



A Population-Based Model for Analyzing Trends in Adolescent Reproductive Health

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ABSTRACT

Reproductive health in adolescents continues to be a major concern in the world, with high inequality in reproductive health outcomes, including teen pregnancies and sexually transmitted diseases (STIs), among various regions. It is important to know the trends and factors involved in these outcomes with a view of formulating specific interventions. The purpose of the present study is to examine the trends in the reproductive health of adolescents in terms of a population-based model, with consideration of the impact that socio-economic, educational, and healthcare-related factors have had over time. The associated data used in the construction of the population-based model were based on large and publicly available health surveys. The model incorporates a variety of socio-demographic factors, such as age, socio-economic status, educational level and access to healthcare services. Regression analysis and time-series analysis were used as the analytical techniques to analyze the trends and determine important factors affecting the outcomes of reproductive health. The results indicate that those nations in which adolescents receive sexual education courses and which have better access to health care have seen their pregnancy rates drop. Nonetheless, low-income and rural regions continue to have an abundance of adolescent pregnancies and STIs. The determinants of reproductive health outcomes were found to be access to education, socio-economic status, and cultural attitudes. The research emphasizes the need to have a comprehensive sex education, healthcare services that are accessible to adolescents, and the need to take into consideration the socio-cultural influences. Population-based models are useful in the monitoring of reproductive health trends and planning the policies concerning population health to enhance the health of adolescents.

Keywords: *Reproductive Health, Population-Based Model, Teenage Pregnancy, Sexually Transmitted Infections (STIs), Socio-Economic Factors, Health Education, Public Health Policy.*

INTRODUCTION

Adolescent reproductive health means the way in which young people are physically, emotionally and socially well as they transverse through the period of puberty, sexual health and reproductive rights [4]. It covers a wide area of concerns such as healthcare access, sexual and reproductive health education, prevention of early pregnancies and sexually transmitted infection (STIs). The reproductive well-being of teenagers is a very important indicator of the overall health condition and is usually contributed by a number of factors including the socioeconomic status, education, healthcare availability, and cultural norms [1].

The trends in reproductive health among adolescents are of primary significance regarding identifying the emerging problems, creating effective interventions, and guaranteeing health outcomes of the future generations. The awareness of these trends assists in the formulation of specific health policies, the enhancement of education programs and the reduction of the inequality in the access to reproductive health services. Due to the susceptibility of adolescents to reproductive health issues, especially in low-resource areas, it is important to track such trends and reduce the risks and foster healthy behaviors.

Key Contribution:

- Developing a population-based model that would be used to examine long-term trends in the reproductive health of adolescents.
- Determination of socio-economic and cultural determinants affecting the health of adolescents in terms of reproductive health outcomes.
- Provision of evidence-based recommendations for improving adolescent reproductive health policies and programs.

The structure of the paper is the following: in Section II, the review of existing literature on the topic of adolescent reproductive health is provided, with the identification of the major models that are applied to analyze the trends and the gaps in the research. Section III provides the methodology where the data sources, the model development and data analytics are outlined. Section IV contains the results with the observed trends and factors which influence adolescent reproductive health. Section V addresses the findings in the framework of the literature available, and Section VI provides the culmination of the paper with the major findings, recommendations, and future study suggestions.

Literature Review

Adolescent reproductive health is a broad concept that involves such issues like early sexual behavior, use of contraceptives, early pregnancy, and high rate of sexually transmitted diseases [2]. Studies have revealed that the overall education, healthcare access, and socio-economic aspects have a great impact on the reproductive health outcomes. Teens accessing sexual and reproductive health services and education have less risky sexual behaviors, and therefore, there are reduced teen pregnancy and sexually transmitted infections. Nevertheless, the low-resource settings still have significant challenges including lack of healthcare facilities and societal stress that adolescents in low-resource settings have to contend with, further increasing their reproductive health risk. Moreover, the absence of youth friendly services and cultural norms are still considered to be the major obstacles to the enhancement of the reproductive health of adolescents.

Population-based models are critical instruments in the examination of long-term healthy patterns, such as adolescent reproductive health [3]. Large representational data sets are frequently employed with these models in order to detect trends and determinants of health outcomes at a time. Population-based models can be useful in the determination of the factors affecting reproductive health by focusing on variables like socio-economic status, access to healthcare and education. The same models can be used to forecast future trends and provide policy decisions that will help to develop more effective interventions. With a variety of data points, population-based models can provide a detailed picture of trends in adolescent health and the meaning of this information to the health programs of the population [5]. Although the research on adolescent reproductive health is a large body, there are still great gaps especially when it comes to

longitudinal data [6]. The majority are cross-sectional studies, as they show the results of health at a certain point in time, without the ability to follow the changes. Also, the models that are currently used do not tend to embrace the entire spectrum of socio-cultural, family, and healthcare system influences which influence teenage reproductive health. Most of the models are constrained by the limited nature of their focus on one particular determinant, say sexual behavior, without taking the bigger picture. More detailed and integrated, population-based models should be developed so that the multifactorial interactions with adolescent reproductive health are taken into consideration [7].

The importance of socio-economic factors, education and access to healthcare in the reproductive health outcome of adolescent has been emphasized in previous studies [8]. Most of this research, though, is cross-sectional and lacks consideration of long-term trends or the multicomponent effect of different determinants. The use of population-based models has played a vital role in determining the main health patterns however most of the models that are currently in use do not take into account the multi-dimensional aspects of adolescent health [9]. The gap in this literature review is that there still is a great deal of missing in the uniting of various socio-cultural and healthcare determinants within integrated frameworks of worldwide populations. This research is meant to fill such gaps by coming up with an improved multi-faceted population-based model to analyze the trends in reproductive health of adolescents and present actionable information to the public health policy [10].

Methodology

Data Sources and Selection Criteria

Data in this research were located through various population-based health surveys and databases that offer all-inclusive information about the reproductive health of adolescents. These data sets cover national health surveys, including the Demographic and Health Surveys (DHS) and other publicly available data sets of institutions such as the World Health Organization (WHO) and UNICEF, which concentrate on those health indicators that are in specifics to the adolescents. The criteria used to select these datasets were hinged on a number of aspects which include the demographic coverage (urban and rural environment), geographical coverage (to cover a range of socio-economic environments) and time coverage (ideally longitudinal datasets with data points that cut across a number of years). Only those datasets which contained key indicators of reproductive health such as early pregnancies prevalence, contraceptives use, the rate of sexually transmitted infections (STIs), access to reproductive health services were selected. The datasets were also required to cover data about the aspects of socio-economic and education and health outcomes of adolescents that fell in the age group of 10 to 19 years. These criteria made sure that the analysis would be representative of the trends of adolescent reproductive health in various settings and there would be adequate information to be discussed with regard to changes with time and differences between regions.

Development of the Population-Based Model

The population-based model, which was designed in the present study, is aimed at testing the relationship between the factors that affect the trends in adolescent reproductive health over time. It combines several socio-demographic factors, such as age, gender, socio-economic status, education level, and access to healthcare services, to gain a better insight into their associations with reproductive health outcomes, e.g., early pregnancies, the use of contraceptives, and STI prevalence. The model is based on a multi-level structure with individual-level data (e.g. personal health practices) combined with community and health care level data (e.g. access to sexual health education and services). A statistical regression model, namely multivariate logistic regression, was developed, to determine the factors that have the strongest effect on the reproductive health outcome. Interaction effects between variables are also included in the model like the interaction between socio-economic status and education level, that may influence the reproductive health outcomes in complicated manners. The model was tested in terms of cross-validation to prove its accuracy and strength. Further, the sensitivity analysis was conducted to determine the effects of the possible biases or missing data on the results.

Analytical Methods Used in the Study

A statistical and a combination of computational analysis was employed to examine trends in adolescent reproductive health. Descriptive statistics were used to summarize the major health indicators, including the mean and standard deviation between groups of people according to their demographics. The relationships between socio-economic issues, health-care access, and reproductive health were investigated using regression analysis, and the multivariate logistic regression was used to model early pregnancies and STI prevalence. The changes in reproductive health outcomes across time and the future changes were evaluated using time-series analysis, such as ARIMA models. Model reliability was taken care of by cross-validation where the dataset was divided into training and testing groups. The statistical significance was assessed through p-values and confidence intervals and the effect sizes were reported to indicate the important predictors. The findings were understood with respect to bettering reproductive health services and education to the adolescent.

Results

Trends in Adolescent Reproductive Health Over Time

The data analysis has identified various main trends related to the issue of teenage reproductive health during the last decades. In several parts of the world, the rates of teenage pregnancy have been on the decrease, especially in those countries which have sound sexual and reproductive health education systems and have more access to contraceptives. The decreased teenage pregnancies are more pronounced in high-income nations and the rates have been declining to 25 % in the last two decades. On the other hand, the rate of adolescent pregnancy has been relatively high in the low and middle-income countries particularly in the rural and underserved regions. STIs have had an uneven pattern of prevalence, and in some areas, where there has been a lack of sufficient sexual education and access to health care, the trend has been towards an increase. Also, statistics indicate that teenagers in places with greater liberal access to contraceptive methods have much more successful rate of using contraceptive methods that have helped to reduce the cases of unintended pregnancies. Altogether, inconsistent with the evidence of the improvement in the reproductive health outcomes in some areas, inequality can still be observed, especially in respect of socio-economically disadvantaged adolescents.

Factors Influencing These Trends

The socio-economic, cultural and healthcare-related factors have impact on adolescent reproductive health trends. One of the central predictors is education, whereby the influence of sexual education has resulted in postponed sexual activity and appropriate use of contraceptives. The model indicates that the adolescents with high socio-economic status are better placed to secure access to healthcare and education which leads to healthy reproductive behaviors. The availability of healthcare services that are friendly to the adolescent is also a critical factor in terms of contraceptive use and STIs prevention. In the areas that have access to healthcare, the rate of contraceptives is greater and the rates of STIs are lower. Access to reproductive health information, which leads to increased teenage pregnancies and STIs, may be limited by cultural attitudes, including conservative beliefs. Reproductive behaviors are influenced by peer influence as well as media exposure and more peer networks and media exposure are associated with healthier behaviors. These results indicate how adolescent reproductive health is a complicated interaction of many different factors.

Implications for Policy and Practice

The findings have significant implications for both public health practice and policy. First, the study emphasizes the need for age-appropriate, comprehensive sexual and reproductive health education in schools, as regions with such programs have seen decreased adolescent abortion rates. Additionally, improving access to adolescent-friendly healthcare services, including confidential counseling, contraception, and STI prevention, is crucial. Governments should invest in healthcare infrastructure that meets these needs, especially in low-income and rural areas where reproductive health outcomes are still poor. Policies aimed at improving socio-economic conditions, such as access to education and job opportunities, can also help reduce reproductive health risks. Lastly, cultural sensitivity should be integrated

into reproductive health programs, ensuring that interventions respect local beliefs while promoting evidence-based practices. These measures can help reduce reproductive health disparities and improve outcomes, particularly in underserved communities.

Discussion

Interpretation of Results

Findings of the study are consistent with the earlier research results that suggest that the availability of sexual education and healthcare services plays a crucial role in enhancing the reproductive health of adolescents. Teens who have greater access to birth control and education are less prone to dangerous sexual practices that result in reduced rates of STIs and pregnancies. Nevertheless, the rates of pregnancy and STIs in rural and low-income areas are still high, which underscores the persistence of the problem of reproductive health disparities, especially with regard to underserved communities.

Limitations of the Population-Based Model & Future Research

The strength of the population-based model is that it allows combining various socio-demographic determinants and studying long-term tendencies, which provides a complete picture of reproductive health. It gives us some understanding of the intricate interactions between socio-economic, educational, and healthcare access variables. Nevertheless, it is based on secondary data that can be biased in its reporting and might not fully reflect individual-level behavioral influences that can affect the reproductive health outcomes. The model needs to be enlarged with individual behavior data and the effect of particular interventions, such as sexual education programs, needs to be examined in the future. Longitudinal research might determine the effectiveness of these programs in the long term. The interventions that ought to be used to address adolescent reproductive health outcomes are improvement of adolescent-friendly healthcare services, incorporation of comprehensive sex education in schools, and addressing the socio-economic disparities that are essential in enhancing outcomes of reproductive health among adolescents.

Conclusion

This study examined the trends in teenage reproductive health and found that there were substantial differences in the outcomes, including teen pregnancy rates and STIs prevalence rates in various locations. Although in countries that provide comprehensive sex education and have access to healthcare, there are decreasing cases of adolescent pregnancies, the low-income areas, especially the rural ones, have been experiencing increased cases of unintended pregnancies and STIs. Access to education, socio-economic status, healthcare services, and cultural beliefs are some of the main factors contributing to these trends. The results indicate that group-specific interventions within underserved groups must enhance adolescent reproductive health outcomes. Population-based models as the model developed in the present study is a critical tool that helps in gaining insight into the multifactorial effects that drive traditions of reproductive health among teenagers. Through these models, socio-economic, educational, and healthcare aspects can be incorporated into an overall framework, which offers useful perspectives in policy formulation and health programs for people. Findings of the study point to the relevance of the widespread use of sex education, the accessibility of adolescent-friendly healthcare, and the elimination of socio-cultural obstacles to birth control. Through these gaps, the public health initiatives can successfully lower adolescent pregnancies and STIs, which will lead to the improvement of the health status and happiness of future generations.

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