BENEFIT-COST ANALYSIS

ADOLESCENTS

Analysis of Adolescent Health Interventions for RAJASTHAN

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RAJASTHAN PRIORITIES AN INDIA CONSENSUS PRIORITIZATION PROJECT

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Cost-benefit Analysis of Adolescent Health Interventions for Rajasthan

Rajasthan Priorities
An India Consensus Prioritization Project

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Academic Abstract

The total number of adolescents (10-19 years) in Rajasthan is 15.7 million (Census, 2011), which constitutes about 23 percent of the total state population, a potential demographic dividend for the economy. However, there are some key health issues associated with the adolescents that require immediate attention which can otherwise lead to immediate health problems, long term disorders, or poor health later in life and hinder their ability to grow and develop to their full potential. Among others, the key issues affecting the development of adolescents in India as well as Rajasthan include high rate of child marriage, high prevalence of anemia, especially among females and various problems related to mental health. In this paper, the authors have reviewed the current status and magnitude of these major problems and have also analyzed prospective interventions using cost benefit analysis to address the same in an efficient manner. The analysis reveals that interventions aimed at delaying child marriage through incentives in-kind, preventing anemia among adolescent girls through iron and folic acid supplementation and addressing mental health issues of adolescents in schools through universal screening, and providing further treatment after case finding can yield higher benefit per unit of invested cost. The analysis is based on sound secondary evidence in terms of data and other findings and the robustness has been checked.

Policy Abstract

The Problem

Adolescence (10 to 19 years) is the transitional period of physical, physiological and psychological development from puberty to adulthood. More than 1.2 billion people worldwide are adolescents; this indicates that roughly one in every six people is an adolescent. Adolescents face challenges like poverty, lack of access to healthcare services, unsafe environments, etc., and have specific needs that vary with gender, life circumstances and socioeconomic conditions. Adolescence is a critical phase in a person's life as it is also a period of preparation for undertaking greater familial, social, cultural and economic responsibilities in adulthood (Sivagurunathan et al. 2015). About 21 percent (243 million) of India's total population is in the age group of 10 to 19 years (Census of India, 2011). This share is slightly higher in Rajasthan at 23 percent (15.7 million).

This study has looked into three critical problems that affect adolescents in the context of Rajasthan. These problems are: prevalence of girl child marriage, prevalence of anemia among adolescent girls, and mental health problems among the adolescent population in schools. Though analyzed in the context of Rajasthan, these problems have a direct and immediate as well as long-term bearing on the health of adolescents, and are equally applicable for other states in India or any developing country facing similar problems.

As per NFHS-4 (2015-16), 35 percent of women in the age group of 20-24 years in Rajasthan were married before 18 years of age, making them a victim of child marriage. The current analysis has looked into both social and economic cost of child marriage. The solution suggested for this problem is transfer of a consumable to the household on the condition that the girl child is not married before the age of 18 years. This is in contrast to the existing schemes under which cash incentive is provided to the household.

Another critical adolescent health issue is anemia. The *Annual Health Survey 2014* has revealed that the prevalence of anemia among adolescent girls in Rajasthan is 81 percent. The requirement for iron increases in adolescence due to nutritional needs for growth. This requirement further increases for girls due to the onset of menstruation, making them more

vulnerable to anemia and posing a major threat to safe motherhood in the future. Though there are existing programs that target adolescents, the larger focus for anemia prevention has remained on pregnant and lactating mothers, and infants and children. Hence, the needs of adolescent girls may remain unmet.

Adolescent mental illness is a growing area of public health concern and a leading cause of disability in young people around the globe. The National Mental Health Survey of India (2015-16) has reported that the prevalence of mental disorders is 7.3 percent among children aged 13 to 17 years in India, including depressive disorders (2.6 percent), disabilities affecting intellectual status (1.7 percent), agoraphobia (2.3 percent), autism (1.6 percent), psychotic disorders (1.3 percent) and phobic anxiety disorders (1.3 percent). The report suggests early recognition and intervention will help realize favorable outcomes in this area.

Intervention 1: Delaying child marriage in Rajasthan by providing incentives

Overview

Child marriage poses huge social as well as economic costs. All major states and the Union government in India have different schemes encouraging the protection and education of the girl child. Most of these schemes provide for cash incentives on the condition that the girl child is not married off before the legal age of marriage, which is 18 years in India. However, various studies have shown these schemes have not been able to yield the desired results. This is also corroborated by various indicators like prevailing child marriage rates that are still high, especially in case of some major states. - Rajasthan being one of them, the skewed sex ratio and wide gender gap in education and employment.

The proposed intervention will provide incentives to households in rural areas in the form of a consumable on the condition that their girl children are not married before 18 years of age. The decision on the consumable can be taken by policy makers depending on local needs. A common consumable might not have the same utility in different parts, given the range of intra-state disparities. The dropout rate for girls increases dramatically between the upper primary and secondary levels, and the chances of a girl child's marriage are much higher once she is taken out of school. Hence, this intervention aims to target around 6.9 lakh 14-year-old

girls who are both in school and out of school, and follow this cohort for next the 4 years till they reach 18 years of age.

Implementation Considerations

The intervention will be implemented through the *panchayati raj* system by the department in charge of women and child development in the state. The *gram panchayat* will be given the authority to spread awareness about the intervention, identify beneficiaries, and revise the list at regular intervals to ensure only eligible households receive the benefits. The consumable can be distributed through the public distribution system network in the state through which food grains and other items are already being distributed. The data on enrollment, disbursement and monitoring of the intervention will be included in the Management Information Systems to minimize any discrepancy in the demand and/or supply side of the intervention.

Costs

The cost of providing the incentives for each beneficiary is based on the analysis of a similar successful program in Bangladesh. This comes to around Rs. 2,239 per beneficiary, which is 2.4 percent of per capita income of the state[1], for a total cost of 457 crore over four years. Reduction in child marriage also results in higher enrolment in schools. The marginal cost of education due to increased schooling resulting from the intervention is estimated at 13 crores. And lastly, the implementation cost of the program that includes transport, staff and other program-related expenses is estimated at 1,530 crores. Total cost of this proposed intervention is Rs. 2,000 crore over a period of four years, after applying a discount rate of 5 percent.

Benefits

The major benefit of the intervention arises from averted child marriages and associated benefits. The intervention is expected to reduce the child marriage rate from the existing 35 percent to 26.6 percent, a reduction of 25 percent. This translates to around 61000 fewer

[1] This is equivalent to the cost of similar intervention in Bangladesh where cooking oil was given to the household on the condition that the girl child is not married off before a certain age.

child marriages in the state in four years due to the intervention[2]. The averted social cost of child marriage that includes cost of higher fertility rate, domestic violence, stunting among the children and maternal mortality, are considered as potential benefits of this intervention. Incremental benefits in wages with increased years of schooling have also been included. Both these benefits are spread over the later years of lives of the beneficiaries. Finally, the amount of incentives provided to each beneficiary within the program, which is part of the cost, has been included as this is a transfer and hence also a benefit for the household. The total of benefits from the intervention for one cohort amounts to Rs 6,728 crores after discounting at 5 percent.

Intervention 2: Preventing anemia among the adolescent girls through iron and folic acid supplementation

Overview

As stated above, the prevalence of anemia among adolescent girls in Rajasthan is very high. At the current prevalence rate, around 60 lakh adolescent girls are suffering from any type of anemia, of which 1.2 lakh are suffering from severe anemia. The immediate impact of iron deficiency is reduced physical fitness, which affects academic performance. In the long run, this affects maternal and child health and further increases the burden of the disease.

The proposed intervention aims to provide weekly iron and folic acid supplementation and biannual deworming with an aim of covering all adolescent girls aged 10 to 19 years. For school-going girls, the intervention will be implemented through the existing educational set up, where teachers can act as supervisors and spread awareness about the efficacy of this program. For out-of-school adolescent girls, monthly counselling sessions by healthcare providers at the community level will be conducted for awareness generation. This intervention is in line with the existing weekly iron and folic acid supplementation (WIFS) program. The WIFS program includes both boys and girls, but the proposed intervention in this study covers only girls for cost effectiveness and other reasons cited above.

[2] The baseline has taken the child marriage rate at 35 percent in Rajasthan. This is based on the NFHS-4 data

Implementation Considerations

The providers, within and out of schools, will prepare a demand chart at least two months prior to the date of distribution to ensure adequate supply of the supplements and other materials in a timely manner. Lack of awareness in terms of benefits as well as side-effects and resulting poor adherence are major challenges in the success of this intervention. It is proposed that apart from the counselling and supervision by teachers and community health workers, a mechanism should be developed where peers keep a check to ensure better program adherence. Moreover, data on coverage of the program, and gaps and challenges during implementing the same will be conveyed to supervising officials for better decision making. The program can be later scaled up to include all adolescents, irrespective of their gender.

Costs and Benefits

Costs

The costs of providing iron and folic acid supplements and of facilitating counselling sessions for the program are considered as direct costs. The opportunity cost of time spent by the out-of-school girls for attending counselling sessions has also been included in the cost and has been valued on the basis of the existing wage rate for the given education level in the state. Adding these two components, the total annual cost of the intervention is Rs 83 crore.

Benefits

The number of cases with mild, moderate and severe anemia has been calculated on the basis of existing prevalence rate in the state. Disability weight is applied to each category to estimate the value of years lived with disability (YLDs). The intervention is expected to bring down the prevalence rate from existing 81 percent to 47 percent, a reduction of 42 percent averting 25 lakh cases of anemia in the target group. The benefit from this intervention is the averted number of cases in different categories and the total value of averted YLDs after excluding the impact of side-effects suffered by some beneficiaries during the course of the program. The estimated total value of benefits per annum is Rs. 766 crore at 5 percent discounting (Table 1).

Table 1: Total anemia cases averted and accrued benefits due to iron and folic acid supplementation among adolescent girls in Rajasthan

Anemia	Cases Averted	YLD Per case	Total YLDs	Value per DALY, 2017 (Rs.)	Total benefits (Rs. Crore)	Total benefits after excluding side effect (Rs. Crore)
Mild	1,905,818	0.00262	4998	285853	142.9	126.9
Moderate	561,444	0.03410	19143	285853	547.2	485.8
Severe	61,810	0.09770	6039	285853	172.6	153.2
Total	**2,529,072**		**30,180**		**862.7**	**765.9**

Source: Authors' calculation; benefits assume a 5% discount rate

Intervention 3: School-based behavioral screening and further mental health services for the adolescents

Overview

Mental health is one of the neglected areas in the healthcare sector in developing countries. According to WHO, the rate of treatment for severe cases of mental disorder in less developed countries is in the range of 14-23 percent[3]. The unmet need for mental health in adolescents hampers their overall development, affecting their lives at a later stage. This intervention will consider adolescents from classes VI to XII enrolled in both private and public schools, which roughly covers the 11-17 years age group of the state's school-going population. It comprises screening the mental health status of adolescents, referring them to appropriate care providers and treating them for respective disorders. The participation will be voluntary and require the consent of the adolescent and their parent or guardian. The screening will be carried out through a self-administered questionnaire based on three scales - mood and feeling questionnaire, youth self-report aggression scale and 3-point Likert scale. The students screened positive for illnesses will be scheduled for clinical behavioral health evaluation. Positive cases found at that stage will be referred for specialized mental

[3] https://pdfs.semanticscholar.org/6898/1d738295a4abf860df5bcab080a96f2d93ee.pdf

healthcare services with adequate follow-ups to ensure that the child is linked to a facility for proper treatment.

Implementation Considerations

The screening questionnaire will be reviewed, assessed and modified upon consultation with educationists, psychiatrists and psychologists. Cultural appropriateness will be examined, and necessary modifications will be carried out prior to the intervention. Parents and teachers will be informed about the purpose of the intervention and their role throughout the process. These key stakeholders have critical roles to play for ensuring that adolescents participate in this intervention.

Costs and Benefits

Costs

The cost of human resources dedicated to different stages of screening, material development and dissemination for the screening, and other costs related to the intervention are calculated. Additionally, the proportional cost for clinical assessment and to prepare the students for referral, cost for successful linkage to specialized care providers and the average cost of mental health services for each adolescent is calculated as the cost per beneficiary. The total annual cost of the intervention amounts to Rs. 189 crore at 5 percent discounting.

Benefits

The number of years of life lost (YLL) and years lived with disabilities (YLD) due to mental illness among the adolescents is calculated from the *Global Burden of Diseases* data. Further, the number of averted YLL and YLD is calculated following the intervention and it is multiplied with the respective values of statistical life years and disability adjusted life. The sum of annual benefit of the intervention at 5 percent discount rate is Rs. 264 crore.

BCR Table

Table 2: BCR Summary Table

Intervention	Benefit (Rs. Crore)	Cost (Rs. crore)	BCR	Quality of Evidence
Delaying child marriage via direct incentives	6728	2000	3.4	Medium
Preventing anemia among adolescent girls	766	83	9.2	Strong
School based behavioral screening and further mental health services for the adolescents	264	189	1.4	Medium

Notes: All figures assume a 5 percent discount rate

1. Introduction

Adolescence is a transitional stage of life from puberty to adulthood which ranges between 10 to 19 years of age (WHO, 2014). A spectrum of physical, psychological, and social and development occurs during this period. There are more than 1.2 billion adolescents worldwide, constituting 18 percent of the total global population. India is home to more than 243 million adolescents, which is nearly one fifth of its total population (UNICEF, 2011a; Sivagurunathan *et al.*, 2015). Rajasthan has 15.7 million adolescents, which is 23 percent of the state's total population (Census, 2011).

Although adolescence is not considered as a risk period for most infectious diseases, the health status of adolescents is often affected by varying conditions emerging from their transitional state, as well as diverse social determinants of health (Laski, 2015). Critical health problems start or aggravate during this period of life; which includes substance abuse, mental health problems such as depression, anxiety, mood disorders, psychological disorders, eating disorders, etc. (Sunitha and Gururaj, 2014). Each of these health issues can affect the development of an adolescent, resulting in higher disease rates as well as economic burden to the affected individual, their caregivers, families and communities.

Though most of the problems associated with adolescents are common across the globe, some are more peculiar to less developed countries. One such problem is child marriage. There are more than 700 million women around the globe who get married before 18 years of age and most of them live in low- and middle-income countries (UNICEF, 2014). The number continues to increase by 37,000 each day and nearly 15 million each year (UNICEF, 2014; Wodon *et al.*, 2017). More than one-third of all girls become victims of child marriage in developing countries, contributing to a spectrum of health hazards and allied socioeconomic consequences (UNICEF, 2014). Apart from health-related issues, child marriage primarily affects the educational and economic opportunities of adolescent girls in their adulthood. Early marriage often leads to teenage pregnancy, which results in higher fertility and population growth (Wodon *et al.*, 2017). It also affects maternal health outcomes to varying extents. Adolescent girls under 15 years of age are nearly five times more likely to die during childbirth, compared to the women in their 20s (IWHC, 2017). They are also at higher risk for pregnancy-related injuries like obstetric fistula, unsafe sexual practices leading

to unsafe abortions, and sexually transmitted infections and other complications. Moreover, teenage pregnancies contribute to the mortalities and morbidities of the offspring, which is a serious concern for population health. Children born to teenage mothers suffer from low birthweight, stunting and other nutritional disorders (Raj *et al.*, 2010). According to another study, child marriage contributes to 6.3 percent of all cases of under-five stunting, which revalidates the impact of child marriage across generations (Presler-Marshall and Jones, 2017). Another estimation has revealed that undernutrition may lead to a loss of more than 10 percent of Gross Domestic Product in sub-Saharan Africa and south Asian countries due to lost productivity (Shekar, Dayton Eberwein and Kakietek, 2016).

In addition to these physical impacts, child marriage also affects the brain development and cognitive capabilities of the offspring with lasting consequences in their adulthood (Wodon, 2016). Moreover, girls who get married at an early age often lack autonomy and become victims of historical maldistribution of power in conjugal life, leading to intimate partner violence that affects the physical and psychological wellbeing of the victim as well as the offspring and increases the risk of violence during adulthood (UNFPA, 2014, WHO, 1997, Aizer, 2011, Crombach and Bambonyé, 2015).

As per NFHS-3 (2006), around 47 percent of married women aged 20-24 years were married before the age of 18, which is the legal marriageable age for women in India. A decade later, around 27 percent women in the same age group reported being married before the legal age (NFHS-4). The burden of child marriage is higher in the rural population. It has also been observed that the median age at first marriage is 22.7 years for women with 12 or more years of schooling, compared to 17.2 years for women without any schooling, indicating the significance of education in preventing child marriages.

The rate of child marriage in Rajasthan is much higher than the national average. Among respondents within the same age group, the rate of those who got married before the legal age of marriage is 35.4 percent. In the rural areas of Rajasthan, the prevalence is even higher at 40.5 percent (NFHS-4).

Another critical adolescent health problem is the high prevalence of anemia, especially in less developed countries. It is characterized by reduced hemoglobin concentration, red cell count or packed cell volume which subsequently affect oxygen delivery at the tissue level (Balarajan

et al., 2011). The World Health Organization defines anemia based on hemoglobin concentration levels which vary in different population groups as following - for children aged 12 -15 years and non-pregnant women aged more than 15 years, the threshold level of hemoglobin used to define anemia is less than 12 gm/dL, whereas the level is considered as less than 11 gm/dL for children up to 5 years and pregnant women, for men aged above 15 years, a hemoglobin concentration less than 13 gm/dL is considered as anemic (Beutler and Waalen, 2006).

During 2015-16 in India, the prevalence of any anemia (hemoglobin level <12 gm/dl) among women aged 15 to 49 years was 53 percent, which included 40 percent cases with mild anemia (hemoglobin level between 10 to 11.9 gm/dl), 12 percent cases of moderate anemia (hemoglobin level between 7 to 9.9 gm/dl) and 1 percent cases with severe anemia (hemoglobin level less than 7 gm/dl) (NFHS-4). The prevalence across India is much higher among the population with lowest wealth index (58.6 percent) compared to the highest wealth index (48.1 percent). Also, rural women have higher prevalence (54.2 percent) compared to their urban counterparts (50.8 percent).

In Rajasthan, 47 percent women in age group 15 to 49 years are anemic as of 2015-16. This includes 35 percent with mild anemia, 11 percent with moderate anemia and 1 percent with severe anemia (NFHS-4). Anemia is observed to be higher among children between 6 to 59 months of age with a prevalence of 60 percent. This tends to continue to the adolescence when lower dietary intake compared to demand and increased blood loss due to menstruation aggravate anemia among adolescent girls. This is evident in the Annual Health Survey 2014 which reveals that the prevalence of anemia among adolescent girls is 81.4 percent in Rajasthan. The burden of anemia is predominantly higher among vulnerable demographic groups living in rural or tribal areas, having less wealth and low education, even in the national scenario (NFHS-4:Rajasthan, 2016b).

Adolescent mental health is a growing area of public health concern which defines the course of development, and quality of lives and prospects in the productive future of adolescents. Many neuropsychiatric conditions affect their journey to adulthood and these disorders are considered to be the leading causes of disability among young people around the globe (WHO, 2018). Many mental health disorders begin during late childhood and early

adolescence. It is estimated that 10 to 20 percent children and adolescents experience mental health disorders, and about half of all mental illnesses emerge by the age of 14 years and three-quarters by the mid-20s (WHO, 2018).

Several psychiatric epidemiological studies have been conducted in India to estimate the prevalence of different psychiatric disorders. A lack of awareness about mental health and allied disorders in the country often leads to poor access to mental health services. In most cases, only patients with severe mental disorders are diagnosed and treated, leaving those with minor mental disorders without timely diagnosis and treatment (Math and Srinivasaraju, 2010). Many of these disorders emerge during adolescence and if left untreated, can carry forward to adulthood, increasing the burden of disease and making treatment difficult and costlier.

There is a substantial gap in research focusing on the specific prevalence of different mental health disorders among adolescents in India (Malhotra, 2014). However, epidemiological evidence is available from countries with similar contexts that shows the burden of mental and developmental disorders, and illustrate their impact on health-seeking and other dimensions of adolescent lives. Earlier epidemiological studies have revealed the prevalence of child and adolescent mental disorders in the context of India, which considered the whole spectrum of child and adolescent age groups, i.e. 0 - 19 years. A systemic review and meta-analysis provided the overall prevalence from sixteen community-based studies on 14594 children and adolescents and seven school-based studies on 5687 children and adolescents (Savita Malhotra, 2014). The prevalence of child and adolescent mental health disorders in the community was found to be 6.7 percent, and within schools it was found to be 23 percent.

Apart from such studies, nationwide studies reported the prevalence of mental disorders is 7.3 percent among children aged 13 to 17 years (MoHFW, 2016). The prevalence among children in urban metros is nearly double (13.5 percent) compared to rural children (6.9 percent). Major illnesses include depressive disorders (2.6 percent), disabilities affecting intellectual status (1.7 percent), agoraphobia (2.3 percent), autism (1.6 percent), psychotic disorders (1.3 percent) and phobic anxiety disorders (1.3 percent). The survey also estimated the prevalence of depression as 6.9 percent, anxiety as 15.5 percent, tobacco addiction as 7.6

percent and alcohol consumption as 7.2 percent in a study based on the state of Himachal Pradesh (MoHFW, 2016). There is a gap in evidences that can illustrate the true burden of mental health disorders among Rajasthan's adolescents but the high prevalence in different states warrants careful assessment and management of such disorders in the context of Rajasthan.

In this paper, the authors discuss prospective interventions to address each of the above-mentioned adolescent health problem and analyze the benefit-cost ratio for the same in the context of Rajasthan.

2. Delaying child marriage in Rajasthan by providing incentives

2.1 Description of intervention

Most of the schemes implemented by various state governments to prevent child marriage among girls include conditional cash transfers in the various life stages of a girl child, beginning with birth - which is conditional upon institutional delivery, until marriage - which is conditional upon attaining age of 18 years, the legal age of marriage for a female in the country. Most of these schemes aims to break the stereotype where the girl child is looked upon as a burden for the household.

One of the earliest such programs was *Apni Beti Apna Dhan (ABAD)*, or "Our Daughter, Our Wealth" initiated by the Government of Haryana in 1994. The scheme was supposed to encourage further education of girls and cause a rise in their age of marriage by changing the attitude of families towards girl children. However, a study by the International Center for Research on Women (ICRW) shows the program had no effect on delaying the age of marriage among girls who participated in the program. On the other hand, the study found beneficiaries were more likely to get married exactly at age 18. According to the study, "this is likely because many beneficiary families saw the cash as a way to help defray the cost of a

wedding or to contribute to a dowry payment"[4]. Hence, incentives under such schemes need to be designed carefully to achieve desired results and more importantly, to avoid any unfavorable outcomes.

Another study based on the cycle distribution program in Bihar to reduce the gender gap in secondary education found that the enrolment of girls increased by 30 percent. The cycle distribution program was effective in increasing girls' enrolment compared to other conditional cash transfer programs carried out in similar settings. It was suggested that transfer of a non-cash item / consumable generated externalities beyond the cash value of similar programs and are hence are more likely to succeed (Muralidhran and Prakash, 2013).

A randomized trial in southern Bangladesh examined a program under which free cooking oil was given to girls between the ages of 15 to 17 years on the condition of that they stay unmarried. The oil incentives led to significantly reduced child marriage rates and increased years of schooling for girls, in relation to girls in the control group. Girls who participated in the program were 21-30% less likely to marry under the age of 16 and 19-22% more likely to be in school[5] (Buchmann, et al. n.d). The findings from this program have been used in framing the intervention for this study.

Under the proposed intervention, the authors intend to apply the learnings from earlier schemes to ensure that incentives offered to delay marriages for girls are effective and efficient. Considering the poor performance of cash incentives, the authors have chosen the transfer of a consumable to the household of the target cohort. For their calculations, the authors have taken a static model in which only girls in the age group of 14 years in rural households are taken as a target cohort, which is followed for the next four years till they reach the age of 18. The consumable to be transferred is not pre-decided and has been kept variable to allow flexibility. It can be decided by policy makers based on local social, cultural and economic needs given, the vast geographical spread of the state. The consumable is transferred at regular intervals in a year to the eligible household on the condition that the

[4] https://www.icrw.org/news/icrw-releases-results-of-conditional-cash-transfer-evaluation-to-tackle-child-marriage-in-india/

[5] http://www.copenhagenconsensus.com/sites/default/files/field_child_marriage.pdf

girl is not married off in this period. Non-conformity would debar the household from availing the benefits of the program. Though it is expected that girls' enrolment would increase in secondary education due to delay in marriage, the program does not differentiate between school-going and out-of-school girls. Age, marital status and area (rural) are the only conditions for eligibility.

The cost of the intervention will be the direct cost of the incentive itself and the cost of running the program in the state. It will use the existing framework of the *panchayati raj* system to identify beneficiaries and revise the list on a regular basis.

The enrollment, disbursement and monitoring data of the intervention will be included to the Management Information Systems to minimize false enrollments or any other discrepancy in the demand and/or supply side of the program. The intervention will benefit 6.9 lakh 14-year-old girls in rural Rajasthan who will receive the incentive for the next four years.

2.2 Data

The authors have collected the data required for this analysis from various sources. First, they have used the census data, data from published government reports and large-scale population-based surveys such as the National Family Health Survey. Further, they have searched for, retrieved and reviewed published literature from PubMed and Google Scholar using relevant keywords, without applying any specific time frame for the publication. They have reviewed published reports and other documents put out by different development agencies working in the context of Rajasthan. They have also collected administrative data from the Department of Women and Child Development, Government of Rajasthan.

2.3 Literature Review

The economic and social impacts of child marriage involve a range of costs starting from the individual to the entire population. Child marriage encourages girls and women to have children earlier, adversely affecting their reproductive health outcomes and increasing direct and indirect costs over their lifetime (Wodon *et al.*, 2017). In such scenarios, the direct costs

will be hospitalization and other healthcare expenditure during pregnancy, on childbirth and while treating complications following parturition (Kingkaew *et al.*, 2016). In contrast, indirect costs would include the healthcare cost of children born to teenage mothers, missed educational attainment of the girls and loss of productivity throughout their lifetime, and low quality of living (UNFPA, 2013). Further, the social cost of child marriage would include intimate partner violence, lack of autonomy and decision-making, inadequate awareness about healthcare and other rights leading to under-utilization of available services, poverty at the household level and so on (Parsons *et al.*, 2015). Furthermore, child marriage costs the nation in terms of higher fertility, undesired population growth, burden of illiteracy, poor health and poverty. This implies ending child marriage can yield great benefits to the nation (UNFPA, 2012). Previous studies show benefits accrued from lower population growth by ending child marriage in 106 countries would be $566 billion in 2030 (Wodon *et al.*, 2017). Moreover, other benefits accrued from saving child lives and preventing childhood malnutrition would provide benefits worth $16 billion and $82 billion in 2030 for averted cases of under-five mortality and stunting, respectively (Wodon *et al.*, 2017).

The legal age of marriage in India is 18 years for females and 21 years for males. Marrying before this age is a crime, yet studies have shown that such laws have failed to check child marriages in less developed countries (Field *et al.*, 2016). Though laws that prohibit dowry are already in place, it has had little impact on child marriages in the country. Another approach of delaying child marriage by increasing the years of schooling has been found to be cost-effective in a previous study conducted by Copenhagen Consensus in Bangladesh (Field *et al.*, 2016). Incentivizing schooling among adolescent girls through Female Secondary School Stipend has shown several prospects to improve the scenario. First, additional years of schooling increase the qualification of the adolescent girl which facilitates better wages in job market after finishing the school. Also, higher rate and duration of schooling is associated with better self-development and empowerment which increases the autonomy of the girls to decide about their age at marriage. Moreover, these empowered girls can take better decisions about their health resulting better reproductive health outcomes throughout their reproductive age.

The benefits of education are never limited to individuals, and enhance the well-being and development of their family members and offspring as well. The children of an educated mother are more likely to receive education, immunization and other benefits in the future (Vikram, Vanneman and Desai, 2012). This leads to reduced healthcare costs, social costs and better economic outcomes in the broader sense. An intervention to provide cooking oil to unmarried women in Bangladesh was also found to be cost-effective (Field *et al.*, 2016). However, it is also necessary to consider the social context where the girl child is often seen as a cost in comparison to a boy child who is perceived as an earning-member in the future. Higher child marriage rates among people living in poverty is attributable to this perception.

Education is a concurrent subject in India, on which state and central governments can legislate. A major program for elementary education in the country, the *Sarva Shiksha Abhiyan* (SSA) is the Indian government's flagship program launched to achieve the Universalization of Elementary Education (UEE) in a phased manner (NIC-RJ, 2018). This program is mandated by the 86th amendment to the Constitution of India, which aims to ensure compulsory education to the children aged 6 to 14 years. SSA lays special emphasis on serving vulnerable girls and on promoting technical and technological education for bridging the digital divide in the country. Another program, *Rashtriya Madhyamik Shiksha Abhiyan*, was launched in 2009 with an objective to increase access to secondary education of optimal quality (GoI, 2016). It aimed to achieve a higher enrolment rate of 75 percent from a baseline rate of 52.26 percent in 2005-06. This program also promotes the quality of education by improving the standards, and removing bias based on gender, disabilities and other socioeconomic barriers.

The centrally-sponsored 'Rajiv Gandhi Scheme for Empowerment of Adolescent Girls (RGSEAG) SABLA' was introduced on a pilot basis in 2010-11 in 205 districts selected from all States and UTs for improving the dropout rate of girl students, increasing literacy rate among women, reducing the number of girls married before the age of 18 and facilitating female work participation (GoI, 2015b). Other similar schemes like *Kishori Shakti Yojana, Beti Bachao Beti Padhao and Aapki Beti Yojana* focused on empowering women through proper education and life skills training (GoI, 2015a).

Government of Rajasthan has started its own scheme called *Mukhyamantri Rajshree Yojana* which provides cash incentives for upbringing and educating daughters who are defined as *Lakshmi* (goddess of prosperity) of the households (GoRJ, 2018a). This scheme was rolled out in June, 2016. Starting from her birth to class XII, incentives of up to Rs. 50,000 are provided to the parent of the girl child for ensuring her education, health and overall care. The beneficiaries of the scheme are entitled to receive Rs. 2,500 at the birth of a daughter, Rs 2,500 for one year of vaccination, Rs 4,000 for admission in class I, Rs 5,000 for admission of the girl child in class VII, Rs 11000 for admission in class X and finally, Rs. 25,000 on completion of school education and passing class XII (GoRJ, 2018a). There are other schemes in the state like *Palanhar Yojana* and *Mukhya Mantri Hunar Vikash Yojana* that aim to improve the educational and socioeconomic status of vulnerable adolescents who are orphaned or living in institutional homes (GoRJ, 2018b).

Apart from these specific initiatives, the Government of India has introduced a holistic program called Rashtriya Kishor Swasthya Karyakram (RKSK), which was launched on 7 January, 2014 with principles of adolescent participation and leadership, equity and inclusion, and strategic partnerships with other sectors and stakeholders (NHM, 2013). This program emphasizes on gender equity envisioning an enabling environment for all adolescents to realize their full potential by making informed and responsible decisions related to their health and well-being. Initiatives like this have been working towards improving the overall condition of adolescent girls and their autonomy to delay the age at first marriage (NHM, 2015a).

2.4 Calculation of Costs and Benefits

In this proposed intervention, the authors estimate the costs as well as benefits for a cohort of 6.9 lakh adolescent girls aged 14 years in Rajasthan till they reach 18 years of age. The baseline for child marriage rate in Rajasthan is taken as 35.4 percent (NFHS-4). Therefore, the number of girls marrying before the age of 18 is estimated to be around 2.4 lakh for the next four years or approximately 60,000 every year. This study considers the experience of the Bangladesh incentive program mentioned above to estimate the outcome of the intervention.

On the basis of the above assumptions, the averted cases of child marriage in Rajasthan after the intervention would be around 15,000 per year. For consistency in cost and benefit, the value of the consumable is based on the intervention in Bangladesh, which comes to around 2.4 percent of the per capita GSDP of Rajasthan per year or Rs. 2,239. This is provided to each girl in the cohort who is not married on her 15^{th}, 16^{th}, 17^{th} and 18^{th} birthdays. The total annual cost changes over the years as progressively more girls are married and become ineligible for the transfer. For a program covering a cohort of 14 year old girls, the first years' payment is 144 crore, and the last year's payment is estimated at 113 crore. The total cost of the transfer for the program is 457 crores over four years at a 5% discount rate.

In addition, the study from Bangladesh suggests conditional cash transfers reduce school dropout rates and increase enrolment per year by 20.5 percent. This would boost enrolment rates of secondary schooling from 39% to 47% and upper secondary rates from 22% to 26% after adjusting for dropouts. Approximately 50,000 more girls would attend secondary school and 25,000 girls would attend upper secondary as a result of the intervention. The additional cost of schooling for these girls (Rs 6315 for secondary, and Rs 10,294 for upper secondary) and the opportunity cost for work they could have done if they had stayed out of school (Rs. 7548) leads to a total cost of additional education of 13 crore at a 5% discount rate.

The last category of cost is the indirect cost per child to implement this intervention, which includes costs of training, transportation, human resources, awareness campaigns and other behavioral change communication programs, and costs for monitoring and evaluation. In the Bangladesh study this component of cost was very large, probably due to the high costs of transporting and distributing oil, the consumable used in that program. The equivalent cost in the Rajasthan context would be Rs. 7490 per girl. It is possible that the scaled cost of this would be lower if, for example, consumables were distributed using the public distribution system for food grains. However, in the absence of any other information we apply the unit cost identified in the Bangladesh study, which leads to a total cost of Rs. 1530 crore at the 5% discount rate.

Adding the direct cost of the incentives, additional cost of schooling - including the opportunity cost, and the indirect costs, the authors have arrived at the total cost for the proposed four year intervention which is 2,000 crores at a 5% discount rate.

For calculating the benefits of preventing child marriage, the authors use the estimated social cost of child marriage, which includes costs due to higher fertility rate, domestic violence, stunting among children and high maternal mortality from another paper in the *Rajasthan Priorities* series (Mithal, 2018). The avoided social cost of child marriage is the major benefit of the intervention and equals 11-13 lakh per girl depending on the year she would have otherwise been married. The total benefit from avoided marriage is 6,247 crore at the 5% discount rate. Additionally, the authors have also estimated incremental benefits in lifetime wages that accrue due to increased years of schooling. This equals 24 crores at the 5% discount rate. Finally, the value of the consumable, which will be provided to each beneficiary and is included as a benefit as well.

For costs and benefits, the authors estimate discounted values at 3 percent, 5 percent and 8 percent. Table 3 gives the benefit cost ratio (BCR) of preventing child marriage in Rajasthan.

Table 3: Benefit Cost Ratio of delaying child marriage through providing incentives

Discount	Benefit (in Rs Crore)	Cost (in Rs Crore)	BCR
3%	10,594	2,092	5.1
5%	6,728	2,000	3.4
8%	3,732	1,873	2.0

Source: Author's Calculations

2.5 Assessment of Quality of Evidence

The structure of the intervention is based on evidences from another south Asian country, Bangladesh, which has similar cultural and socioeconomic dimensions as India. Though there are differences in population dynamics if the context of Rajasthan is considered, societal challenges have shown similar trends in the past. Problems like illiteracy and poverty aggravate the issue of child marriage in the patriarchal social structures of both countries, as well as the respective states considered. In the light of such ideations, the authors consider the quality of evidence as "medium". However, population-based projections are derived from large-scale surveys that adopt generalizable samples, providing better acceptability of the estimates derived through economic analysis.

3. Preventing anemia in adolescent girls through iron and folic acid supplementation

3.1 Description of intervention

Although anemia is prevalent among adolescent boys and girls, its prevalence is much higher among girls, as has been evident from multiple large population-based surveys (GoI, 2000; AHS:Rajasthan, 2014). There are several reasons for the higher prevalence of anemia in adolescent girls. First, adolescent girls experience chronic blood loss due to monthly menstrual cycles (NHLBI, 2014). Moreover, adolescent girls, particularly those who get married before 18 years and who live in rural areas, start childbearing during late adolescence and often experience repeated pregnancies. It is evident that mothers with greater number of pregnancies and deliveries will have higher chances of developing chronic anemia (Masukume *et al.*, 2015). Third, adolescent females experience hormonal changes in their bodies during pregnancy and lactation that increase the demand for iron and calcium, leading to chronic iron deficiency anemia (WHO, 2006). Fourth, adolescent girls are seen to be negligent about nutrition – a critical requirement for their growth and development (MoHFW, 2013). Moreover, recurrent infections such as urinary tract infections are common in adolescent girls, increasing their susceptibility to anemia (Cullis, no date). Adolescent girls also contribute more to household chores than boys. Increased physical labor and inadequate dietary intakes make them vulnerable to iron-deficiency anemia (Wouthuyzen-Bakker and van Assen, 2015). Considering the higher prevalence and magnitude of anemia among girls, the proposed intervention will focus only on adolescent girls. However, the intervention can be eventually scaled up with necessary adjustments in the design to cover all adolescents, irrespective of their gender.

This intervention will be implemented by providing weekly iron and folic acid supplementation and biannual deworming with an aim to cover all girls aged 10 to 19 years in Rajasthan. The beneficiaries will undergo an awareness building exercise for one hour per month to improve the compliance with timely consumption. This will be conducted in schools by trained teachers as part of the regular curriculum and by healthcare providers at the community level focusing on out-of-school adolescent girls. The providers within the school

as well as out of the school will prepare a demand chart at least two months prior to the date of distribution to ensure adequate supply of the supplements and other materials in a timely manner.

Both the providers and the beneficiaries will be informed about the benefits of the intervention, short and long-term consequences of anemia and the importance of their participation. Data on coverage of the program, and gaps and challenges during its implementation will be conveyed to supervising officials in the state for better decision making.

3.2 Data

For this intervention, the authors have used data from multiple sources. This includes data from Census of India, latest published government reports and different rounds of large-scale population-based surveys conducted in the state like National Family Health Survey), Annual Health Survey report for Rajasthan, and published literature from PubMed and Google Scholar found using relevant keywords. In this process, the authors have primarily focused on papers that provide data specific to the context of Rajasthan or India. In cases where relevant information is unavailable, studies in the context of developing countries or developed countries were used with necessary adjustments.

They have also collected administrative data from the National Health Mission Office, Government of Rajasthan. Further, they have reviewed published reports and other documents by different development agencies working in the context of Rajasthan.

3.3 Literature Review

The consequences of anemia are documented in various studies conducted in different contexts. Anemia can alter the health status in critical situations of maternity. Excessive loss of blood before, during and after childbirth can diminish the reserves of blood within the circulatory system. A reduced level of hemoglobin less than 4 g/dL increases the risk of heart failure during any stage of maternity (Buseri *et al.*, 2008). Anemia also increases mothers' susceptibility to various infections, resulting in poor perinatal health outcomes (WHO, 2015). With a wide range of adverse effects to the health of pregnant women, anemia contributes to 20 percent of all maternal deaths (Khaskheli *et al.*, 2016).

In addition, anemia in mothers often affects the health of children, including adverse birth outcomes, preterm birth and low birthweight (Balarajan *et al.*, 2011). More importantly, iron deficiency anemia is associated with poor cognitive and motor development of children (Saloojee and Pettifor, 2001). A meta-analysis estimated an increased association (odds ratio 1.73, 95 percent CI 1.04 to 2.41) of IQ points per 10 g/dL increase in hemoglobin level (Balarajan *et al.*, 2011).

Anemia affects the transportation of oxygen to the tissue level in adults, resulting in impaired productivity of affected individuals. Such phenomenon is observed in developing countries where physical labor is still prevalent. Decreased productivity further reduces quality of life at an individual level; whereas lost income affects the individual's dependent household and the entire economy suffers from lost production. The economic burden of that lost productivity for human capital of South Asia is estimated at $4.2 billion annually (Balarajan *et al.*, 2011).

Many preventive strategies are suggested in scientific literature to control anemia. This includes; improving dietary intake both in terms of quality and quantity, increasing diversity within the consumed food materials with higher bioavailability of iron, fortification of staples with iron, fortification of targeted foods for high-risk, controlling diseases that are associated with anemia like malaria and helminth infestations, improving knowledge and practices among the communities, and providing iron and folic acid supplementation to the vulnerable population who are at higher risk of anemia which includes adolescent girls as well (Balarajan *et al.*, 2011).

In all the states of India, a notable measure to address the challenge of anemia among adolescents aged 10 to 19 years is the Weekly Iron and Folic Acid Supplementation (WIFS) program which includes supervised consumption of iron (100 mg) and folic acid (500 microgram) supplements with biannual deworming medications (NHM, 2015). It targets in-school adolescents from classes VI to XII and out-of-school adolescent girls. It utilizes the existing human resources framework and works through the convergence of multiple agencies for the implementation of the program.

Results from earlier studies have shown good compliance with IFA supplements and more than 90 percent of the girls consumed most of the tablets (85 out of 90 tablets), resulting in an increment of 17.3 gm/L hemoglobin among the beneficiaries (Kanani and Poojara, 2000).

This consumption was associated with a significant weight gain of 0.83 kg in the intervention group, compared to girls in the control group. This indicates the potential of this supplement for anemia correction and growth promotion among adolescent girls. As adolescent girls are more prone to be anemic and iron deficiency anemia is most prevalent among all types of anemia, providing iron folic acid supplement with adequate support can serve as an effective strategy to overcome the challenge of adolescent anemia in Rajasthan.

3.4 Calculation of Costs and Benefits

The authors have taken the prevalence of anaemia (81%) for adolescent age group from 10 to 19 years in Rajasthan from the Annual Health Survey 2014. Further, they estimate a reduction of 42 percent over a a period of 6 months due to the intervention, based on the findings from a large-scale study in a district of Uttar Pradesh (Vir et al., 2008).

Given 74 lakh adolescent girls in the state, this provides the estimated number of averted cases of anaemia for each year as around 25 lakh cases. The distribution of type of anaemia (mild, moderate or severe) among women aged 15 to 19 years has been taken from the state report of National Family Health Survey-4 for Rajasthan and with some adjustments applied for the distribution of adolescent girls aged 10 to 19 years. Using the proportion of that distribution to three groups - mild anemia (10-11.9 g/dL), moderate anemia (7-9.9 g/dL) and severe anemia (less than 7.0 g/dL), they estimate the prevalence of different levels of anemia among adolescents. They have estimated the rate of averted cases in each group assuming that the weightage of correction of anemia is the same for each group. Applying this rate to the total number of anemia averted cases, they calculate the number of adolescents who have had mild, moderate and severe anemia earlier. For each of the adolescents belonging to any of these categories, they estimate the years lived with disabilities due to anemia using the following equation (Murray, 1996):

YLD = D[kce^ra/(r+b)^2(e^-(r+b)(L+a)[-(r+b)(L+a)-1]-e^-(r+b)*a[-(r+b)a-1]]+[(1-k)/r](1-e^rL)]*

Here, “K” is age weighting factor, “C” is constant, “r” is the discount rate. “A” is age at onset of disability, “b” is the parameter from age weighting function, “L” is the duration of disability and “D” is the weight for disability.

In this equation we apply r=0.03, K=1 and beta=0.04 for the base cases. Further, they use the values for K, C, r, a, b, L and D as 0, 0.1658, 0.03, 16, 0, 0.67 and 0.004. In addition, we apply the disability weights to mild, moderate and severe anemia as 0.004, 0.052 and 0.149 respectively (GBD, 2015). Based on these estimates, 25 lakh cases of anemia avoided from the intervention correspond to 30,180 YLDs avoided per year.

As per *Rajasthan Priorities* common assumptions, each YLD is valued at 3 times GSDP per capita, or Rs. 2.9 lakh. This gives a total value of 758 crore per year at the 5% discount rate, after adjusting for side-effects, reported by 18.7 percent of the beneficiaries (Vir *et al.*, 2008).

The cost of intervention per adolescent per year based on earlier studies is estimated at Rs 49, after adjusting for inflation (Vir *et al.*, 2008). This study has also found a compliance rate of more than 90 percent for school-going adolescents and 86 percent for out-of-school adolescents. The direct costs total 36 crore per year. As mentioned earlier, the intervention includes components of counseling for awareness about and compliance with the intervention for out-of school girls, which represent 37% of the target group. The time costs of attending these counseling sessions are included in the cost estimates. Assuming monthly sessions of one hour of counselling totaling 12 hours per annum, it is equivalent to 1.5 working days for the out-of-school girls. The authors have also calculated the opportunity cost for out-of-school girls on the basis of prevailing wage rates adjusted for the education level as well as the age group. Adding this indirect cost of 47 crore to the previously calculated direct cost of intervention, the total cost of the intervention for one year is arrived at and then further scaled up for four years, the proposed period of the intervention. Based on these calculations the Benefit Cost Ratio (BCR) is given in table 4.

Table 4: Benefit Cost Ratio of preventing anemia among the adolescent girls

Discount rate (%)	Benefit (in Rs. crore)	Cost (in Rs. crore)	BCR
3%	771	83	9.3
5%	766	83	9.2
8%	758	83	9.1

Source: Author's Calculations

3.5 Assessment of Quality of Evidence

Authors have derived cost data for this intervention from a study that was conducted on a large sample of 1.5 lakh adolescent girls in a central district of Uttar Pradesh. Although differences in size and population exist between the two states, the likelihood of similarities in health behavior among adolescent girls is high in both states located in the northern part of the country. Also, to calculate other components of the calculations, they have adopted data from population-based projections as on large-scale surveys which adopted generalizable samples. It allows the findings to have better credibility in the context of Rajasthan. Therefore, they consider the quality of evidence as "strong".

4. School-based behavioral screening and further mental health services for the adolescents

4.1 Description of intervention

This intervention will consider adolescents in secondary and higher secondary schools (classes VI to XII) in the state. It provides for screening the mental health status of the adolescents, referring them to appropriate providers and treating them for respective disorders. The intervention also promotes positive mental health through increasing awareness among students, parents or guardians and teachers, who advocate for mental well-being among school-going adolescents.

Though the program will be offered to all students, participation will be voluntary and will require the assent of the adolescent and the consent of the parent or guardian. Authorizations from the school authority, relevant school health institutions and local health authorities will be taken to conduct the program.

Parents and teachers will be informed about the purpose of the intervention and their roles throughout the process. These key stakeholders have critical roles to play for facilitating adolescents' participation in this intervention.

Prior to the intervention, students will be informed about the program thoroughly. Considering the presence of learning difficulties and communication disorders among adolescents within the same class, the message of communication should be prepared in a way such that it is understandable by a student of primary level or class V, which is lower than the intervention group. The intervention should not be conducted during class timings, affecting regular educational activities. Instead, a convenient time should be fixed upon following a participatory discussion with students, teachers, parents or guardians and the mental healthcare providers.

The students will be enrolled into the intervention and the screening procedure will be conducted, as per an appropriate schedule. They will be asked to complete a self-administered questionnaire written in simplified language for easier communication. As this step doesn't require mental health experts to administer the questionnaire, teaching staff and social workers can conduct the same. This can be an effective strategy in the context of severe paucity in mental health professionals. However, additional staff will be deployed to explain the questions if required. Special attention should also be given to differently-abled students to read/understand the questions. The questionnaire will be prepared based on three scales - mood and feeling questionnaire, youth self-report aggression scale and 3-point Likert scale. The questionnaire will be reviewed, assessed and modified upon consultation with educationists, psychiatrists and psychologists. Its cultural appropriateness will be examined, and necessary modifications will be made prior to its administration in the intervention group.

The findings will be assessed by the mental healthcare providers and positive cases will be sorted out for the screening process. The screened-positive students will be scheduled for the next step of the intervention. At this step, trained clinical mental health evaluators will conduct sessions ranging from half an hour to one hour per student to assess their current and past mental health status, including behavioral disorders, bodily discomforts of psychosomatic origin, learning difficulties, etc. The status of mental health and level of mental illness will be determined, which requires referral to specialized care. A global study shows that only around 19 percent adolescents received mental health services in developing

countries, implying an unmet need for similar services for 81 percent adolescents (WHO, 2004) which would be the target section for this intervention.

Following different rounds of screening, the positive-screened students will be shortlisted, and the findings will be communicated to their parents or guardians. Through motivational interviews and discussions, the necessity of referral and benefits of timely care for better educational and professional outcomes in the future will be explained. Possible barriers like social stigma that requires multiple sessions of discussion, and distance between the residence and mental healthcare centers or providers will be assessed and addressed at this stage, ensuring better compliance with the referrals.

Follow-up visits, telephone calls and interviews will be conducted for timely visits to the specialized provider. The diagnosis and prognosis throughout the clinical management will be followed up in a timely manner.

The opinions of all students who are enrolled in the intervention, their parents or guardians, teachers, schools and other authorities, healthcare providers and other stakeholders will be collected, evaluated and adopted for better implementation of the intervention within the sociocultural context of the school as well as the population.

4.2 Data

The authors have retrieved relevant data for this intervention from the Census of India, National Mental Health Survey 2015-16, published government reports and large-scale population-based surveys conducted in Rajasthan like National Family Health Survey third and fourth rounds, District Information System for Education, published literature from PubMed and Google Scholar found using relevant keywords of interest. Further, they have reviewed grey literature, and other reports and documents published by different development agencies.

4.3 Literature Review

The socioeconomic impact of untreated mental health conditions can be enormously high. Such illnesses severely affect the development of children, their educational attainments and their potential to lead productive lives (WHO, 2018). Children with mental illnesses often face

major challenges due to social stigma, discrimination within peer groups and isolation. Poor mental health has spillover effects into various health and social outcomes such as higher rate of crimes; increased consumption of alcohol, tobacco and other addictive substances; unsafe sexual activities leading to STDs and adolescent pregnancies, etc. It is evident from the National Mental Health Survey 2016 that there is wide gap in treatment of mental disorders in the total population, indicating lack of awareness about mental diseases, lack of availability and accessibility of services, and utilization of the same (MoHFW, 2016) resulting in higher disease burden.

The treatment gap in overall population is about 50-60 percent for schizophrenia, 88 percent for depression, 97 percent for substance abuse and 22-95 percent for seizure disorders. The treatment gap for common mental disorders is 95 percent and 76 percent for severe disorders (MoHFW, 2016).

Another critical issue for mental health is the population's utilization pattern for health services. Several factors like median duration of mental illness, delay in seeking care from time of onset, choice of providers, distance from health center and number of visits to the service provider further contribute to this issue. Previous studies have reported a median duration of depressive disorders as 36 months; this is about 72 months for diseases like bipolar disorder. A delay of 2.5 months was reported for depressive disorders and about 12 months for conditions like epileptic disorders. Further, the median number of visits to service providers was 2, ranging from 1 to 30. In 4 to 50 percent cases, the preferred provider was based on government institutions (MoHFW, 2016).

Earlier studies conducted in European countries indicated the cost of mental disorders varied between 3 to 4 percent of the GNP during 1990. Of this, nearly 2 percent was attributable to treating mentally-ill individuals (WHO, 2003). In addition, the aggregated cost of all mental disorders was USD 148 billion and the indirect cost of mental disorders was equal to or more than the direct cost (WHO, 2003). Similar studies conducted in Canada in 1998 revealed the cost of treatment was 6.3 billion Canadian dollars and cost of lost productivity was 8.1 billion Canadian dollars (Scott *et al.*, 2001). Another study conducted in UK demonstrated the cost of mental illness was 32 billion GBP in 1996-97, of which 45 percent was due to lost productivity (Patel *et al.*, 2013).

The cost of childhood mental illness is huge both in the short and long run. An estimation by WHO shows treating mental disorders among those who suffer from conduct disorders at early ages can incur 70000 USD, whereas similar patients with no previous history of early mental illness required treatment cost of less than 10000 USD (WHO, 2005). The cost of education and criminal justice for an adult with early mental disorders were significantly higher than that for a normal adult (Parkar, Dawani and Apte, 2001). Another study demonstrated that the cost of behavioral abnormalities were 10 times higher in adulthood for those who suffered from mental illnesses at earlier ages (Patel *et al.*, 2013). On the other hand, families incur cost of treatment and miss opportunities to earn livelihoods as they have to spend more time with affected adolescents (WHO, 1975). These findings inform policy makers to invest more in child and adolescent mental health to yield better population health outcomes for the future adult population. But the budget provisions specific to adolescent mental health are rarely found in national and state budgets in India and other countries with similar economies. Therefore, financial expenses for adolescent mental illness are met by out-of-pocket (OOP) expenditures.

In addition to the cost burden, the efficiency and effectiveness of existing psychiatric and psychological interventions for adolescent mental illnesses are studied in different contexts. Evidence shows therapeutic interventions resulted in the improvement of more than 50 percent of beneficiaries compared to the non-treated group, indicating that timely psychiatric, psychological and behavioral interventions can reduce mental health disabilities among adolescents (WHO, 2005). Additionally, community-based outreach programs to ensure lower cost of drugs and basic psychological support can reduce disease burden to a greater extent.

A study in rural India has demonstrated the gradual reduction in cost of treatment as well as dramatic improvement among schizophrenia patients over a follow-up period of 18 months (WHO, 2003). A review of 83 trials of different psychological interventions aimed at prevention of depression among children and adolescents revealed that most of the trials (n=67) were conducted in school settings with a handful of studies at the community-level (Hetrick *et al.*, 2016). Among these trials, 29 were conducted in unselected populations and 53 in targeted populations. As many as 32 trials with 5965 participants reported a reduced rate of depression diagnoses among the participants, compared to the control groups. Overall, the

results show small benefits for preventing depressive symptoms and depression diagnosis up to 12 months, but not beyond that.

Various studies have found that the introduction of integrated mental health improvement programs in educational institutions targeting children and adolescents lead to long-term benefits such as enhanced emotional and social behavior and academic attainments, which are also cost-effective (Levin and Chisholm, 2016). In India, programs for peer counselling and teachers' training on mental health and substance abuse are provided as part of a multicomponent adolescent health intervention called Rashtriya Kishor Swasthya Karyakram (RKSK). Such programs aim to promote adolescent mental health, but have shown limited feasibility and effect due to various logistical and financial barriers in the socioeconomic context of India (Balaji *et al.*, 2011). The evaluation of a school-based preventive program targeting the adolescent population in Mauritius has shown short-term benefits to coping skills, self-esteem and feelings of depression and hopelessness (Rivet-Duval, Heriot and Hunt, 2011). These findings provide insights about the acceptability and feasibility of the intervention in the long term (Levin and Chisholm, 2016). However, most of these analyses provide evidences from high-income countries and there is a lack of adequate evidence on the cost-effectiveness of interventions for adolescent mental health in Rajasthan or any other state in India.

4.4 Calculation of Costs and Benefits

To calculate the cost of each stage of the intervention, the authors have taken proportionate cost inputs from different studies with similar objectives. For the screening programs, they have adopted the cost-effectiveness analysis of a school-based emotional health screening program conducted by Kuo et al. that used a framework borrowed from existing literature on the cost-effectiveness analyses of breast cancer (Kuo *et al.*, 2009).

The authors have considered the cost of human resources dedicated to different stages of screening, material development and dissemination for the screening, and other costs related to the intervention. Cost of the school staff and teachers, value of the parents' time provided for the intervention or any other indirect cost are not considered.

Moreover, the authors have assumed 80 percent enrolment on voluntary basis, based on the experience of the study mentioned above. Since this intervention is implemented through schools, out-of-school children tend to be left out. Enrollment of 80 percent school-going adolescents between classes VI and XII means coverage of around 64 lakh adolescents in Rajasthan. Kuo et al. had estimated that 18 percent students would be screened positive and would require further clinical assessment, and 60 percent of them would require referral services. The same rate is assumed for this analysis to estimate the number of students who would be opting for clinical assessment within the school and the number of the students who would be shortlisted for referrals. The authors have used the same framework to estimate the proportional cost for clinical assessment and for preparing the students for referral. The proportional cost for successful linkage of these referred adolescents to specialized care providers is then calculated. These proportional costs are derived from the same study with suitable modifications to arrive at the total screening cost for adolescents in Rajasthan.

The average annual cost of treatment for serious cases of mental health problems among adolescents has been calculated as per the estimation, after adjustments, in the context of Rajasthan, by Access Economics which adopted a costing framework from earlier studies (Gavin Andrews *et al.*, 2004; Access-Economics, 2009). which adopted a costing framework from earlier studies (Gavin Andrews *et al.*, 2004; Access-Economics, 2009). The opportunity cost of the students' time in the entire process was calculated and was estimated using the prevailing wage rate in the state for different levels of education. The three different costs: screening, treatment and opportunity costs were added to arrive at the total cost of the intervention for Rajasthan. The calculation of different costs has been depicted in Table 5 below.

Table 5: Calculation of costs for school-based mental health services for adolescents

Costs	No. of beneficiaries	Cost per student (in Rs.)	Total cost (in Rs. crore)
Stage 1 – Enrolment and screening (Assuming 80% compliance)	64.4 lakh	23.1	14.9
Stage 2 – Clinical evaluation (Assuming 18% in Stage 1 screen positive and require clinical evaluation)	11.60 lakh	153.9	17.9
Stage 3 – Referral (Assuming 60% of students in Stage 2 need specialized mental care)	5.63 lakh	257	14.4
Stage 4 – Linkage to specialized mental healthcare provider (Assuming 72% successful linkage)	4.05 lakh	361.2	14.6
Cost of treatment	4.05 lakh	3,130	126.8
Total cost of treatment + screening			Rs. 188.6 crore
Opportunity cost of time for treatment + caregivers' time			Rs. 10.1 crore
Total cost (undiscounted)			**Rs. 199 crore**

Source: Authors' calculations

Global Burden of Disease data that for 10-19 year olds, 446 lives are lost each year due to self-harm and there are 19,311 YLDs from mental illness. The rate of averted cases has been adopted from the same frameworks from which the cost of treatment is calculated (Gavin Andrews *et al.*, 2004; Access-Economics, 2009). These studies inform a reduction of 39.9 percent after evidence-based treatment in the best-case scenario with 100 percent coverage. As per WHO, the average unmet need for mental health services to address serious mental illnesses in less developed countries is 80.9 percent. Based on this the authors assess that the intervention would avoid 144 deaths from self harm and 6,230 YLDs from mental illness. Applying the value of a statistical life year and disability adjusted life year for 2017 in Rajasthan, the benefits of the intervention amount to 263.6 crore at the 5% discount rate. This one round of the intervention is expected to be spread over one year. The total value of benefits and costs for this intervention are given in table 6 below

Table 6: Benefit cost ratio of school based mental health services for the adolescents

Discount	Benefit (in Rs. Crore)	Cost (in Rs. Crore)	BCR
3%	268.7	193.2	1.4
5%	263.6	189.4	1.4
8%	256.3	183.7	1.4

Source: Author's Calculations

4.5 Assessment of Quality of Evidence

The estimation of the burden of mental illness among adolescents in Rajasthan and associated cost for the same is challenged by a substantial lack of context-specific data. However, the authors have used data from other studies conducted in different states of India to estimate the disease burden. Also, the cost data has been calculated on the basis of a study conducted outside India. However, these studies provide adequate ground to answer research questions of interest related to the cost-effectiveness through quantitative study designs. Moreover, data from systematic reviews and comparative studies allowed enhanced interpretation of the cost as well as benefit data. Reviewing the overall strengths and weaknesses, the quality of evidences used in analyzing benefit-cost ratio of the mental health intervention for adolescents in Rajasthan has been perceived to be "medium".

5. Limitations of this Study

There are some limitations in this cost-benefit analysis of all three interventions addressing adolescent health issues in Rajasthan. First, the authors have calculated the cost and benefits of a single cohort (14 years of age) for the intervention on child marriage. Though it gives some insights, it may be unable to capture the problem in its entirety.

A common public health problem like anemia affects the general population at large. However, the authors have only included adolescent girls in the intervention, given their unique set of problems in the absence of treatment and resulting benefits post-treatment. Other vulnerable groups such as children, male adolescents, and the overall adult population have been kept outside the purview of this study, which is another limitation. Additionally, the authors have estimated benefits as averted DALYs, whereas an alternative methodology

to estimate the benefits in terms of increased productivity following correction of anemia would provide a different benefit-cost ratio for the same intervention.

In the absence of any credible study for India or any less developed country, the authors have calculated a stage-specific cost structure and benefit accrued due to successful linkage to treatment of adolescent mental illness based on studies in developed countries. Moreover, there is no baseline prevalence of mental illness among school-going adolescents. In addition, the crisis is also prevalent among out-of-school adolescents who would experience higher social cost of mental illnesses. This group has been excluded, given that this intervention is implemented through the schools in the state. Lack of context-specific evidences illustrating costs and benefits of diagnosing and treating mental health problems among the adolescents is another limitation of this study.

6. Discussion and Conclusion

Adolescence offers an opportunity for children to develop themselves as responsible and productive citizens who will lead fulfilling lives in the future. This period requires support from families, communities, societies and the nation at large to combat challenges affecting the health of millions of adolescents in Rajasthan. Apart from other problems, high prevalence of child marriage and anemia predominantly suppress the development of adolescent girls.

All adolescents - both boys and girls - are exposed to the mental health problems emerging from a wide range of risk factors, including their vulnerable age and sociobehavioral aspects. In this analysis, the authors have found that child marriage, anemia in adolescent girls, and childhood mental illnesses result in substantial costs (sum total of economic and social cost) to the individual as well as the economy. In most cases, indirect costs incurred by families of the adolescents and the burden of disease on the state's economy outweigh the direct costs to the affected adolescent. This reiterates the responsibility of policy makers to formulate effective policies that secure the health of adolescents in particular, and the overall population in general.

Child marriage prevention through incentives, both conditional and unconditional – have shown promise to reduce rates in child marriage and improve the educational attainment

leading to better productivity (Field *et al.*, 2016). Though the transfer of incentive to the household can help in delaying the age of marriage for girls in Rajasthan, more important is the behavioral change in a society that considers girl children as a liability. This is being done through various campaigns at the state as well as national levels, but the state still has a long way especially considering its high gender disparity.

Another health intervention focusing on reducing anemia among adolescent girls shows higher cost-effectiveness if cognitive development and labor force participation are considered as potential benefits of the intervention (Horton and Ross, 2007). It informs the opportunity to address a single problem to yield multiple benefits at the individual and population levels through cost-effective and evidence-based interventions. In addition to providing supplementation, other efforts to minimize the risk of anemia should be considered as a part of the holistic approach to improve the overall health of adolescents.

The last intervention discussed in this paper is about improving mental health among adolescents through school-based screening and provision of specialized mental health services to affected individuals. The benefits appear to be nearly twice the cost of the intervention. Though the value of averted years lived with disabilities has been considered as potential benefits, it is likely to be higher if the benefits of improved quality of life and social benefits like lower crime and other benefits are estimated in the context of Rajasthan. The assessment and management of mental illnesses in Rajasthan should be improved in a cost-effective manner, focusing on both curative and preventive measures, to fully tap the potential of the youth in the state.

The study has reviewed preventive as well protective measures for each of the interventions and analyzed the cost-effectiveness. With varying methodologies adopted, all three adolescent health interventions are found to be cost-effective, even in altered scenario with variations in key variables. The evidence-based results show the interventions can be adopted as prioritized policies in Rajasthan, as adolescents play a pivotal role in the future of the state.

.Table 7: Final Summary Table

Interventions	Discount	Benefit (in Rs. crore)	Cost (in Rs. crore)	BCR	Quality of Evidence
Delaying girl child marriage	3%	10,594	2,092	5.1	Medium
	5%	6,728	2,000	3.4	
	8%	3,732	1,873	2.0	
Preventing anemia among the adolescent girls	3%	771	83	9.3	Strong
	5%	766	83	9.2	
	8%	758	83	9.1	
School based behavioral screening and further mental health services for the adolescents	3%	269	193	1.4	Medium
	5%	264	189	1.4	
	8%	256	184	1.4	

Source: Author's Calculations

6. References

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Rajasthan is the largest Indian state. It has a diversified economy, with mining, agriculture and tourism. Rajasthan has shown significant progress in improving governance and tackling corruption. However, it continues to face acute social and economic development challenges, and poverty remains widespread. What should local, state and national policymakers, donors, NGOs and businesses focus on first, to improve development and overcome the state's remaining issues? With limited resources and time, it is crucial that priorities are informed by what can be achieved by each rupee spent. To fulfil the state vision of "a healthy, educated, gender sensitive, prosperous and smiling Rajasthan with a well-developed economic infrastructure", Rajasthan needs to focus on the areas where the most can be achieved. It needs to leverage its core competencies to accelerate growth and ensure people achieve higher living standards. Rajasthan Priorities, as part of the larger India Consensus – a partnership between Tata Trusts and the Copenhagen Consensus Center, will work with stakeholders across the state to identify, analyze, and prioritize the best solutions to state challenges. It will commission some of the best economists in India, Rajasthan, and the world to calculate the social, environmental and economic costs and benefits of proposals.

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