RESEARCH ARTICLE

Adolescent pregnancy and anemia. Ten years of referrals in Northern Greece

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Abstract

Background: Births from adolescent mothers account globally for 10 % of all births and 23 % of maternal morbidity and mortality. Adolescence is a period of rapid biological changes; therefore, teens have a risk of developing iron deficiency anemia. The present study aimed to determine the hematological profile and compare the distribution and the severity of anemia among pregnant adolescents (12-19 years old) over ten years in Northern Greece.

Material and methods: We conducted a retrospective study of pregnant adolescents' medical records and laboratory data recorded during their first prenatal consultation. The laboratory workout was performed in the Thalassemia Prevention Unit of the Hippokration Hospital of Thessaloniki, Greece, from 2013 to 2022.

Results: Two hundred nine of the adolescents were of Greek Nationality (88.3 %) (86 Greek natives of the general population; 41.1 %, 112 members of the Roma community; 53.5 %, 11 members of the Muslim minority of Thrace; 5.2 %) and 29 (11.6 %) were immigrants from the Balkans, Middle East, and Asia. The mean age (± standard deviation) of the 238 pregnant women in our study's cohort was 16.67 ± 1.67 years, and the majority of them (90 %) were approximately between 15-19 years, and 10 % were between 12-14 years. Half of the cohort were Greek Roma (47 %) and were our study's youngest (15.9 ± 1.3 years old) adolescent pregnant women. All registered pregnant adolescents had abandoned school. Our data shows anemia in 33.6 %, iron deficiency anemia in 28.5 %, and iron deficiency in 54.6% of these pregnant adolescents. Migrants and Roma had the lowest hemoglobin levels in the second and third trimesters of pregnancy, respectively, while we found the lowest ferritin levels in Roma and Muslims of Thrace.

Conclusions: Despite existing knowledge regarding adolescent pregnancy prevalence and its adverse effects, it nonetheless remains a socio-medical problem and a matter of concern in our country. HIPPOKRATIA 2024, 28 (1):11-16.

Keywords: Anemia, adolescent pregnancy, iron deficiency, Roma community, immigrants

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Introduction

Approximately 23.5 million girls aged under 19 years become mothers globally each year. It is estimated that 14 % of adolescent girls globally give birth before the age of 18. Births from adolescent mothers account for 10 % of all births around the world and 23 % of maternal morbidity and mortality[1-5]. Pregnancy, especially in children under the age of 15, is associated with higher obstetric, perinatal, and maternal risks than pregnancy in adulthood[6]. In adolescent pregnancy, the risk of iron deficiency anemia (IDA) is greater, while iron intake is usually insufficient for both the young pregnant and the fetus needs[6]. Anemia in pregnancy is classified as severe if hemoglobin (Hb) is below seven g/dL, moderate if Hb is between seven and 9.99 g/dL and mild if Hb is found between 9.99 and 11 g/dL[7-10].

Adolescent pregnancy is usually unintended due to insufficient knowledge regarding safe sex. It often occurs in communities where marriage between minors is a common practice, as is the case for the Roma community, and it may be the result of sexual harassment or violence[11-13]. It is an emerging problem in developing and developed countries all around the globe. In Greece, it was estimated that in 2021, 1,929 neonates were born to adolescent mothers aged 15-19 years among 85,346 pregnant women (2.26 %), and 129 neonates to mothers aged 12-14 (0.15 %), with year-to-year fluctuations[1]. The pregnancies of Hellenic nationality adolescents are mainly concerned with but not exclusively distinct social groups such as Roma individuals and Muslims of Thrace, but also native Greeks of the general population.

Only a few data regarding adolescent pregnancy and anemia currently exist in Greece, although epidemiological data on IDA in developed and developing countries are available[14-18]. This study aimed to determine the prevalence of anemia in pregnant adolescents of Greek and immigrant origin in Northern Greece and examine their hematological characteristics and epidemiological issues.

Methods-Materials

We conducted a retrospective study of pregnant adolescents' medical records and laboratory data recorded during their first prenatal consultation. The laboratory examinations were performed from 2013 to 2022 in the Thalassaemia Prevention Unit of the Hippokration Hospital of Thessaloniki, Greece, which acts as a referral center for pregnant women from the Obstetrics-Gynecology clinics of Aristotle University of Thessaloniki and the referred pregnants from refugee "hot spots" situated in Thessaloniki. During their hospitalization, all subjects received the standards of care according to institutionally approved protocols and guidelines, and this retrospective observational study received retrospective ethical approval from the Hippokration Hospital Scientific Committee (decision No 17057/2024).

We obtained the personal and family history and retrieved the laboratory screening, including full blood count, peripheral blood smear microscopy, Hb, high-performance liquid chromatography (HPLC) electrophoresis, and ferritin levels. We utilized the Coulter ONYX hematological analyzer (Beckman Coulter Inc., Fullerton, CA, USA) to define the red cell indices (red blood cell count, Hb, packed cell volume or hematocrit, mean corpuscular volume, mean corpuscular Hb, RBC distribution width). We operated the VARIANT™ Hb Testing System (Bio-Rad Laboratories, Hercules, CA, USA) and the VARIANT II™ program, an automated cation exchange HPLC instrument for the quantification of Hbs A, F, A_2, S, and other Hbs. We carried out alkaline and acid pH electrophoresis whenever we detected abnormal Hb. We identified Hb H inclusion bodies by peripheral blood incubation with brilliant cresyl blue. We measured the serum ferritin levels applying a micro-enzyme-linked immuno-sorbent assay technique (Abbott Laboratories, Longford, County Westmeath, Ireland), performed in every sample the naked eye single tube red cell osmotic fragility test (NESTROFT), and for laboratory quality assurance, we used internal and external controls.

We defined iron deficiency and IDA according to WHO recommendations[9,10]: iron deficiency involves ferritin levels below 15 ng/mL, and maternal anemia involves Hb levels below 11 g/dL. Heterozygotes for hemoglobinopathies were informed regarding the genetic disorder and counseled. All adolescent females with anemia were prescribed iron supplementation and were provided nutrition health advice.

Values are presented as frequencies and percentages or mean ± standard deviation. We performed the statistical analysis using Microsoft Office Excel 2019 and TIBCO Statistica™, Version 8 [StatSoft (Europe) GmbH, Hamburg, Germany). After checking for normal data distribution, we applied the nonparametric test of Kruskall Wallis ANOVA to compare multiple variables, and a p-level <0.05 was considered statistically significant.

Results

Two hundred thirty-eight pregnant adolescents were screened during the 10-year study period as individuals or very few (5.6 %) as couples at the Thalassemia Prevention Unit. The data was collected during their first hospital attendance. Two hundred nine adolescents were of Greek Nationality (88.3 %) (86 Greek natives of the general population; 41.1 %, 112 members of the Roma community; 53.5 %, 11 members of the Muslim minority of Thrace; 5.2 %), and 29 (11.6 %) migrants (immigrants and refugees) from the Balkans, Middle East, and Asia (Figure 1).

We divided the study's pregnant adolescents into three groups according to the pregnancy trimester. Ninety-seven of the pregnant teens (40.7 %) were earlycomers and screened in the first trimester of pregnancy, 105 (44.1 %) in the second trimester, and 36 (15 %) attended in the third trimester of pregnancy. We report their hematological indices based on their origin in Table 1.

The mean age of the 238 pregnant women was 16.67 ± 1.67 years, and most (90 %) were aged between 15-19 years, while 10 % were between 12-14 years. The latter group was of Greek origin (nine natives/ 17 Roma). In particular, the Roma pregnant adolescents were the youngest group with a mean age of 15.6 ± 1.3 years, while the mean ages of native pregnant adolescents of the general Greek population, members of the Muslim minority of Thrace, and migrants were 17.05 ± 1.74, 17 ± 1.18, and 17.79 ± 1.1 years, respectively (Table 1). The age difference was statistically significant between the Roma group and the general Greek population ($p<0.001$) as well as between the Roma group and the immigrants ($p<0.001$).

Anemia was found in 80 pregnant adolescents (33.6 %) (Figure 2), mild anemia was the case for 24 % of the teens (76 % of anemics), and moderate anemia was the case for 8 % (24 % of anemics) while no cases of severe anemia were observed. IDA was detected in 28.5 % of the teens, and anemia due to thalassemia trait was found in 5 %. Iron deficiency was observed in 130 (54.6 %) of the adolescents (Figure 3), and hemoglobinopathies (carrier state) were detected in 20 (8.4 %) (Table 2). One of the young couples of Roma origin had both thalassemia traits and underwent genetic counseling and prenatal diagnosis during the 12th week of gestation.

Migrants and Roma had lower Hb levels in the second and third trimesters, respectively. In contrast, the lowest ferritin levels were found in Roma and Muslims of Thrace (Table 1). However, there was no significant difference between the groups concerning hemoglobin and ferritin levels.

Discussion

Adolescents are not anatomically and physiologically prepared to conceive and become mothers without risk. The trend of teenage (ages 16-19) pregnancies reported is declining but there are variations among the member states of European Union[1]. Teenage birth rate in Southern Europe is low (average 11 per 1,000) and in Greece it is 11.6 per 1,000, while the highest teenage birth rate is re-

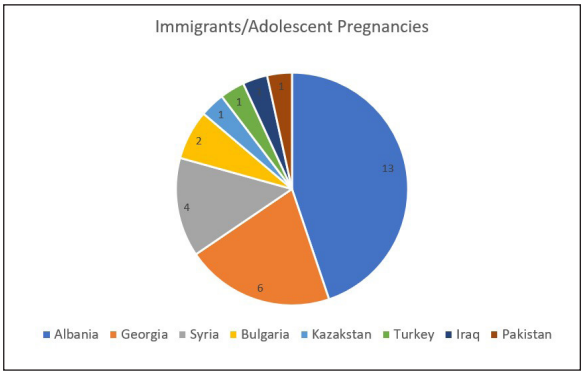

Figure 1: Distribution of pregnancies between adolescent immigrants included in this retrospective study.

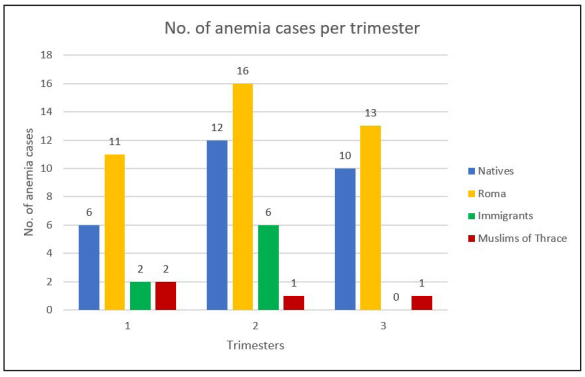

Figure 2: Number of anemia cases per trimester of pregnancy and based on adolescents' origin.

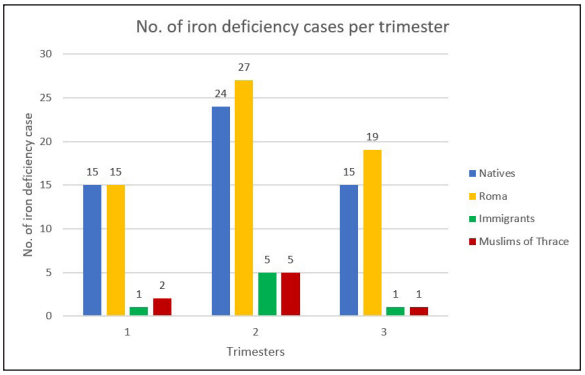

Figure 3: Number of iron-deficient adolescent pregnancies per trimester of pregnancy based on adolescents' origin.

ported in Eastern Europe, most notably in Bulgaria (46.7 per 1,000) and Romania (39.5 per 1,000)[1]. Clinics that treat cases of high-risk pregnancy exist in Greek public and university hospitals free of charge, but there is no availability of free contraceptives for young people.

The current study showed that the mean age of the pregnant was 16.67 ± 1.67 years; most (90 %) were between 15-19 years, while 10 % were between 12-14 years. As it is reported late adolescence (15 to 19 years old) has a six-fold increased risk of adolescent pregnancy[19]. There are different studies that report higher frequency of pregnancy in late adolescence[20]. Therefore, without neglecting the early adolescent group, family planning interventions should focus on female adolescents between 15-19 years old[21,22].

The social environment strongly influences pregnancy at such a vulnerable age and is usually unintended[13]. Poor education for effective contraception and early sexual initiation is a significant problem. As was expected, Greek Roma were the most (47 %) and youngest (15.9 ± 1.3 years old) adolescent pregnancies in our study.

Roma people are considered to belong to "vulnerable social groups" in the Greek state. There are gaps in our knowledge about demographics and data for this popu-

Table 1: Hematological indices according to trimester of pregnancy and origin.

	Number	Age (year)	Hemoglobin	Ferritin	MCV	MCH	RDW %
All	238 (100)	16.6 ± 1.6	11.3 ± 1.0	27.4 ± 3.9	85.8 ± 7.6	28.1 ± 2.9	14.1 ± 2.2
Natives	86 (36.1)	17.0 ± 1.7	11.2 ± 1.0	27.1 ± 3.0	85.0 ± 7.8	27.9 ± 3.0	14.1 ± 1.5
Roma	112 (47)	15.9 ± 1.3	11.3 ± 1.0	27.1 ± 27.2	86.3 ± 7.6	28.2 ± 2.7	14.6 ± 2.5
Muslims/Thrace	11 (4.6)	17 ± 1.1	11.2 ± 1.2	19.0 ± 20.0	89.5 ± 3.5	29.7 ± 2.0	13.6 ± 0.9
Immigrants	29 (12.1)	17.7 ± 1.1	11.4 ± 1.2	30.7 ± 7.7	85.0 ± 7.8	27.7 ± 3.0	14.6 ± 3.0
1st trimester	97 (40.7)						
Natives	37 (38.1)	17.37 ± 1.65	11.7 ± 0.99	37.2 ± 5.3	84.5 ± 7.1	27.8 ± 2.8	14.2 ± 1.8
Roma	44 (45.3)	15.6 ± 1.3	11.6 ± 1.0	40.2 ± 35.0	83.2 ± 8.8	27.2 ± 3.2	14.4 ± 3.7
Muslims/Thrace	4 (4.1)	16.0 ± 1.15	11.4 ± 0.8	31.0 ± 32.0	90.0 ± 0.8	29.7 ± 0.9	13.5 ± 1.0
Immigrants	12 (12.3)	18.2 ± 0.9	12.4 ± 0.88	35.3 ± 9.8	86.7 ± 5.9	28.6 ± 2.0	13.8 ± 1.6
2nd trimester	105 (44.1)						
Natives	40 (38)	16.7 ± 1.7	11.1 ± 0.88	24.4 ± 3.0	86.4 ± 7.5	28.0 ± 3.0	13.9 ± 1.39
Roma	45 (42.8)	15.9 ± 1.5	11.2 ± 0.8	23.1 ± 24.0	89.1 ± 5.1	29.2 ± 1.7	13.6 ± 1.8
Muslims/Thrace	6 (5.7)	17.5 ± 0.8	11.6 ± 0.7	14.5 ± 6.5	89.0 ± 5.2	30.1 ± 2.6	13.9 ± 0.9
Immigrants	14 (13.3)	17.2 ± 1.2	10.9 ± 1.4	28.7 ± 19.0	83.4 ± 9.3	26.8 ± 3.7	15.6 ± 3.8
3rd trimester	36 (15.1)						
Natives	9 (25)	16.7 ± 1.7	11.1 ± 0.9	24.7 ± 24.5	86.0 ± 7.9	28.0 ± 3.1	13.9 ± 1.4
Roma	23 (63)	16.5 ± 1.6	10.8 ± 1.0	11.2 ± 7.7	87.1 ± 7.1	28.4 ± 2.7	14.1 ± 1.7
Muslims/Thrace	1 (2.7)	18	8.2	5	90.8	27.7	13.3
Immigrants	3 (8.3)	18.6 ± 0.5	11.5 ± 0.3	16.6 ± 8.3	86.3 ± 1.5	29 ± 0.1	12.6 ± 0.4

Values are presented as number and percentage in brackets or mean ± standard deviation, MCV: mean cell volume, MCH: mean cell hemoglobin RDW: red blood cell distribution width (percentage).

Table 2: Hemoglobinopathies carrier state among adolescent pregnant.

Hemoglobinopathies (carrier state)	Cases, %
β (Beta) thalassemia	12 (60 %)
α (Alpha) Thalassemia	5 (25 %)
Sickle cell	1 (5 %)
Hemoglobin O-Arab	1 (5 %)
Hemoglobin Natal	1 (5 %)
Total	20/238 (8.4%)

lation group as well as the health state of Greek Roma adolescent mothers. The set of values that characterize Roma people include early marriages (ages 13-17), intermarriages, multiple pregnancies and low divorce rates[22]. The major problem for this group is the lack of pregnancy monitoring, with adverse effects on the health status of the young pregnant.

Teenage pregnancy takes a heavy toll on the parents, their offspring, and society as a whole. Underaged parents tend to abandon school and, therefore, are poorly educated and more likely to live in poverty, having been assigned adult duties before maturing[2]. All our cases had abandoned schools, which also impacts the nutritional "education" of the teenagers[19]. In the literature it is reported that a higher education level is considered as a protective factor for the repetition of adolescent pregnancy[20,21]. On the other hand, the lack of education, besides that of the elementary educational level, increases the risk of adolescent pregnancy approximately by five times[19,20].

During the last years, waves of refugees arrived in Greece, driven out of their homelands because of the ongoing crisis in the region[16,23]. Official statistics have shown that the origin as well as the motive behind their migration differs between groups of refugees, with the majority of them being either economic immigrants or asylum seekers. Currently, it is estimated that 10 % of the population in Greece are immigrants, and of them, 58 % come from Albania. According to our data, 44.8 % of pregnant migrant adolescents were of Albanian origin. The mean age of pregnant migrant adolescents was "higher". At the same time, they could use the services provided by the public sector, such as the health care system, efficiently, showing good compliance in the process.

Our data showed anemia in 33.6 % of pregnant women, with mild anemia at 24 % and moderate anemia at 8 % of teens, while no one had severe anemia. According to the World Health Organization (WHO), Global Health Observatory Data Repository/World Health Statistics, the prevalence of anemia among Greek women of reproductive age (percentage of women aged 15-49) is around 15 %. In comparison, its prevalence is estimated at around 25 % and 28 % for Albanians and women from Georgia. In the literature, it is reported in a cross-sectional study conducted by Pinho-Pombeu et al, in Brazil over nine years (2005-2013) including pregnant adolescents aged 10-19, that the prevalence of anemia was 41.27 %, of which 65.6 % were mildly anemic, 33.86 % were moderately anemic, and 0.52 % were severely anemic[4].

IDA is the most prevalent nutritional insufficiency worldwide for developed countries and a major broad-based health problem in developing and underdeveloped countries. It is also the most common type of anemia in adolescents, with a prevalence of 6 % in developed countries and 27 % in developing ones[1,7]. Anemia is the most frequent gestational complication, and approximately 75 % of all anemias diagnosed in pregnancy are due to iron deficiency. IDA in Greece has been reported as a severe public health problem, especially in infancy and childhood[18]. It is interesting that in Northern Greece, a study by Gombakis et al, which examined 3,100 children up to 15 years of age, evaluated the incidence of iron deficiency to be 14 % and IDA to be 2.9 %[24]. Anemia is also reported in 13.7 % of immigrant and refugee children in our country, according to Pavlopoulou et al, in addition to low ferritin levels which are observed in 17.3 % of migrant children (1–14 years), having in mind that underlying infections can modify low ferritin levels by increasing them to normal ones[25].

For the case of children in Thrace, a recent survey by Zikidou et al, showed that the prevalence of anemia, iron deficiency, and IDA reaches 9.41 %, 6.44 %, and 3.47 %, respectively[26]

The Muslims of Thrace had the lowest ferritin levels. We should keep in mind that the Thrace region is one of the most undeveloped Greek regions, and the reported income is the lowest in Greece, which may affect nutrition habits[27], while it is reported in the literature that socioeconomically deprived communities have higher IDA in Europe.

The main limitation of our study was that we did not have exact data about nutrition habits during pregnancy, socioeconomic status, or information regarding the body mass index of the enrolled pregnant. Moreover, an actual control group of non-pregnant adolescents was not available except for the results of our institution's Gombakis et al survey, which was conducted in the same region.

To our knowledge, there is a paucity of research about anemia in adolescent pregnancies in our country, although there are reports about perinatal outcomes and obstetric complications[28-30]. We found IDA in 28.5 % and iron deficiency in 54.6 % of adolescent pregnancies. These results pose a severe threat to adolescent pregnancies that could lead to several consequences during postpartum, both for mother and baby.

Migrants and Roma had the lowest hemoglobin levels in the second and third trimesters of pregnancy, respectively, while we found the lowest ferritin levels in Roma and Muslims; although not statistically significant, it is evident that they are in need of special care. In the first trimester, the fetus's iron intake is low. In the second and third trimesters, higher acquirements for iron exist, and poor nutrition of migrant pregnant adolescents might play a role in the decline of Hb levels.

The hemoglobinopathy carrier state detection is im-

portant and showed results similar to the general population of Greece. Greek citizens, immigrants, and legal residents use the health care system and the National Hemoglobinopathy Prevention Program[31].

Overall, pregnancy at a young age is a significant problem worldwide. Despite the knowledge about the prevalence of adolescent pregnancy and its adverse effects, it still remains a socio-medical problem and a matter of concern in our country. Health professionals should focus on this problem, consider the European Academy of Pediatrics' recommendations about adolescent pregnants[21], and support the intake of iron-rich food. IDA risk assessment tools could help identify high-risk adolescents for iron deficiency anemia[5]. If young women were educated nutritionally, this could lead to a better iron state. We should improve the sociodemographic environment, support and empower adolescent girls through education, and provide adequate prenatal care.

Conflict of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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