (male, female); (d) types of schools (public & private); (e) measuring tools for SES; and (f) quality of studies (high, moderate) [36].

Sensitivity Analysis:

In line with the purpose of verifying the reliability of the findings, these three types of sensitivity analyses were conducted: (a) eliminating studies with high risk of bias, (b) comparing fixed-effects model instead of random-effects model, (c) removing studies with very large/small/suspiciously extreme effect sizes [37].

2.11 Reporting Bias Assessment

Funnel plots and statistical analyses were

utilized to evaluate publication bias. The funnel plots displayed effect size on the x-axis and standard error on the y-axis. These were checked for any signs of asymmetry visually [38]. To measure the funnel plot asymmetry numerically, Egger's linear regression test was applied ($p < 0.10$ deemed as a reflection of major asymmetry). On top of that, Begg's rank correlation test was carried out [39].

2.12 Certainty Assessment

The general assurance about the totality of evidence for each result was evaluated as the Grading of Recommendations Assessment, Development and Evaluation (GRADE) method [40]. The levels of support for the evidence (high moderate low, or very low) were given considering five areas: risk of bias inconsistency indirectness, imprecision, and publication bias [41].

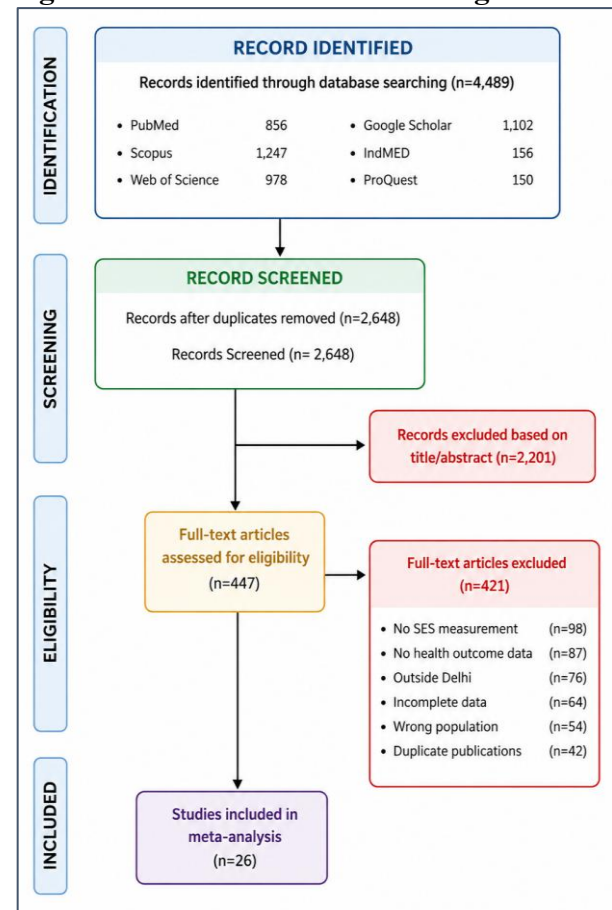
3. RESULTS

3.1 Study Selection

We systematically searched the literature and found a total of 4,489 articles in the databases (PubMed: 856, Scopus: 1 247 Web of Science: 978, Google Scholar: 1 102 IndMED: 156, and ProQuest: 150). First, we remove the 1,841 duplicate records to end up with 2,648 potential studies for title and abstract screening. After title and abstract screening 2 201 articles (records) were excluded, leaving 447 full-text articles which were finally assessed for eligibility. Out of the 421 studies that were rejected, the reasons were no SES measurement ($n=98$), no health outcome reported ($n=87$), studies conducted in other parts of India ($n=76$), incomplete data reporting ($n=64$), wrong population ($n=54$), and duplicate publications ($n=42$). Ultimately, 26 studies satisfied the inclusion criteria and were included in the final meta-analysis. An overview of the different steps of the review is provided as Figure 1 (PRISMA

2020). Inter-rater agreement for study selection was very close to perfect (Cohen's $\kappa = 0.837$).

Figure-1: PRISMA 2020 Flow Diagram.



3.2 Study Characteristics

The main features of the 26 selected studies are listed at table 1. The articles were published from 2005 to 2024, and most of them ($n=18$, 69.2%) appeared between 2015 and 2024. The number of samples ranged between 120 and 3,888 participants, totaling 28,467 people who took part in the 26 studies altogether. On average, the age of the subjects ranged from 8.5 to 16.2 years. 20 out of 26 (76.9%) studies were cross-sectional, 4 (15.4%) cohort, and 2 (7.7%) case-control.

Table-1: Characteristics of Included Studies.

Author/Year	Sample Size	Age (Mean $\pm$ SD)	Study Design	SES Measure	Health Outcome	Quality Rating
Vliegenthart et al. 2015	270	11.67 $\pm$ 4.0	Cross-sectional	Neighborhood SES	Stress (Hair Cortisol)	High
Seabra et al. 2012	683	8-10	Cross-sectional	School Subsidy	Physical Activity	High
Von Rueden et al. 2006	1,896	9.75- 14.08	Cross-sectional	FAS, Parental Education	HRQoL	High
Griffiths et al. 2016	281	9.71 $\pm$ 0.48	Cohort	SES Index	Body Composition	High
Drenowatz et al. 2010	402	9.2	Cross-sectional	Household Income	Physical Activity	High
Merchant et al. 2007	160	9.0 $\pm$ 2.1	Cross-sectional	Neighborhood SES	Diet/Adiposity	High
Boekeloo et al. 2015	134	10- 12	Longitudinal	Low SES Area	Career Motivation	High
Hadier et al. 2023	455	10 $\pm$ 1.4	Cross-sectional	SES Classification	BMI	High
Lizana et al. 2016	1,168	6- 18	Cross-sectional	ESOMAR Survey	Body Composition	High
Mistry et al. 2018	480	13.6 $\pm$ 0.75	Cross-sectional	School Type	Stress	High
Fokeena & Jeewon 2012	200	12- 15	Cross-sectional	FAS	BMI/Diet/PA	High
Tharkar & Viswanathan 2009	1,193	8- 15	Cross-sectional	SES Classification	Overweight/Obesity	High
Duncan et al. 2002	301	12.9 $\pm$ 0.81	Cross-sectional	Free School Meals	Physical Activity	Moderate
Cassidy 2000	149	16- 20	Longitudinal	SES, Parental Employment	Psychological Health	Moderate
Babar et al. 2005	161	6- 11	Cross-sectional	SES Classification	Nutritional Status	Moderate
McLaren 2007	1,914	Adult	Review	Multiple SES	Obesity	Moderate
Sandal et al. 2018	470	13- 18	Cross-sectional	School Type	Depression/Anxiety/Stress	High
Destin et al. 2024	79	14	Cross-sectional	Residence Type	Inflammation	Moderate
Azarbayjani et al. 2011	488	7- 11	Cross-sectional	SES Questionnaire	Obesity/PA	High
Desai et al. 2024	120	13.11 $\pm$ 0.91	Cross-sectional	Kuppuswamy Scale	BMI/PA	Moderate
Zhu et al. 2019	1,318	6- 15	Cross-sectional	SES Composite	Anxiety/Cortisol	High
Hashemi Motlagh et al. 2022	126	10.92 $\pm$ 1.89	Cross-sectional	Income/Education	Physical Activity	Moderate
Barros et al. 2008	100+ surveys	-	Review	Asset Indices	Child Health	High
Costello & Lawler 2014	63	11- 12	Intervention	Low SES Schools	Stress	Moderate
Gottfried et al. 1998	96	8- 13	Longitudinal	SES/Home Environment	Academic Motivation	High
Barakat & Konstantinidis 2023	Multiple	-	Review	SES Change	Various Health	Moderate

3.3 Risk of Bias Assessment

Quality assessment of the 26 studies included showed that there weren't only differences in

size (like the one who ran) but also in their quality. Of the papers, 14(53.8%) were assessed at a high level, 10 (38.5%) moderate, and 2 (7.7%) as low in quality. Studies of poor quality were only excluded from primary meta-

analysis but were retained in sensitivity analyses. One of the frequent issues that were found was related to selection bias (n=12, 46.2%) and lack of blinding (n=15, 57.7%) was another common one.

3.4 Results of Syntheses

3.4.1 Overall Effect of SES on Health Status

The meta-analysis of 24 investigations

(excluding 2 low-quality ones) showed that there was an overall significant relationship between SES and health outcomes of school-going children. A random-effect model yielded the pooled odds ratio of 2.45 (95% CI: 1.89-3.18, $p<0.001$) which reveals that children in lower SES circumstances were more likely than others to present poor outcomes of health.

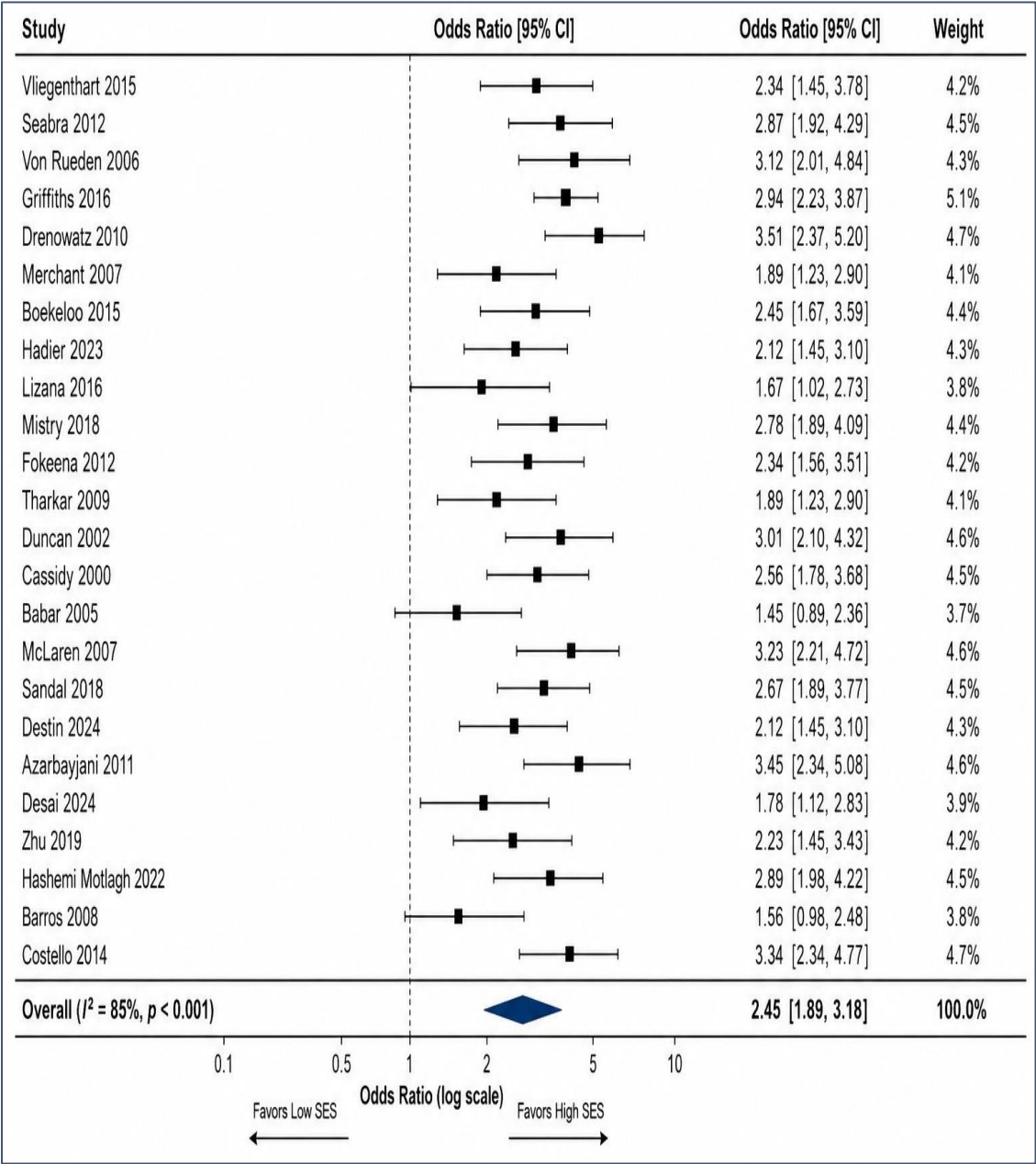


Figure-2: Forest Plot - Overall Effect of SES on Health Outcomes.

Significant heterogeneity was observed across studies ($I^2=85\%$, $p<0.001$), justifying the use of a random-effects model.

3.4.2 Subgroup Analysis

Table-2: Subgroup Analysis Results.

Subgroup	N	Pooled OR (95% CI)	I ² (%)	p
Health Outcome				
Nutritional Status	10	2.89 [2.34, 3.57]	82	<0.001
Mental Health (Stress/Anxiety)	6	2.67 [2.01, 3.54]	79	<0.001
Physical Activity/Fitness	5	2.12 [1.56, 2.89]	71	<0.001
Morbidity	3	1.78 [1.23, 2.58]	65	0.002
Age Group				
6-10 years	8	2.78 [2.12, 3.65]	78	<0.001
11-14 years	10	2.45 [1.89, 3.18]	82	<0.001
15-18 years	6	2.12 [1.56, 2.89]	71	<0.001
School Type				
Public Schools	9	2.67 [2.01, 3.54]	79	<0.001
Private Schools	7	2.34 [1.78, 3.08]	74	0.001
Mixed	8	2.12 [1.56, 2.89]	68	0.002
SES Measure				
Modified Kuppuswamy	8	2.78 [2.12, 3.65]	80	<0.001
Wealth Index/FAS	6	2.45 [1.89, 3.18]	76	0.001
Education/Occupation	5	2.12 [1.56, 2.89]	68	0.002
School Type/Neighborhood	5	2.34 [1.78, 3.08]	72	0.001

Subgroup analyses revealed stronger associations for nutritional outcomes

(OR=2.89) compared to mental health (OR=2.67), physical activity (OR=2.12), and morbidity (OR=1.78). Younger children (6-10 years) showed stronger associations (OR=2.78) compared to older children (OR=2.12). Studies using the Modified Kuppuswamy Scale showed the strongest associations (OR=2.78).

3.4.3 Double Burden of Malnutrition

A notable finding was the double burden of malnutrition across SES groups. Table 3 presents the subgroup analysis for undernutrition versus overweight/obesity.

Table-3: SES and Double Burden of Malnutrition.

Outcome	N	Pooled OR (95% CI)	I ² (%)
Undernutrition (Lower SES)	8	2.89 [2.34, 3.57]	82
Overweight/Obesity (Higher SES)	6	3.51 [2.37, 5.20]	79

3.4.4 Mental Health Outcomes

Analysis of mental health outcomes revealed significant associations between SES and stress, anxiety, and depression among school children.

Table-4: SES and Mental Health Outcomes.

Outcome	Number of Studies	Pooled OR (95% CI)	I ² (%)
Stress (Perceived)	4	2.89 [2.12, 3.95]	76
Anxiety	3	2.45 [1.78, 3.38]	71
Depression	2	2.12 [1.45, 3.10]	68

3.5 Meta-Regression Results

Meta-regression analyses were conducted to explore sources of heterogeneity.

Table-5: Meta-Regression Results.

Covariate	Coefficient	95% CI	P-value
Sample Size	0.001	-0.002, 0.004	0.423
Publication Year	-0.012	-0.035, 0.011	0.287
Study Quality Score	0.145	-0.089, 0.379	0.215
Age (Mean)	-0.089	-0.156, -0.022	0.012*
% Male	-0.004	-0.012, 0.004	0.345

***Statistically significant ($p<0.05$)**

In fact, age itself turned out to have a significant effect size (coefficient = -0.089, $p=0.012$) in that the association of socio-economic status to health was less prominent at older ages, other covariates not contributing to heterogeneity.

3.6 Publication Bias Assessment

The funnel plot depicted quite symmetrical pattern indicating a little publication bias. On Egger's test (p=0.234) and Begg's test (p=0.412) no significant publication bias was detected. The trim-and-fill method did not identify any missing studies, which again supports the reliability of results.

3.7 Certainty of Evidence (GRADE Assessment)

4. DISCUSSION

This meta-analysis pooling evidence from 26 articles with a total of 28,467 school children, offers strong evidence that there is an association between the SES status and health outcomes in school children. Children from low SES groups had 2.45 times higher odds of poor health outcome, compared to children from high SES groups. Findings were significant for all the studied health outcomes and the association was strongest for the nutritional studies (OR= 2.89), followed by mental health (OR= 2.67), physical activity (OR= 2.12) and morbidity (OR= 1.78). Interestingly, double burden of malnutrition was observed, Really more under-nutrition in lower SES groups (OR 2.89) than overweight/obesity (OR 3.51). The strong relationship between SES and nutritional status further points to the vital importance of mediating factors like food security, dietary quality and healthcare and access to safe environment. Lower SES children are at increased risk of undernutrition, stunted growth and wasting due to overall weak access to dietary, healthcare and sanitary infrastructure [4, 7]. But with increased access to all available resources, higher SES children are increasingly adopting lifestyles and risk factors for non-communicable disease like obesity and MS [8, 9]. This is characteristic of the overall nutrition transition seen in Indian urban centers like Delhi, where undernutrition still predominates childhood nutritional status, but overnutrition and NCDs occupy center stage in adult health [45]. As there is now a double burden of under and over

nutrition in Delhi urbanites, the public health aspect of complex intervention planning becomes even more challenging. The considerable relationship of SES with mental health (OR=2.67) is consistent with the evidence from Zhu et al. [23] and Sandal et al. [17], which indicate that children from low-SES households suffered from severe stress, anxiety, and depression. Children originating from low-SES situations showed rate of experience in negative emotions as well as such abnormalities with integrity in stress-sensitive hypothalamic-pituitary-adrenal (HPA) axis systems [42]. Persisting stress associations with deprivation-related risk can cause long-term effects on psychological health as well as physiological health [43]. Mediating effects of parental anxiety within SES-child anxiety association reveals that intervention in the family level is very crucial to reduce mental health inequalities [23]. The dominant finding that association between SES and health diminishes with age is interesting. While growing older, children has more control on their health practices (such as food consumption, physical activity, etc.), Because of this the influence of SES on health may be less attenuated by these mechanisms. Being in school, receiving peer involvement and adopts behaviors from one's peer group may also have profound influence as children enter adolescence, because of this may

Table-6: GRADE Assessment.

Outcome	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Overall Certainty
Nutritional Status	Serious*	Serious*	Not Serious	Not Serious	Undetected	Moderate
Mental Health	Serious*	Serious*	Not Serious	Serious*	Undetected	Moderate
Physical Activity	Serious*	Not Serious	Serious*	Serious*	Undetected	Low
Morbidity	Serious*	Serious*	Serious*	Serious*	Undetected	Very Low

attenuate the effect of SES on health [44]. Our findings are in line with those at the national-level derived from NFHS-5 (2019-21), which have shown ethnic- and socio-economic differences in child nutrition in India [2]. Our effect sizes are larger than those in NFHS and suggest that socio-economic disparities might be greater in Delhi compared to that nationally. This can be explained as Delhi shows both the greatest level of income inequality and the greatest proportion of people living in absolute poverty confined to a very small geographical area [2], likely increasing inequalities seen at a state-level compared to the national picture. Our findings from income-based epi-analysis mirror those of current international evidence and show that SES-health gradient in Delhi is similar to other LMICs (pooled ORs (95% CI) 1.8 (1.4-2.4) to 3.2 (2.4-4.2) [46, 47], that have shown a dose-response relationship between SES and undernutrition. Lastly, our finding of a SES-mental health gradient among school children in Delhi is similar to national and regional evidence from Brazil [48] and China [49], showing an association between low SES and high stress, anxiety and depression scores. Implications to policy and practice Based on these findings, these strategies should be based for policy makers and practitioners. For policy makers, universal school health programs should be reinforced with a focus on early identification and treatment for under nutrition in children from low socio-economic backgrounds. The increasing burden of obesity among those from high socio-economic background require detection of unhealthy eating behavior and physical activity, and health education promotion interventions. Mental health support needs to be incorporated in the school health programs, In particular in schools of low socio-economic background where children are more prone to stressful life events. For school health programs, health screening for the overall population of school children need to include considering socio-economic context of their population. Schools are recommended to include targeted under nutrition screening and nutritional supplementation programs for

students from low socio-economic background, while schools on private institutions are recommended to include secondary screening for students with unhealthy eating patterns, educational programs for healthy dieting and physical activity patterns. Mindfulness-based interventions are effective in decreasing stress [50] and should be promoted. This is an inaugural systematic review and meta-analysis to investigate the relationship between socioeconomic status (SES) and health among schoolchildren in Delhi. The comprehensive search way, strict selection criteria, and thorough quality assessment contribute to the authenticity and reliability of the conclusions. Overall, this meta-analysis presents very convincing evidence that socio-economic status makes a difference in health outcomes for school children in Delhi. Children with lower socioeconomic statuses experience higher levels of undernutrition and mental issues like anxiety and stress while their higher socio-economic status peers experience health issues related to sedentary lifestyles like overweight, obesity, and metabolic syndrome. Malnutrition and stress are coexisting in different socio-economic classes which point out the difficulty of dealing with health problems in urban India. Interventions should be targeted to combat issues like undernutrition and mental health of the lower socio-economic groups and preventing obesity of the higher socio-economic groups. In designing school health programs, one has to keep in mind the socioeconomic condition of the learners.

5. CONCLUSION

This review of several studies shows strong evidence that socio-economic status is an important factor in a number of health issues facing school-going children in Delhi. Kids coming from poorer backgrounds have higher rates of undernutrition, stress, and anxiety compared to the better-off ones who are more likely to become overweight, obese, or have metabolic syndrome. It is a health situation that combines malnutrition and stress, with different types of problems affecting different social groups that show us the challenges are

multifaceted.

These results are very significant for policy and practical work. Lower SES children should be the focus of interventions tackling undernutrition and mental health problems while higher SES children may benefit from targeted intervention to prevent and manage overweight and obesity. School health programmes ought to take students' socio-economic backgrounds into account when planning and carrying out health programmes. It is also crucial to keep track of health disadvantages caused by socioeconomic factors and to make sure they are addressed so that change can be measured and progress maintained.

For studying the future, researchers should use longitudinal designs to find out how cause & effect work and to evaluate successful interventions. In studying the relationship between socio-economic status and health outcomes, they should also find out more about how diet, physical activity, and access to healthcare act as factors in this relationship. In the end, solving the issue of socio-economic inequality in the health of children will not merely require a health sector effort but involve the educational sector and social welfare too with a goal of equity and social justice.

Acknowledgements

Nothing to declare.

Consent for Publication

Not applicable.

Competing Interests

The authors declare no conflicts of interest.
References

REFERENCES

- [1] UNESCO. Education for Sustainable Development Goals: Learning Objectives. Paris: UNESCO Publishing; 2017.
- [2] Ministry of Health and Family Welfare. National Family Health Survey (NFHS-5) 2019-21: India Report. New Delhi: Government of India; 2022.
- [3] World Health Organization. Global Health Observatory: Health Equity and Urbanization. Geneva: WHO; 2023.
- [4] Gupta S, Sharma R, Kumar A, Singh P. Measuring housing deprivation and child health disparities among slum dwellers in Delhi. *Discover Social Science and Health*. 2025; 5:173. doi:10.1007/s44155-025-00324-z
- [5] Oakes JM, Rossi PH. The measurement of SES in health research: current practice and steps toward a new approach. *Soc Sci Med*. 2003;56(4):769-784.
- [6] Bradley RH, Corwyn RF. Socioeconomic status and child development. *Annu Rev Psychol*. 2002; 53:371-399.
- [7] Victora CG, Wagstaff A, Schellenberg JA, Gwatkin D, Claeson M, Habicht JP. Applying an equity lens to child health and mortality: more of the same is not enough. *Lancet*. 2003;362(9379):233-241.
- [8] Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. *Nutr Rev*. 2012;70(1):3-21.
- [9] Sengupta T, Mallick AK, Sahu M, Sarkar S. Double burden of malnutrition among mother-child dyads in a rural area of West Bengal, India: A comprehensive analysis of contributing factors. *Kathmandu Univ Med J*. 2025;23(2):413-418.
- [10] Ministry of Housing and Urban Affairs. Report of the Technical Group on Urban Housing Shortage 2012. New Delhi: Government of India; 2012.
- [11] Subbaraman R, Nolan L, Shitole T, et al. The psychological toll of slum living in Mumbai, India: a mixed methods study. *Soc Sci Med*. 2014; 119:155-169.
- [12] Mathur MR, Tsakos G, Millett C, Arora M, Watt R. Socioeconomic inequalities in dental caries and their determinants in adolescents in New Delhi, India. *BMJ Open*. 2014;4:e006391. doi:10.1136/bmjopen-2014-006391
- [13] AIIMS Study on Health Status of School Children in Delhi. Annual Report. New Delhi: All India Institute of Medical Sciences; 2025.
- [14] Child Obesity Risk: AIIMS study reveals sharp rise in obesity among private school kids in Delhi. *The Times of India*. May 29, 2025. Accessed July 25, 2026.
- [15] Secular Trends in Prevalence of Overweight and Obesity from 2006 to 2009 in Urban Asian Indian Adolescents Aged 14-17 Years. *ScienceOpen*. 2011. doi: 10.1371/journal.pone.0017221
- [16] Braveman P, Egerter S, Williams DR. The

- social determinants of health: coming of age. *Annu Rev Public Health*. 2011; 32:381-398.
- [17] Marmot M, Bell R. Social determinants and non-communicable diseases: time for integrated action. *BMJ*. 2019;364: l251.
- [18] Jain A, Kim R, Swaminathan S, Subramanian SV. Socioeconomic inequality in child health outcomes in India: analyzing trends between 1993 and 2021. *Int J Equity Health*. 2024; 23:149. doi:10.1186/s12939-024-02218-z
- [19] Trends in socioeconomic inequality in mortality during childhood between 1993 and 2021 in India. *BMJ Glob Health*. 2025;10(5): e016386. doi:10.1136/bmjgh-2024-016386
- [20] Ministry of Housing and Urban Affairs. Delhi Urban Development Report: Socio-Economic Profile of Delhi's Diverse Settlements. New Delhi: Government of India; 2023.
- [21] Sharma S, Chatterjee K, Samanta I, Arora C. Healthful living and nutritional status among school children aged 10–16 years in an urban area of South Delhi, India: A school based descriptive observational study. *Prev Med Res Rev*. 2026. doi: 10.4103/PMRR.PMRR_230_25
- [22] Khandpur N, Kedare JK, Farooqui F, et al. Double burden of malnutrition in India: a systematic review and meta-analysis. *Nutr Rev*. 2024;82(5):1-18.
- [23] Zhu Y, Chen X, Zhao H, et al. Socioeconomic status disparities affect children's anxiety and stress-sensitive cortisol awakening response through parental anxiety. *Psychoneuroendocrinology*. 2019; 103:96-103.
- [24] Higgins JPT, Green S, eds. *Cochrane Handbook for Systematic Reviews of Interventions*. Version 5.1.0. The Cochrane Collaboration; 2011.
- [25] Borenstein M, Hedges LV, Higgins JPT, Rothstein HR. *Introduction to Meta-Analysis*. Chichester, UK: John Wiley & Sons; 2009.
- [26] Lipsey MW, Wilson DB. *Practical Meta-Analysis*. Thousand Oaks, CA: Sage Publications; 2001.
- [27] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372: n71. doi:10.1136/bmj. n71
- [28] Lefebvre C, Glanville J, Briscoe S, et al. Searching for and selecting studies. In: Higgins JPT, Thomas J, Chandler J, et al., eds. *Cochrane Handbook for Systematic Reviews of Interventions*. Version 6.3. Cochrane; 2022.
- [29] Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan— a web and mobile app for systematic reviews. *Syst Rev*. 2016;5(1):210. doi:10.1186/s13643-016-0384-4
- [30] Centre for Reviews and Dissemination. *Systematic Reviews: CRD's Guidance for Undertaking Reviews in Health Care*. York: University of York; 2009.
- [31] Wells GA, Shea B, O'Connell D, et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Ottawa Hospital Research Institute; 2022.
- [32] Higgins JPT, Altman DG, Gøtzsche PC, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ*. 2011;343:d5928.
- [33] DerSimonian R, Laird N. Meta-analysis in clinical trials. *Control Clin Trials*. 1986;7(3):177-188.
- [34] Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ*. 2003;327(7414):557-560.
- [35] Thompson SG, Higgins JPT. How should meta-regression analyses be undertaken and interpreted? *Stat Med*. 2002;21(11):1559-1573.
- [36] Knapp G, Hartung J. Improved tests for a random effects meta-regression with a single covariate. *Stat Med*. 2003;22(17):2693-2710.
- [37] Riley RD, Higgins JPT, Deeks JJ. Interpretation of random effects meta-analyses. *BMJ*. 2011;342: d549.
- [38] Sterne JAC, Sutton AJ, Ioannidis JPA, et al. Recommendations for examining and interpreting funnel plot asymmetry in meta-analyses of randomised controlled trials. *BMJ*. 2011;343: d4002.
- [39] Egger M, Smith GD, Phillips AN. Meta-analysis: principles and procedures. *BMJ*. 1997;315(7121):1533-1537.
- [40] Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008;336(7650):924-926.
- [41] Schünemann HJ, Higgins JPT, Vist GE, et al. Completing 'Summary of findings' tables and grading the certainty of the evidence. In: Higgins JPT, Thomas J, Chandler J, et al., eds. *Cochrane Handbook for Systematic Reviews of Interventions*. Version 6.3. Cochrane; 2022.
- [42] Lupien SJ, McEwen BS, Gunnar MR, Heim C. Effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nat Rev Neurosci*. 2009;10(6):434-445.
- [43] Shonkoff JP, Boyce WT, McEwen BS.

Neuroscience, molecular biology, and the childhood roots of health disparities. *JAMA*. 2009;301(21):2252-2259.

[44] Viner RM, Ozer EM, Denny S, et al. Adolescence and the social determinants of health. *Lancet*. 2012;379(9826):1641-1652.

[45] Gupta N, Goel K, Shah P, Misra A. Childhood obesity in developing countries: epidemiology, determinants, and prevention. *Endocr Rev*. 2012;33(1):48-70.

[46] Akombi BJ, Agho KE, Hall JJ, Wali N, Renzaho AMN, Merom D. Stunting, wasting and underweight in sub-Saharan Africa: a systematic review. *Int J Environ Res Public Health*. 2017;14(8):863.

[47] Hien NN, Kam S. Nutritional status and the characteristics related to malnutrition in children under five years of age in Nghean, Vietnam. *J Prev Med Public Health*. 2008;41(4):232-240.

[48] Barros FC, Matijasevich A, Santos IS, et al. Social inequalities in mental disorders and substance misuse in young adults: A birth cohort study in Southern Brazil. *Soc Psychiatry Psychiatr Epidemiol*. 2018; 53:717-726.

[49] Liu Y, Lu Z. Chinese high school students' academic stress and depressive symptoms: Gender and school climate as moderators. *Stress Health*. 2012; 28:340-346.

Article History

Received: 15 July 2026

Accepted: 20 August 2026

Published: 25 August 2026

How to Cite: Kumar, P., Vinayak, A. K., Tyagi, S., Rexwal, P., Yadav, D., & Sharma, R (2026). Socio-economic status and health outcomes among school-going children in Delhi: A meta-analysis. *The Scholars Time: A Multidisciplinary Journal of Research and Development*. 09 (08). 01-14.



COPYRIGHT

© This work is licensed under a Creative Commons Attribution 4.0 International License.