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THE RELATIONSHIP BETWEEN ANEMIA AND ANXIETY DISORDERS AMONG ADOLESCENT GIRLS IN BEKASI DISTRICT, INDONESIA: A CROSS-SECTIONAL STUDY
Hubungan Antara Status Anemia dengan Gangguan Kecemasan pada Remaja Putri di Kabupaten Bekasi, Indonesia: Studi Cross-Sectional

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ABSTRACT

Background: Anxiety disorders are major mental health problem in Indonesia. In addition, the prevalence of anemia in adolescents is still high. Research shows that low iron levels can increase the risk of mental disorders, including anxiety disorders. Many studies have linked anemia to depressive symptoms, but research on anxiety disorders has not been widely studied. **Purpose:** to analyze the relationship between anemia and anxiety disorders in female adolescents. **Methods:** Quantitative research with a cross-sectional design conducted in three distinguished public schools in Bekasi Regency. The number of samples was 173 female adolescents selected using purposive random sampling techniques with inclusion criteria of being willing to provide blood samples, female students aged 15-18 years, and residing in Bekasi Regency. The exclusion criteria included students who were on a diet and consuming antidepressant medications. Anemia status was measured by Quick Check HB and anxiety disorders were assessed using the Depression Anxiety Scale (DASS 42) questionnaire. **Results:** Anemia in female adolescents was found to be 31.2%. Anxiety disorders were found to be 78.6%. The Bivariate test showed that there was no relationship between anemia status and depressive disorders (p-value = 0,167). **Conclusion:** There is a relationship between anemia status and depressive disorders in adolescents.

Keywords: anemia, anxiety, mental health, hemoglobin, female adolescents

ABSTRAK

Background: Gangguan kecemasan menjadi masalah kesehatan mental utama di Indonesia. Selain itu, prevalensi risiko gangguan mental, termasuk gangguan kecemasan. Banyak studi yang mengkaitkan anemia dengan gejala depresi akan tetapi penelitian dengan gangguan kecemasan masih belum banyak diteliti. Tujuan: untuk menganalisis hubungan status anemia dengan gangguan kecemasan pada remaja. Metode: Penelitian kuantitatif dengan desain cross-sectional yang dilakukan di tiga sekolah unggulan di Kabupaten Bekasi. Jumlah sampel sebanyak 173 remaja putri yang dipilih dengan menggunakan teknik purposive random sampling dengan kriteria inklusi bersedia diambil darahnya, berusia 15-18 tahun, dan berdomisili di Kabupaten Bekasi. Kriteria eksklusi mengonsumsi obat antidepresan dan sedang menjalani diet. Status anemia diukur Quick Check HB dan ganguan kecemasan dinilai mengguunakan kuesioner Depression Anxiety Scale (DASS 42). Hasil: Remaja putri anemia ditemukan sebesar 31,2%. Gangguan kecemasan ditemukan sebesar 78,6%. Uji bivariant menunjukkan tidak ada hubungan anatara status anemia dengan gangguan depresi (p-value = 0,167). Kesimpulan: Terdapat hubungan antara status anemia dengan gangguan depresi pada remaja. Perlu adanya studi lanjutan untuk melihat hubungan antara anemia dengan kecemasan.

Kata kunci: anemia, kecemasan, kesehatan mental, hemoglobin, remaja putri

INTRODUCTION

Anemia remains a significant public health concern in Indonesia. It is a condition where the number of red blood cells or hemoglobin levels in the blood is below normal limits (Hb < 12 g/dL). The World Health Organization (WHO) reported that the prevalence of anemia among adolescent girls in Indonesia in 2019 was 31.2% (WHO, 2021). Female adolescents are particularly vulnerable to iron deficiency anemia due to menstrual iron losses. This condition can lead to multiple adverse health consequences including impaired concentration, weakened immunity, reduced physical capacity, diminished academic performance, and decreased productivity. Furthermore, anemia elevates risks for maternal mortality, preterm delivery, low birth weight, and childhood stunting (Kemenkes, 2021). Among adolescents, primary etiological factors include inadequate dietary iron intake during periods of rapid growth (Youssef *et al*., 2020). Iron functions in the development of cognitive, behavioral and motor functions (Hergüner *et al*., 2012). A clinical study reported that iron deficiency contributes to social, academic and emotional impairments (Beard, 2008).

Iron is an important component of hemoglobin. In brain development, iron plays a role in myelination of the substantia alba (white matter) (Beard, 2008) and development of neurotransmitters, including dopamine, noreepinephrine, and serotonin (Burhans *et al*., 2005). Animal studies using iron-deficient rat models revealed significant reductions in extracellular norepinephrine concentrations within the caudate putamen, attributable to altered norepinephrine transport protein expression in the locus coeruleus and basal ganglia (Anderson *et al*., 2009). Rats with significant brain iron depletion in the corpus striatum, prefontal cortex and midbrain showed decreased activity and increased anxiety-like behavior (Beard *et al*., 2002). In brief, iron deficiency anemia is significantly associated with changes in monoamine neurotransmitters and abnormal myelination of sunstansi alba that are likely related to mental disorders that appear in childhood or adolescence (Chen *et al*., 2013). Extensive research evidence suggest that iron plays an important role in neurological function and development. Iron deficiency in the brain disrupts neurotransmitter (glutamatt and γ-aminobutyric acid (GABA)) homeostasis, leading to deficits in memory, learning, and behavior as well as emotional and psychological problems (Kim & Wessling-Resnick, 2014). A study reports that low hemoglobin levels (anemia) are associated with severe depressive symptoms (Stewart & Hirani, 2012). Symptoms of low hemoglobin such as pallor, fatigue, dizziness, shortness of breath during physical activity, and heart palpitations are also frequently experienced by people with depression or anxiety disorders (Milligen *et al*., 2014).

Previous studies have shown that iron supplementation has been shown to reduce the risk of anxiety disorders. Iron plays an important role in a number of enzymes involved in the synthesis of neurotransmitters, including serotonin, dopamine, and norepinephrine which are involved in regulating mood and anxiety (Lee *et al*., 2020). Anxiety is one of the mental health problems often experienced by adolescents. Anxiety is the body's reaction to stress and can occur even when there is no threat (Parenting Montana, 2024). The World Health Organization (WHO)'s Data in 2019 showed that around 301 million people worldwide experience anxiety disorders, with around 58 million of them being children and adolescents (Fadhilah *et al*., 2024). The Indonesia-National Adolescent Mental Health Survey (I-NAMHS) reported that 26.7% of 5,664 adolescents in Indonesia aged

10-17 years had anxiety disorders. Adolescent girls have a prevalence of 6.7% higher than adolescent boys (Center for Reproductive Health *et al*., 2022).

This study aims to analyze the relationship between anemia status and anxiety disorders in adolescents. Anxiety in adolescents has a negative impact on decreased academic performance and poor interaction with peers. The long-term impact of anxiety in adolescents can affect work, marriage and the lives of adolescents in the future (Bahri and Kholidin, 2024). The urgency of this study is the prevalence of anemia in adolescents is quite high and the high number of anxiety disorders in adolescents today. This raises the suspicion of a relationship between anemia status and the incidence of anxiety in adolescents. Research linking anemia with anxiety disorders in adolescents has not been widely conducted, so the author is interested in researching this topic. This study is expected to provide a better understanding of how anemia can affect anxiety disorders and can help in designing interventions to improve adolescent mental well-being.

METHOD

Design Study

This study was a quantitative study with a cross-sectional design conducted from August to November 2024.

Population and Sample

The research location was at SMA (Senior High School) Negeri 1 Tambun Selatan, SMA Negeri 1 Cikarang Pusat, and SMA Negeri 1 Cikarang Utara. The population in this study were all female students in the three schools. The minimum sample in this study was 162 people taken based on the purposive random sampling technique. Schools were selected purposively because they are leading public schools in Bekasi Regency with A accreditation. Leading schools have quite high academic competition which can cause students to easily experience stress (Desi *et al*. 2020). The research sample was selected randomly from a list of all female students in each school who met the inclusion and exclusion criteria. The sample inclusion criteria were domiciled in Bekasi Regency, aged 15-18 years and willing to take part in the research. The sample exclusion criteria were female students who were taking antidepressants and were not on a diet. Female students who met the inclusion and exclusion criteria were given an explanation of the research process. Every student who was willing to participate in the research was asked to sign an informed consent.

Data Collection and Data Analysis

The instruments used in this study were Easy Touch GCHB Kemenkes RI AKL No: 20101710009 to examine anemia levels and the Depression Anxiety and Stress Scales (DASS-42) questionnaire to assess anxiety disorders in adolescents. The DASS-42 questionnaire consists of 14 questions about stress, 14 questions about anxiety, and 14 questions about depression. Questions about anxiety were numbered 2, 4, 7, 9, 15, 19, 20, 23, 25, 28, 30, 36, 40, and 41. The way to calculate the anxiety score was by adding up the scores of the 14 questions about anxiety. The DASS-42 questionnaire has anxiety validity with a Cronbach alpha value of 0.866 and a reliability of 0.822 (Shayan et al., 2021). Data was categorized as anemia if Hb levels were <12 gr/dl and anxiety if anxiety scores were >7. Peripheral blood examination using Easy Touch GCHB was carried out by researchers assisted by enumerators. Data collection was carried out by trained enumerators. The DASS-42 questionnaire was printed and filled out by research participants with the assistance of enumerators. Data analysis was carried out

using SPSS. Data processing was carried out using the chi square test.

Ethical Clearance

This study has received ethical approval with the number B.LPPM-UHB/937/09/2024 from the health ethics research commission of Harapan Bangsa University.

RESULT

This study was attended by 173 female adolescents aged 15 to 16 years. The table below showed that most respondents were 16 years old (59%). Respondents who had anemia were 54 people (31.2%). Respondents who had anxiety disorders were 136 people (78.6%).

Table 1. Characteristic Distribution of Respondent

Variable	n	%
Age		
15	4	2,3
16	102	58,9
17	61	35,3
18	6	3,5
Anemic Status		
Anemia	54	31,2
Normal	119	68,8
Anxiety Level		
Anxiety	136	78,6
Normal	37	21,4

Table 2. Relationship between Anemic Status and Anxiety Level

Variable	Anxiety		Normal		p-value
	n	%	n	%	
Anemia	39	72,2	15	27,8	0,167
Normal	97	81,5	22	18,5	

Based on the Table 2, it was known that 72.2% of female adolescents who were categorized as anxious in the anemia group were anxious, while in the non-anemic group, more were anxious, namely 81.5%. The prevalence ratio of 81.5%: 72.2% = 1.12 times more people have anxiety disorders in the non-anemic group compared to the anemic group. Thus, anxiety was more common in non-anemic female adolescents. However, data analysis using the chi-square test obtained a p-value of 0.167 (p> 0.05) which means that there was no significant relationship between anemia and anxiety in adolescents.

DISCUSSION

This study aimed to analyze the relationship between anemia status and anxiety disorders in female adolescents. This study showed that 31.2% of female adolescents have anemia and 78.6% of adolescents experienced anxiety disorders. However, in contrast to the theory, anxiety disorders in this study were more common in female adolescents who were not anemic. The prevalence of anemia in this study was not significantly different from the 2024 screening results in 12 senior high schools in Bekasi Regency, which reported that 35.8% of adolescents had anemia (Asmawati *et al.*,

2024). The prevalence of anemia among female adolescents was attributed to the physiological effects of menstruation. Iron is a vital nutrient that plays a crucial role in the prevention of anemia. Anemia, also known as a lack of healthy red blood cells, can be caused by insufficient iron levels in the body (Setiawan *et al*., 2023). The prevalence of anxiety disorders in the study population was found to be 78.6%. Anxiety is a feeling of worry or fear in response to an anticipated threat about something that has not yet occurred in the future (American Psychiatric Association, 2013). Anxiety disorders have been reported as a major mental health issue among adolescents in Indonesia (Center for Reproductive Health *et al*., 2022). This aligned with the findings of this study, which showed that 78.6% of the 173 respondents experienced anxiety disorders.

The Center for Health and Safety Culture stated that adolescents are at a stage of learning to make life decisions while facing academic performance and pressure (Parenting Montana, 2024). Previous research has shown that adolescent anxiety is associated with low life satisfaction, high chronic stress, poor coping skills, limited adaptability, and even a risk of poor educational achievement (Pickering *et al*., 2020). As indicated by the findings of Pickering *et al*. (2020), females demonstrated a higher propensity to manifest anxiety disorders in comparison to males. This phenomenon can be attributed to the higher levels of estrogen observed in women compared to men. Estrogen has been demonstrated to exert a significant impact on serotonin (5-HT) levels within the brain. Previous studies have shown that estrogen increases serotonin, which plays a crucial role in regulating mood. Additionally, estrogen has been observed to inhibit GABA receptors, the brain's primary inhibitory system responsible for suppressing aversive stimuli (Assyifa *et al*., 2023). In addition to

being more susceptible to anxiety disorders, female subjects demonstrated a heightened propensity for anemia, a condition precipitated by the menstrual cycle.

The bivariate test results showed no significant relationship between anemia status and anxiety disorders. Consistent with this study, research in the Netherlands reported no association between anxiety disorders and hemoglobin levels or anemia status. A possible explanation was that anxiety was not solely caused by low iron levels, which play a role in dopamine and serotonin regulation for mood but was also influenced by the subject's overall health status (Milligen *et al*., 2014). Moreover, measuring anemia status using only hemoglobin levels may not be sufficient to prove correlation between anemia and anxiety disorders. Emotional states can be highly fluctuating, whereas changes in hemoglobin levels take time to adjust according to the lifespan of red blood cells for approximately 120 days.

These findings contradicted research conducted on Gen Z adolescents at Malang Ministry of Health Polytechnic of Health, which reported a significant effect of anemia on adolescent anxiety (Yuliawati *et al*., 2024). This statement aligns with a study in Turkey, which found that adolescents with iron deficiency anemia had higher anxiety levels compared to a healthy control group (Tekin *et al*., 2022). The relationship between anemia and anxiety may be due to emotional dysregulation resulting from iron deficiency (Suveg *et al*., 2010). Additionally, Lozoff *et al*. (2000) revealed that iron deficiency anemia in infancy was associated with a higher likelihood of anxiety disorders later in life (Lozoff *et al*., 2000). A clinical epidemiological study reported that iron deficiency anemia significantly increased the risk of anxiety disorders among children and adolescents, with an OR of 2.17 (95% CI =

1.49–3.16) (Chen *et al*., 2013). This means that children and adolescents with iron deficiency anemia were 2.17 times more likely to develop anxiety disorders.

Research in Libya also showed that anxiety disorders were more common in individuals with low serum ferritin levels (Elfituri *et al*., 2025). Serum ferritin levels reflected iron stores used by body tissues, including neuronal cells. Iron functions as a coenzyme for tyrosine hydroxylase in dopamine and norepinephrine synthesis, and for tryptophan hydroxylase in serotonin synthesis (Uygun *et al*., 2022). The correlation between low ferritin levels and anxiety disorders may be attributable to iron's influence on neurotransmitter regulation. An imbalance in neurotransmitters has been demonstrated to induce heightened anxiety and stress responses (Printz, 2017). A distinguishing feature of the present study is the utilization of blood hemoglobin levels for the assessment of anemia, a methodological approach that differs from previous studies. However, low hemoglobin levels are not solely caused by iron deficiency. Low hemoglobin levels in the body can also result from deficiencies in folate and vitamin B12 (Kurniasih, 2022).

Some limitations of this study include the relatively small sample size and the possibility that anemia was influenced by poor dietary habits. A strength of this study is the scarcity of research linking anemia status to anxiety disorders. This study focused on the mental health risks of anemia in adolescents. Further research is needed to analyze the severity of anxiety disorders, as assessed by mental health professionals such as psychologists or psychiatrists.

CONCLUSION AND SUGGESTION

This study showed that 31.2% of female adolescents had anemia, while 78.6% experienced anxiety disorders. The present study was unable to ascertain a significant relationship between anemia and anxiety disorders among female adolescents in the Bekasi Regency.

For future research, additional independent variables such as socioeconomic status, lifestyle, parental education, family history of anxiety disorders, or sleep quality which may influence anxiety disorders should be included. Further studies are also required to examine the relationship between anemia and anxiety. Furthermore, the assessment of hemoglobin levels can be enhanced through the implementation of laboratory tests, thereby ensuring a more precise measurement.

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AUTHOR CONTRIBUTION

The author was responsible for data collection, processing, and analysis, as well as literature review and manuscript writing.

CONFLICT OF INTEREST

The authors declared no conflict of interest in this research.

REFERENCES

American Psychiatric Association. (2013). Diagnostic and statistical manual of

mental disorders (5th ed.). American Psychiatric Association.

Anderson, J. G., Fordahl, S. C., Cooney, P. T., Weaver, T. L., Colyer, C. L., & Erikson, K. M. (2009). Extracellular norepinephrine, norepinephrine receptor and transporter protein and mRNA levels are differentially altered in the developing rat brain due to dietary iron deficiency and manganese exposure. *Brain Research, 1281*, 1–14. https://doi.org/10.1016/j.brainres.2009.05.050

Asmawati, S., Novita, A., & Supriadinata, S. (2024). Evaluasi implementasi program pencegahan stunting pada balita di Wilayah Puskesmas di Kabupaten Bekasi Jawa Barat. *Journal of Public Health Innovation, 4*(2), 288–296. https://doi.org/10.34305/jphi.v4i02.1140

Assyifa, F., Fadilah, S., Wasilah, S., Fitria, Y., & Muthmainah, N. (2023). Hubungan Jenis Kelamin Dengan Tingkat Kecemasan Pada Mahasiswa Pskps Fk Ulm Tingkat Akhir Dalam Pengerjaan Tugas Akhir. *Homeostasis, 6*(2), 333–338.

Bahri, Marlistiani, and Farid Imam Kholidin. 2024. Terjebak Dalam Ketakutan: Kualitatif Tinjauan Sistematis Kecemasan Sosial Pada Kehidupan Remaja. *Al-Musyrif: Jurnal Bimbingan Dan Konseling Islam, 7*(1), 98-110. https://doi.org/10.38073/almusyrif.v7i1.1750.

Beard, J. L. (2008). Why Iron Deficiency Is Important in Infant Development1–3. The Journal of Nutrition, 2534–2536.

Beard, J. L., Erikson, K. M., & Jones, B. C. (2002). Neurobehavioral analysis of developmental iron deficiency in rats.

Behavioural Brain Research, 134, 517–524.

Burhans, M. S., Dailey, C., Beard, Z., Wiesinger, J., Murray-Kolb, L., Jones, B. C., & Beard, J. L. (2005). Iron deficiency: Differential effects on monoamine transporters. *Nutritional Neuroscience, 8*(1), 31–38. https://doi.org/10.1080/10284150500047070

Center for Reproductive Health, University of Queensland, & Johns Bloomberg Hopkins School of Public Health. (2022). National Adolescent Mental Health Survey (I-NAMHS) Laporan Penelitian. Pusat Kesehatan Reproduksi.

Chen, M.-H., Su, T.-P., Chen, Y.-S., Hsu, J.-W., Huang, K.-L., Chang, W.-H., Chen, T.-J., & Bai, Y.-M. (2013). Association between psychiatric disorders and iron deficiency anemia among children and adolescents: a nationwide population-based study. *BMC Psychiatry, 13*(1), 161. https://doi.org/10.1186/1471-244X-13-161

Desi, D., Felita, A., & Kinasih, A. (2020). Gejala depresi pada remaja di sekolah menengah atas. *Care: Jurnal Ilmiah Ilmu Kesehatan, 8*(1), 30-38. https://doi.org/10.33366/jc.v8i1.1144

Fadhilah, G. Z. N., Saputra, R. A., & Wibowo, A. H. (2024). Deteksi Tingkat Gangguan Kecemasan Menggunakan Metode Random Forest. *Jurnal Teknik, 13*(1). http://dx.doi.org/10.31000/jt.v13i1.10648

Elfituri, Z., Alshwesh, R., Dardar, H., Alshibani, Y., & Koubas, A. (2025). Exploring the Potential Relationship between Low Serum Ferritin Levels and Mental Illness in Psychiatric

Patients. *Attahadi Medical Journal, 2*(1), 5–7. https://doi.org/10.69667/amj.25102

Hergüner, S., Keleşoğlu, F. M., Tanıdır, C., & Çöpür, M. (2012). Ferritin and iron levels in children with autistic disorder. *European Journal of Pediatrics, 171*(1), 143–146. https://doi.org/10.1007/s00431-011-1506-6

Kim, J., & Wessling-Resnick, M. (2014). Iron and mechanisms of emotional behavior. *The Journal of Nutritional Biochemistry, 25*(11), 1101–1107. https://doi.org/10.1016/j.jnutbio.2014.07.003

Kurniasih E. Hubungan Asupan Zat Gizi Makro (Protein, Lemak, Karbohidrat) dan Zat Gizi Mikro (Zat Besi, Asam Folat, Vitamin B12) dengan Kadar Hemoglobin Atlet Futsal Putri Universitas Pendidikan Indonesia Bandung. *Jurnal Gizi dan Kesehatan Manusia. 2*(1), 28-35.

Lee, HS., Chao, HH., Huang, WT. et al. Psychiatric disorders risk in patients with iron deficiency anemia and association with iron supplementation medications: a nationwide database analysis. *BMC Psychiatry 20*, 216 (2020). https://doi.org/10.1186/s12888-020-02621-0

Milligen, B. A. L., Vogelzangs, N., Smit, J. H., & Penninx, B. W. J. H. (2014). Hemoglobin levels in persons with depressive and/or anxiety disorders. *Journal of Psychosomatic Research, 76*(4), 317–321. https://doi.org/10.1016/j.jpsychores.2014.01.004

Lozoff, B., Jimenez, E., Hagen, J., Mollen, E., & Wolf, A. W. (2000). Poorer Behavioral and Developmental Outcome More Than 10 Years After Treatment for Iron Deficiency in Infancy. *Pediatrics, 105*(4), 1–11. https://doi.org/10.1542/peds.105.4.e51

Pickering, L., Hadwin, J. A., & Kovshoff, H. (2020). The Role of Peers in the Development of Social Anxiety in Adolescent Girls: A Systematic Review. *Adolescent Research Review, 5*(4), 341–362. https://doi.org/10.1007/s40894-019-00117-x

Printz, C. (2017). Anxiety and depression may contribute to an increased risk of death in some cancers. *Cancer, 123*(13), 2389–2389. https://doi.org/10.1002/cncr.30812

Kemenkes. (2021, January 25). *Remaja Sehat Komponen Utama Pembangunan SDM Indonesia*. https://sehatnegeriku.kemkes.go.id/baca/umum/20210125/3736851/remaja-sehat-komponen-utama-pembangunan-sdm-indonesia/

Muhammad Irwan Setiawan, Cahyani, L. I., Mulya, F. A., Safitri, I., Isnawati Isnawati, Pinkan, L. C., … Puspitasari, Y. (2023). Penyuluhan Kepada Remaja Putri Untuk Meningkatan Pengetahuan Dan Sikap Terhadap Konsumsi Tablet Tambah Darah. *Jurnal Pengabdian Ilmu Kesehatan, 3*(1), 124–132. https://doi.org/10.55606/jpikes.v3i1.1662

Shayan, N. A., Niazi, A.-R., Waseq, A. M., & Özcebe, H. (2021). Depression, Anxiety, and Stress Scales 42 (DASS-42) in Dari-Language: Validity and Reliability Study in Adults, Herat, Afghanistan. *Bezmialem Science, 9*(3), 356–362. https://doi.org/10.14235/bas.galenos.2020.4250

Stewart, R., & Hirani, V. (2012). Relationship Between Depressive Symptoms, Anemia, and Iron Status in Older Residents From a National Survey Population. *Psychosomatic Medicine, 74*(2), 208–213. https://doi.org/10.1097/PSY.0b013e3182414f7d

Suveg, C., Morelen, D., Brewer, G. A., & Thomassin, K. (2010). The Emotion Dysregulation Model of Anxiety: A preliminary path analytic examination. *Journal of Anxiety Disorders, 24*(8), 924–930. https://doi.org/10.1016/j.janxdis.2010.06.018

Tekin, U., Köker, S. A., & Uçar, H. N. (2022). Comparison of Anemic and Non-anemic Iron-deficient Adolescents in Terms of Psychosocial Aspects and Quality of Life: A Case Control Study. *Bakirkoy Tip Dergisi / Medical Journal of Bakirkoy, 18*(2), 238–246. https://doi.org/10.4274/BMJ.galenos.2022.2021.12-15

Parenting Montana. (2024). *Stress and Anxiety for Your 17-Year-Old*. https://toolsforyourchildssuccess.org/tools/17-years-old/stress-and-anxiety/

Uygun, S. D., Goker, Z., Karaca Kara, F., & Üneri, Ö. (2022). Serum Vitamin B12, Folate, and Ferritin levels in Children and Adolescents with Anxiety Disorders; Controlled Study. *Van Medical Journal, 29*(3), 260–266. https://doi.org/10.5505/vtd.2022.95867

WHO. (2021). *WHO Global Anaemia estimates*. https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children

Youssef, M. A. M., Hassan, E. S., & Yasien, D. G. (2020). Effect of iron deficiency anemia on language development in preschool Egyptian children. *International Journal of Pediatric Otorhinolaryngology, 135*, 110114. https://doi.org/10.1016/j.ijporl.2020.110114

Yuliawati, D., Putri, V. N., & Salsabila, S. C. (2024). Pengaruh Anemia terhadap Kesehatan Mental pada Remaja Gen Z Poltekkes Kemenkes Malang. *Jurnal Studi Keperawatan, 5*(2), 1–4.