DOI: https://doi.org/10.52131/pjhss.2022.1003.0284

Pakistan Journal of Humanities and Social Sciences

Volume 10, Number 3, 2022, Pages 1187–1196

Journal Homepage:

https://journals.internationalrasd.org/index.php/pjhss

The Socio-Economic Determinants of Anemic Pregnancies in South Asia – Empirical Evidence from National Aggregates

Maryam Ishaq[1], Ismat Nasim[2], Tusawar Iftikhar Ahmad[3]

[1] Department of Economics, The University of Lahore, Pakistan. Email: maryam.ishaq@econ.uol.edu.pk
[2] Lecturer, Department of Economics, Government Sadiq College Women University, Bahawalpur, Pakistan. Email: ismat.nasim@gscwu.edu.pk
[3] Associate Professor, Department of Economics, The Islamia University of Bahawalpur, Pakistan. Email: tusawar.iftikhar@iub.edu.pk

ARTICLE INFO

Article History:
Received: July 24, 2022
Revised: September 28, 2022
Accepted: September 29, 2022
Available Online: September 30, 2022

Keywords:
Anaemic Pregnancies
Adolescent Fertility
Public Health Spending
Robust Regression Model
Panel Data Co-integration

Funding:
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Anaemia is the most common and prevalent maternal health issue in developing countries. South Asia is part of the developing world and is severely affected by the problem of anaemia in pregnant women. Unlike earlier studies which sought evidence more from cross-sectional data sets, this study investigates the explanatory power of adolescent fertility and low health expenditure on exceptionally high rates of anaemic pregnancies using modern econometric techniques with longer data sets comprising national aggregates. The results strongly suggest that for seven regional states, the proposed relationship holds valid. The robustness of short-run individual country estimates is challenged by testing the relationship through modern long-run pooled data estimators. The results are reasonably encouraging, recognizing the significant role of adolescent fertility and low levels of health spending, thus determining trend patterns of anaemic pregnancies region-wide.

Corresponding Author's Email: ismat.nasim@gscwu.edu.pk

1. Introduction

Amongst the most widespread nutritional deficiencies in pregnant women, anaemia stands at the forefront. The World Health Organization (WHO) defines anaemia in pregnant women as a medical state in which "the number and size of red blood cells, or the haemoglobin concentration, falls below an established cut-off value (11 g/dL), consequently impairing the capacity of the blood to transport oxygen around the body". Anaemia is the most commonly prevalent maternal health issue in developing countries. It is a global challenge, not only for poorer populations of the world but also for developed countries. As reported by (WHO, 2015), the prevalence of anaemia has been highest in South Asia, and Central and West Africa. India, Pakistan and Bangladesh are the country's most affected in South Asia. As revealed by United Nations' surveys of anaemia prevalence in pregnant women aged 15-49 years, which investigated 32 Asian countries, 89.5% of the total pregnant women are anaemic. An even more alarming fact, as reported by WHO, states that globally, approximately half of the maternal deaths due to anaemia are contributed by South Asia, where India is responsible for 80% of the total maternal deaths in the region. Nutritional disorders comprising iron deficiency and micronutrient deficiency, and malaria and hookworm infection are considered to be the most common causes of anaemic pregnancies in developing regions of the world.

Do all the reasons for anaemic pregnancies lie with physiological and medical factors? Certainly not, because a sizeable number of socioeconomic factors, child marriages, poor living standards, and health-seeking behaviours across different cultures also serve as important determinants of anaemia prevalence amongst pregnant women. The South Asian region stands out in the prevalence of child marriages; the region accounts for about half of the total child marriages occurring globally. Child marriage refers to a marital contract (formal or informal)

eISSN: 2415-007X

where one or both of the spouses are under the age of 18. Such marriages are unlawful according to the national laws of South Asian states, as well as strictly prohibited by international human rights treaties. Nevertheless, the region is reportedly persisting with child marriages very freely. In South Asia 46% of the total women (24.4 million) aged between 20-24 years got married before the age of 18 years.

The extent of child marriage prevalence varies from country to country in South Asia. Bangladesh, Afghanistan, India and Nepal report the highest percentages of child marriages in the region with 66%, 46%, 46% and 41% respectively (C. UNICEF, 2012). In Bangladesh, India, Nepal and Pakistan, however, a significant reduction has been reported in younger adolescence marriages (14 years and below) over the last 25 years; nevertheless, there has been no significant change in the marriage of girls aged 16-17 for any nation except Bangladesh. The primary factors driving child marriage include poverty, protection of girls' sexuality from premarital sex, gender discrimination, and limited educational and professional opportunities for girls and inadequate execution of child marriage laws.

Forced marriage in adolescence is only one side of the picture. Once a premature girl gets married, she is faced with the difficult challenge of proving her fertility soon after marriage. The male dominated family culture, orthodox ethnic norms and inaccessibility to information on reproductive health prevent adolescent girls from deciding on their motherhood independently. It is natural for an adolescent girl to find herself unprepared for childbirth at such an early age, and thus she is challenged during pregnancy, not only physically, but also mentally and emotionally. The existing studies on adolescence marriages and associated medical issues in India reveal rampant anaemia and associated complications of pregnancy to be significantly higher in under 18 mothers than in older women (Pachauri & Jamshedji, 1983; Ramachandran, 1989; Sharma & Sharma, 1992). As a consequence, childbirth complications and maternal mortality rates for girls between the ages of 15 and19 years old is twice as high as the same rate for women giving birth between 20 and 24 years old.

The issue is made worse by high rates of premature births and low birth weight infants, who are more vulnerable to death. Not only are this but girls with longer child-bearing years more prone to miscarriage, stillbirths, malnutrition, cervical cancer, sterility, and other problems (UNICEF, 2009). Furthermore, physical, sexual, psychological and economic violence are some of the most obvious consequences of adolescent marriages in South Asia (Kapoor, 2000; Levine, 2009). According to the results of the study of Kumar et al. (2019), a very high anemia prevalence among pregnant women is a worrying symptom and an indicator of inadequate nutrition and health care use. Age, profession, parity, timing of the first ANC checkup, consumption of IFA, and deworming of participants were all substantially linked with anemia. It was shown that mild to severe anemia was common among the adult female population. Additionally, there is a correlation between anemia in female adults and age, marital status, the number of children each woman had, reading level, and monthly family income. The findings of Naeemullah, Ijaz, Darwesh, Khan, and Ishtiaq (2022) indicated that strategies such as health education and awareness services, required nutrition, use of fruits and vegetables, and iron supplementation were required to put a stop to anemia among the female adults.

The findings of this study by Alam, Khanum, Jahan, and Ahmed (2021) indicated that, regardless of gestational week, anemia affects more than one third of pregnant women, but it is more prevalent in those who present in the second trimester of pregnancy, are younger, leaner, and thinner, have a history of prior pregnancies, and have a poor obstetric history. In Ethiopia, anemia affected more than one-third of pregnant mothers. Pregnant women in areas with high anemia prevalence should be given adequate concern. Maternal age, being a Muslim, having four to six household members, having two children under five, being the head of the household, wanting the current pregnancy later, having no terminated pregnancies, and being between 13 and 17 years old at the first sexual encounter were all factors associated with anemia in the study of (Woldegebriel et al., 2020). The birth outcomes of pregnant women may be impacted by the observed incidence of anemia. To lower the high prevalence of anemia among pregnant women in the nation, the involved organizations should concentrate on strengthening and stressing the interventions targeting the variables indicated.

An analysis of geographical variations in anemia incidence and contributing factors among pregnant women was conducted by (Naik & Sasdhar, 2019). Lower levels of female education,

prenatal care, and postpartum care are inversely related with anemia in pregnant women, but female literacy, poverty rate, and body mass index (women who are overweight or obese) are positively associated with anemia. This study by Sunuwar et al. (2020) examined the factors of anemia for the seven selected SSEA countries. This suggested that anemia is a serious public health problem in SSEA countries. In the analysis, anemia was more common in some countries than others. Geographical and cultural factors, as well as the different eating patterns in various countries, may be to blame. To ascertain the occurrence and risk factors of anemia and lower rate of iron supplements among pregnant women in Malaysia, a systematic review was undertaken by (Abd Rahman, Idris, Isa, Rahman, & Mahdy, 2022). Extremes of reproductive age, late prenatal booking, non-compliance with hematinic, during the second or third trimester, poor mother educational level, low family income, and unemployment were factors that were strongly linked with anemia in pregnancy. In comparison to metropolitan locations, it was shown that rural areas had a greater rate of anemia in pregnancy.

Anemia prevalence was a minor public health worry. Iron folic acid supplementation did not get enough early and timely absorption. It was discovered by Samuel, Darebo, Desta, and Mulugeta (2020) that few people had a diverse diet or foods high in iron. In order to boost the adoption of prenatal care services, increase micronutrient intake through food based methods, and manage infections, community mobilization and health education are advised. Highly constrained levels of primary and maternal health care expenditure in South Asia are another critical factor, which contributes substantially to anaemia prevalence amongst pregnant women. Inaccessibility to adequate health care facilities and low levels of public health expenditure (as a ratio to GDP) is affecting the population in general. However, women tend to fare worse because of their extra needs during their reproductive years and their constrained ability to access available medical care and facilities. Moreover, the widespread gender discrimination between male and female children fuels female malnutrition from the time of her birth. Nepal and India are reportedly marked with unprecedented levels of malnutrition in under five girls, which can result in iron deficiency, anaemia and other types of nutritional deficiencies in adolescent girls and women of reproductive age (Kurz & Johnson-Welch, 1994; Ransom & Elder, 2003).

Bearing the above stated facts in mind, the study aims at empirically evaluating adolescent fertility and low health expenditure as plausible determinants of anaemic pregnancies in South Asia. Despite its immense importance in regional gender concerns, the issue has remained largely empirically unexplored in earlier studies. This research contribution investigates the proposed relationship empirically, employing modern time-series estimation methods. The acquired results are tested for their robustness using pooled data estimation techniques. Section 2 of this paper lays out the theoretical framework established to analyse the anaemic pregnancy trends in South Asia, explained by trend behaviours of adolescent fertility and health spending. Section 3 covers the individual country analysis, estimating the proposed model through short-run time-series estimators. Section 4 deals with testing the hypothesized relationship in the long-run, using panel data estimation tests. Finally, Section 5 summarizes the research findings obtained in Sections 3 and 4, followed by several key implications.

2. Data Description, Model and Methodology

To see the role of adolescent fertility and maternal health expenditure in determining the short- and long-term trends of anaemic pregnancies in South Asia, time-series and pooled data estimators are employed individually to see how consistent the estimates are. In the short-run, the proposed relationship is established through dynamic least squares regression modelling. For detecting the (plausible) long-run association between model variables, panel co integration methods are used. In econometrics, co integration refers to a long-run equilibrium relationship, established between two or more non-stationary time-series. The study employs a co integration approach (for long-run analysis) to examine the causal power of adolescent fertility and maternal health expenditure in deriving the trend behaviours of regional anaemic pregnancies in South Asia.

$$anaemic\ pregnancies = f(adolescence\ fertility, health\ expenditure) \quad (1)$$

The above stated proposed relationship is investigated empirically using the below stated set of sample countries, model variables and sample data set for South Asia. Sample Countries are Afghanistan, Bangladesh, India, the Maldives, Nepal, Pakistan and Sri Lanka. For the three model variables, the time-series data is sourced from Health, Nutrition and Population Statistics,

World Bank Database. The data set ranges from 1990 to 2018 at annual frequency. The database comprises health, nutrition, population and associated indicators data, originally taken from multiple sources, provided below along with a short description of model time-series. The empirical analysis in this study involves the following three time-series.

- *Prevalence of anaemia among pregnant women (%)*: This is the model regressand. It represents the percentage of pregnant women whose haemoglobin level is less than 110 grams per litre at sea level. The World Bank sources the data from the World Health Organization.
- *Adolescent fertility rate*: Adolescent fertility rates will be the first regressor in individual country regressions as well an in panel data estimations. It is the number of births per 1,000 women aged 15-19 years. The series is originally sourced from United Nations Population Division, World Population Prospects.
- *Health Expenditure per capita (constant $, 2011 Purchasing Power Parity, PPP)*: This will be the second regressor in country regressions. The series is a ratio of total national health expenditure to total population of the country that captures the health services facilities. Health care facilities include the awareness and provision of related instruments to those who need, balance and nourished diet activities, and emergency aid. The health services have not included the water and sanitation facilities provision. From international Database, dollars-converted using 2011 as base, the Purchasing Power Parity (PPP) rates are taken and it is originally sourced from the World Health Organization, Global Health Expenditure Database.

The inter-relationship of anaemic pregnancies and its proposed determinants will be verified empirically using time-series (individual country analysis) and panel data (pooling the individual country data) co integration estimators. The two types of estimation approaches involve various distinct steps. The forthcoming sections of the paper briefly describe the two methods individually, besides reporting and elaborating on their subsequent findings.

2.1 Individual Country Analysis

In this section, each sample country from South Asia will be individually tested with the proposed model (Equation 1), by establishing a short-run relationship between anaemic pregnancies and its determinants (in dynamic form) using M-Estimator from robust regression modelling. The estimator is proclaimed to be highly efficient against influential data points, commonly found in time-series data samples, resulting in non-normally distributed regression errors. To see the short-run dynamics of inter-linkage of anaemic pregnancies and its determinants, the M-Estimator will estimate the proposed relationship through the dynamic least squares regression model, rather than the static one. For this, one needs to know the exact order of integration of model variables, so that the functional form of the dynamic equation can be specified precisely.

2.2 Testing the Order of Integration of Model Variables

The Dickey-Fuller Generalized Least Squares (DF-GLS)[1] unit root testis employed to determine the order of integration of three model time-series. The test was introduced by Eliot, Rothenberg and Stock (ERS) in 1996 as an improvement over the Dickey-Fuller (DF) type unit root testing procedures. Using a generalized least squares rationale, the test has the best overall capability in terms of small sample size and power, when an unknown mean or trend is present in the series.

2.3 Dynamic Regression Model

In this study, the short-run sensitivity of anaemic pregnancies in the South Asian region towards significantly higher rates of adolescent fertility and low volumes of health expenditure is gauged by employing the dynamic least squares regression model. The model is distinct from *'ordinary least squares model in levels'* and is '*dynamic*' in the sense that each model variable is measured in its dynamic/differenced state. Thus, a dynamic least squares regression is a *'model in differences'* where a non-stationary time-series is differenced in accordance with the number

[1]Augmented Dickey-Fuller (ADF) unit root test can be run with both drift and linear time trend terms; in a similar way DF-GLS can be employed in two forms: GLS de-trending and GLS demeaning. The GLS de-trending series is regressed on a both constant and linear trend, and then resultant residual series is used in a standard DF regression. As with the visual examination of the model variable, the time-series appeared to have a prominent trend, so the de-trending specification of the DF-GLS unit root test is used as an estimator.

of unit root(s) it contains. The estimable version of dynamic least squares regression model, employed for analysing the plausible long-run co-movement between anaemic pregnancies and its two determinants, is expressed in the following form:

$$\Delta ap_{i,t} = \gamma_0 + \underset{(+)}{\vartheta_1 \Delta af_t} + \underset{(-)}{\vartheta_2 \Delta he_t} + v_t \qquad (2)$$

Where ϑ_1 and ϑ_2 are the short-run slope coefficients measuring the degree of responsiveness of national aggregates of anaemic pregnancies towards a unit change in the national adolescent fertility rate and national health expenditure per capita. Intuitively speaking, the two coefficients are expected to hold positive and negative values, respectively, owing to the anticipation that pregnancies at an early age are found to bear positive correlation with anaemic pregnancies and higher expenditure per capita tends to dampen the prevalence of anaemia during pregnancy.

3. Estimating the Dynamic Regression Model through the Robust Regression Approach

Least squares regression models (both ordinary and dynamic) are found to be yielding inconsistent estimates when the errors are non-normally distributed. This is particularly true in the case of heavy tailed errors, explained by the presence of influential outlier data points in the sample. Treating such samples using the weighing scheme of ordinary least squares regression modelling gives a misleading representation to influential data points, thus yielding unreliable regression results. To combat this issue, the paper employs M-Estimator from the scheme of robust regression models. Robust regression models are designed to deal with *'contaminated'* data sets, containing outliers or influential data points, thus yielding non-normally distributed regression errors.

Huber's M-Estimator (the maximum likelihood estimator) is the most popular method of robust regression modelling, introduced by Huber (1964). Unlike ordinary least squares regression, which assigns uniform weights to errors, this method employs a weighing scheme giving linear but true representation to errors, in accordance with their weights. Also, contrary to ordinary least squares regression modelling, which minimizes the sum of squared errors, the robust regression approach relies both on minimizing the sum of squared errors as well as the sum of absolute errors, that is, the method of least absolute deviations.

This section of the paper begins test-by-test reporting of results acquired through estimating the DF-GLS unit root testing procedure and Huber's M-Estimator regression model[2]. The estimates against the two tests are individually reported in Table 2 and Table 3, respectively. Starting with the DF-GLS unit root test, the results for the three model time-series for South Asian countries are reported in Table 2. On testing the order of integration of model variables, the DF-GLS unit root test yields mixed results. Although the three time-series tend to be level stationary for a larger number of subject countries, there are a few cases where they turn out to be first-differenced stationary, that is, I(1) (see Afghanistan, Bangladesh, the Maldives, Nepal and Sri Lanka for the series of adolescent fertility). Note also that for India and Pakistan, adolescent fertility is proving to be integrated of order two even, that is, I(2). On the whole, the order of integration of the model time-series is highly mixed.

The trend movements in model variables (as evident from the presence of unit root(s)) makes the use of the static regression model implausible and calls for employing the dynamic specifications of the least squares regression model to evaluate (statistically) our hypothesized relationship. After having established the order of integration of model variables, the next task is to identify the underlying short-run co-movement between South Asian anaemic pregnancies and its two determinants, if there is any. As discussed previously, the theoretical formulation of the model allows for a dynamic relationship between variables.

Table 2: DF-GLS Unit Root Test Results[3]

Test Results for Level Time-Series

[2] The test is applied using EViews. EViews allows for Huber-White least squares regression estimator. The test follows White's method and thus yields White's robust standard errors by adjusting the usual standard errors against heteroskedasticity of any unknown form.
[3] DF-GLS regression includes intercept and linear time trend as deterministic regressors.

Country	Anaemic Pregnancies (ap)	Adolescent Fertility (af)	GDP Per Capita[4](gdp_pc)	Health Expenditure (he)
Afghanistan	-0.89	-2.85	-4.13***	-5.26***
Bangladesh	-1.69	-1.66	-3.00*	-3.82***
India	-3.98***	-1.55	-3.19**	-5.91***
The Maldives	-5.74**	-1.22	-4.29**	-4.98***
Nepal	-6.39***	-0.54	-5.12***	-3.03*
Pakistan	-0.53	-1.49	-3.41*	-3.80***
Sri Lanka	-3.98***	-2.45	-3.78**	-2.19
Test Results for First-Differenced Time-Series				
Country	**Anaemic Pregnancies** (Δap)	**Adolescent Fertility** (Δaf)	**GDP per Capita** (Δgdp_pc)	**Health Expenditure** (Δhe)
Afghanistan	-3.97***	-2.92*	-	-
Bangladesh	-2.09	-2.64	-	-
India	-	-2.15	-	-
The Maldives	-	-3.49**	-	-
Nepal	-	-3.24**	-	-
Pakistan	-4.58***	-2.27	-	-
Sri Lanka	-	-3.19**	-	-5.08***
Test Results for Second-Differenced Time-Series				
Country	**Anaemic Pregnancies** Δ(Δap)	**Adolescent Fertility** Δ(Δaf)	**GDP per Capita** Δ(Δgdp_pc)	**Health Expenditure** Δ(Δhe)
Bangladesh	-4.26****	-4.59***	-	-
India	-	-3.46**	-	-
Pakistan	-	-4.86***	-	-

Note, (i) For each sample country, trend and intercept are included as deterministic regressors to unit root regression equations, (ii) For 10%, 5% and 1% significance levels, the test critical values are -2.89, -3.19 and -3.77 respectively, (iii) Lag length is determined by automatic selection based on the Schwarz Information Criteria (SIC), subsequently adjusted to produce white noise in the residuals, if necessary. (iv) *, ** and *** show the significance of the coefficients at 10%, 5% and 1% significance level, respectively.

Empirically, the dynamic formulation of hypothesized relationship (see Equation 2) is tested using Huber's M-Estimator regression model. Huber's M-Estimator test results are reported in Table 3. The table shows the coefficients borne by two regressors individually against each of the subject countries. The validity of the results is parameterized through two distinct criteria: (i) the short-run slope coefficient(s) should be statistically significant at 10% or better significance level, and (ii) each of the two slope coefficients should hold an intuitively correct sign (positive and negative for af andhe, respectively). The test yields a mix of evidence in support of the proposed model.

Talking about the adolescent fertility first, the series bears intuitively correct (positive) and statistically significant slope coefficient (always at better than 5% statistical significance) in the case of Afghanistan, the Maldives and Sri Lanka only. The coefficient value for the three countries ranges from 0.64 to 6.18. This implies that during short-run, a 1 %(annual) increase (decrease) in the fertility rate of adolescent girls tends to increase (decrease) the ratio of anaemic pregnancies by 64% to 618% on average. The cases of India, Nepal and Pakistan yield positive but insignificant slope coefficients, thus invalidating the proposed hypothesis (when adolescent fertility is the model regressor) statistically.

Bangladesh is the only subject country which generates a statistically significant but negative slope coefficient on adolescent fertility. Because the coefficient bears an undesirable sign, this prevents the two variables from holding an intuitively valid relationship in a desirable direction. Looking into the short-run causal effect of per capita health expenditures on anaemic pregnancies, the evidence is rather strong, because seven subject states are favouring the negative effect of per capita health expenditure on our regressand. The relationship was always found to be statistically significant at better than 5% significance level.

The short-run slope coefficient for four regional states (India, the Maldives, Nepal and Sri Lanka) was found to be lying between -0.01 to -0.57, that is, a 1% annual increase (decrease) in per capital health expenditure tends to induce a decrease (increase) of 1% to 57% (on average) in national levels of anaemic pregnancies. Pakistan is the only state in our set of sample

[4] Growth rates of health expenditures per capita and GDP per capita are taken for all countries.

countries which bears a statistically highly significant but intuitively undesirable coefficient, thus denying a valid short-run association between the two time-series.

Table 3: Summary of Short-Run Test Results against Huber's M-Estimator Regression Model

Countries	Model Regressors			Does Valid Short-Run Co-Movement Hold between ap and af?
	af	he	gdp_pc	
Afghanistan	0.66*** [16.23] 3.09*** [2.67]	- -	- -0.04 [-1.57]	Yes
Bangladesh	-1.60*** [-13.23] -1.41*** [-6.95] -1.50*** [-8.46]	- -0.07 [-1.57] -0.07* [-1.80]	- - -0.23* [-1.73]	No
India	0.06 [0.20] -0.05 [-1.07] -0.05 [-1.03]	- -0.01*** [-13.76] -0.01*** [-10.76]	- - -0.00 [-0.02]	No
The Maldives	-1.75*** [-11.43] -0.89*** [-5.16] -0.99*** [-3.74]	- -0.01*** [-6.27] -1.01*** [-5.46]	- - 0.04 [1.12]	Yes
Nepal	3.10*** [5.01] -0.10 [-0.27] -0.07 [-0.16]	- -0.19*** [-10.23 -0.19*** [-14.57]	- - -0.11 [-0.85]	Yes
Pakistan	0.08* [1.68] 0.01 [0.54] 0.01 [0.39]	- 0.01*** [6.72] 0.02*** [7.53]	- - -0.04 [-1.60]	Yes
Sri Lanka	6.51*** [5.17] 6.58*** [5.30] 6.06*** [4.01]	- -0.15*** [-3.00] -0.16*** [-3.21]	- - -0.36 [-0.71]	Yes

NOTE, (i) Sample t-statistics are given in squared brackets, (ii) *, ** and *** are showing significance of coefficients at 10%, 5% and 1% significance level, respectively.

On the whole, there is reasonably sufficient amount of empirical evidence in support of our proposed relationship between anaemic pregnancies and its two determinants during short-run. Adolescent fertility in conjunction with per capita health spending drives short-run patterns of South Asian regional anaemic pregnancies wholly for three out of seven states (Afghanistan, the Maldives and Sri Lanka) only. The proposed relationship is partly true for two of our sample countries (India and Nepal), when one of the two determinants are bearing a valid and statistically significant short-run association with the model regressand. Bangladesh and Pakistan are the only two sample countries yielding invalid and/or insignificant causal relationship amongst our model variables. These results call for an investigation of the hypothesized linkage between model variables (Equation 1) for their (plausible) association in the long-run using panel data estimation methods.

In the preceding sections of the paper, the anaemic pregnancies in South Asian countries were tested empirically against its two determinants, using time-series estimation procedures.

This study also conducts a pooled data analysis to verify the authenticity of proposed hypothesis in long-run. The individual cross-sections (countries) will be pooled together, so that the panel of countries can be tested for their combined power against the proposed inter-relationship of anaemic pregnancies and its determinants. For establishing a long-run co-integrating relationship between model variables, the Johansen-Fisher Combined Maximum Likelihood (ML) based panel co-integration test will be conducted. Similar to individual country analysis, the responsiveness of ap towards model regressors (af and he) will be estimated through Panel Fully Modified OLS (PFMOLS) single equation co integration regression estimator.

4. Results

Starting from testing all three model entities for their order of integration, the corresponding pooled data estimation results are reported in Table 4. LL unit root test results suggest that all three cross-section series are integrated of order one. From the p-value of sample statistics, one can clearly reject the null hypothesis of unit root for the first-differenced series. This implies that three cross-section series are reasonably eligible to be tested through the Johansen-Fisher Combined panel co-integration test for establishing their (plausible) long-run association.

Table 4: Summary of Long-Run Test Results for Panel Unit Root and Co integration Testing Procedures[5, 6]

Levin and Lin Panel Unit Root Test to Homogeneous Cross Sections			
Cross-section Series	Sample Statistics	*p*-value	Order of Integration
Δap	-5.03	0.00	I(1)
Δaf	-2.94	0.00	I(1)
Δhe	-4.72	0.00	I(1)
Johansen-Fisher Panel Co integration Test Results[7,8]			
	Fisher Stat (Trace Stat)	Fisher Stat (Max Eigen value Stat)	Does Valid Co integration Hold?
Case 3: Intercept (no trend) in co integrating equation and VAR			
No. of Estimated Co integrating Vectors	3	3	No
Case 4: Intercept and trend in co integrating equation-no trend in VAR			
No. of Estimated Co integrating Vectors	2	2	Yes
Results for Panel FMOLS (PFMOLS) Co integration Regression Estimator			
Long-Run Co integrating Vectors for Model Variables[9]			
af		he	
0.08		-0.02	
(0.02)		(0.00)	
[3.16]		[-6.64]	

Considering the test results obtained by applying the Fisher-Johansen panel co-integration test, the results are moderately supportive the valid long-run association between the model's individual variables. As per the test requirements, the user has to specify the lag length. For the optimal lag length selection, the study proceeded through Panel VAR, following the lag length selection by Schwarz Information Criterion (SIC). The two individual test specifications yield different results. The Trace and the Maximum Eigen value statistics of specification 3 of the test found no evidence of a valid co integrating vector for the estimated models. The test statistics commonly produce a rank of 3, challenging my unit root test findings, and proving the model variables to be level stationary; the rank of the test (r)isequal to the number of model entities (n). However, specification 4 of the test provides definite support for valid long-run co integration. Both the Trace and the Maximum Eigen value statistics yield a rank of 2, indicating that the model series establish two valid co integrating vectors/points, thus indicating their consistent co-movement in the long-run.

[5] All three panel entities (ap, af and he) take cross-section series in level form.
[6] Afghanistan is not included in the panel, due to the unavailability of health expenditure (he) data.
[7] The test is a maximum likelihood based rank test.
[8] Lag selection is done through panel VAR, following the Schwarz Information Criterion (SIC).
[9] Standard errors and t-ratios are reported in parenthesis and squared-brackets, respectively.

Having established valid co integration between model entities, the final step of pooled data analysis involves the estimation of long-run slope coefficients of adolescent fertility (af) and health expenditure (he), using the Panel Fully Modified OLS (PFMOLS) estimator. The PFMOLS test results confirm the Johansen-Fisher Combined panel co integration test results. Regressing anaemic pregnancies (ap) on adolescent fertility (af) and health expenditure (he), both af and he tend to drive long-run trend movements of ap highly significantly. Consistent long-run cointegration is established between ap and its proposed determinants, parallel to my individual country estimates and the Johansen-Fisher panel co integration test results. ap holds an intuitively correct association with af and he, where af and ap are directly proportional and he bears a negative relationship with ap. However, the changes in af hold relatively more sizeable effects for ap. A 1% increase (decrease) in adolescent fertility rate causes an 8% increase (decrease) in anaemic pregnancies in panel countries. Similarly, a percentage increase (decrease) in per capita health expenditure will induce a decrease (increase) of 2% in anaemia prevalence at regional level.

5. Conclusion

This paper verifies the reasonable, short- and long-run determinants of widespread anaemia amongst pregnant women in South Asia. Two socioeconomic factors, that is, high fertility rates in adolescent girls and low levels of health spending, are tested for their causal relationship with unprecedented levels of anaemic pregnancies in the region. The hypothesis is tested for its validity through a sample of seven South Asian states, both in short- and long-run. The study uses Huber's M-Estimator for investigating the dynamic version of the proposed model for establishing short-run causality, proceeding from adolescent fertility and health expenditure towards anaemic pregnancies. Wholly (or at least partly), for more than half of the subject states, valid association is proven amongst model variables, at 5% or better statistical significance. Huber-White least squares regression estimates yield statistically significant short-run coefficients against adolescent fertility with values ranging from 0.64 to 6.18, which is substantially high. Likewise, low levels of per capita health expenditure also turn out to determine the short-term patterns of anaemic pregnancies for the most part. The (statistically) evident causality between anaemic pregnancies and pre-mature fertility survived successfully, when the relationship is tested for its validity in long-run using pooled data econometric procedures. The Johansen-Fisher combined panel co integration test suggests valid co integration points for model variables. The Panel Fully Modified OLS (PFMOLS) test estimates further validate the long-run association, as established through the Johansen-Fisher combined co integration test. PFMOLS generates a long-run coefficient of value 0.08 on the part of adolescent fertility and -0.02 for per capita health expenditure.

The study holds several implications for national social policy making authorities, addressing gender inequality, minimum age of marriage, women empowerment on health and reproductive behaviour, and similar issues. There is a dire need for an increased number of programs and national action plans to spread reproductive health information and services to young people both before and after marriage. Creating awareness about the benefits of education in young girls during their adolescence may also bring radical improvements. Women with secondary education are expected to recognize their physical and nutritional needs, and thus be more capable of protecting themselves against maternal malnutrition during pregnancy. They are more likely to acquire prenatal and postnatal care, thus minimizing the chances of anaemia during pregnancy. Governments should also play their role by disbursing more in the health sector, so that the public sector contribution to the total national health expenditure may be raised. The situation also calls for poverty reduction at national levels, so that the purchasing power of the people in terms of medical and health facilities may be improved. The societal and cultural norms and traditions in South Asian countries need to be revolutionized, where even till today, young girls are taken as an economic burden and early marriage, as an act of unburdening. The fears attached to premarital sex, loss of virginity in an irregular sexual encounter and sexual abuse, are fuelling the problem of early marriage, which should come to an end by ensuring more security and protection for women by national law making and enforcing authorities.

References

Abd Rahman, R., Idris, I. B., Isa, Z. M., Rahman, R. A., & Mahdy, Z. A. (2022). The Prevalence and Risk Factors of Iron Deficiency Anemia Among Pregnant Women in Malaysia: A Systematic Review. *Frontiers in nutrition, 9*. doi:10.3389/fnut.2022.847693

Alam, F., Khanum, S., Jahan, I., & Ahmed, J. U. (2021). Prevalence and Sociodemographic Factors Responsible for Anaemia in Pregnancy: Experience in a Military Hospital in Bangladesh. *BIRDEM Medical Journal, 11*(1), 52-56. doi:10.3329/birdem.v11i1.51030

Kapoor, S. (2000). Domestic Violence against Women and Girls. Innocenti Digest 6.

Kumar, V., Jain, M., Shukla, U., Swarnkar, M., Gupta, P., & Saini, P. (2019). Prevalence of Anemia and its Determinants among Pregnant Women in a Rural Community of Jhalawar, Rajasthan. *National Journal of Community Medicine, 10*(04), 207-211.

Kurz, K. M., & Johnson-Welch, C. (1994). The Nutrition and Lives of Adolescents in Developing Countries: Findings from the Nutrition of Adolescent Girls Research Program. *International Center for Research on Women. ICRW Reports and Publications*, 1.

Levine, R. (2009). C; Greene, M; Grown, C. *Girls Count: A Global Investment & Action Agenda*.

Naeemullah, N. Q., Ijaz, B., Darwesh, N. M., Khan, Z., & Ishtiaq, M. (2022). Frequency and Risk Factors of Anemia Among Adult Female Population of District Swat Khyber Pakhtunkhwa Pakistan. *Pakistan Journal of Medical & Health Sciences, 16*(04), 988-988. doi:10.53350/pjmhs22164988

Naik, K., & Sasdhar, P. S. (2019). Socio-Economic Determinants of Anemia among the Pregnant Women in Karnataka. *Indian Journal of Economics and Development, 7*(11), 1-5.

Pachauri, S., & Jamshedji, A. (1983). Risks of Teenage Pregnancy. *Journal of Obstetrics and Gynaecology, 33*(3), 477-482.

Ramachandran, P. (1989). Nutriiton in pregnancy in women and nutrition in India. Editors. C. Gopalan, Surinder Kaur, Special Publication no. 5. *Nutrition Foundation of India*.

Ransom, E., & Elder, L. (2003). *Nutrition of women and adolescent girls: why it matters*: Population Reference Bureau.

Samuel, S., Darebo, T., Desta, D. T., & Mulugeta, A. (2020). Socio-Economic and Dietary Diversity Characteristics are Associated with Anemia among Pregnant Women attending Antenatal Care Services in Public Health Centers of Kembata Tembaro Zone, Southern Ethiopia. *Food Science & Nutrition, 8*(4), 1978-1986. doi:10.1002/fsn3.1485

Sharma, V., & Sharma, A. (1992). Health Profile of Pregnant Adolescents among Selected Tribal Populations in Rajasthan, India. *Journal of Adolescent Health, 13*(8), 696-699. doi:10.1016/1054-139X(92)90066-K

Sunuwar, D. R., Singh, D. R., Chaudhary, N. K., Pradhan, P. M. S., Rai, P., & Tiwari, K. (2020). Prevalence and Factors Associated with Anemia among Women of Reproductive age in Seven South and Southeast Asian Countries: Evidence from Nationally Representative Surveys. *PloS one, 15*(8), e0236449. doi:10.1371/journal.pone.0236449

UNICEF. (2009). Early Marriage in South Asia: A Discussion Paper. *Rep. UNICEF ROSA*.

UNICEF, C. (2012). *Afghanistan Multiple Indicator Cluster Survey 2010-2011:* . Retrieved from

WHO. (2015). *The Global Prevalence of Anaemia in 2011*: World Health Organization.

Woldegebriel, A. G., Gebregziabiher Gebrehiwot, G., Aregay Desta, A., Fenta Ajemu, K., Berhe, A. A., Woldearegay, T. W., & Mamo Bezabih, N. (2020). Determinants of Anemia in Pregnancy: Findings from the Ethiopian Health and Demographic Survey. *Anemia, 2020*. doi:10.1155/2020/2902498