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PREVALENCE OF ANAEMIA AND ASSESSMENT OF KNOWLEDGE, ATTITUDES, PRACTICES AND CONCERNS ABOUT ANAEMIA AMONG FEMALE STUDENTS IN UNIVERSITY OF PAPUA NEW GUINEA

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ABSTRACT:
Anaemia is among the major public health problems in most resource limited countries. It occurs when the haemoglobin (Hb) concentration in the blood is lower than the recommended WHO cut-off values. Some recent studies revealed that most female university students had an appropriate level of knowledge about anaemia, but showed a lack of positive attitude and good practices towards preventing it. The aims of this study were to determine the prevalence of anaemia and to evaluate the Knowledge, Attitudes, Practices and Concerns (KAPC) about anaemia among female students in the University of Papua New Guinea (UPNG). In this institution-based cross-sectional observational descriptive study, 217 female students consented to participate. The Point-of-Care HemoCue® Hb 301 was used to determine the haemoglobin levels of the consented female students. A self-designed pretested questionnaire was used for data collection. The self-administered questionnaire was designed to assess the Knowledge, Attitudes, Practices, and Concerns (KAPC) of female students about anaemia. Of the 217 students only 169 (77.9%) gave consent for measurement of their Hb level. The mean Hb level for all the students was 11.7 ± 1.92 g/dL, the range was 8.3 to 15.4 g/dL. Mild to moderate status of anaemia was prevalent among 45.6% (77/169) of the students. This indicates severe public health significance. The knowledge, attitudes, practices and concerns scores were 74.4%, 85.0%, 77.8% and 81.4% respectively. The scores indicated fair knowledge, good attitudes, practices and concerns about anaemia. A statistically significant relationship was found between Knowledge and Attitudes (p-value= 0.000); Knowledge and Practices (p-value= 0.000); Attitudes and Practices (p-value= 0.000); Attitudes and Concerns (p-value= 0.000). There were no statistically significant differences between the KAPC scores for the anaemic and non-anaemic students.

Keywords: Anaemia, university, female students, knowledge, attitudes, practices, concerns

INTRODUCTION:

According to the World Health Organization (WHO), United Nations Children's Fund (UNICEF), Centres for Disease Control and Prevention (CDC) and other international agencies, anaemia is a condition in which the number of red blood cells (consequently their oxygen-carrying capacity) is insufficient to meet the daily physiologic needs of the body [1, 2]. This occurs when the haemoglobin (Hb)

concentration in the blood is lower than the recommended WHO cut-off values [1, 2]. It is a significant aspect of malnutrition that affects women of reproductive age (15-49 years). Anaemia has multiple causes, both nutritional (vitamin and mineral deficiencies) and non-nutritional (infections, infestations and genetic) that may coexist. Anaemia is associated with poor cognitive and motor development, and work capacity [1-4]. It is considered to be among the top ten contributors to the global burden of diseases [1 – 4].

Recent reports by WHO indicated that in 2019, the global anemia prevalence was increased to 29.9% (95% uncertainty interval (UI) was 27.0% to 32.8%) in women of reproductive age, equivalent to over half a billion women aged 15-49 years. The prevalence was 29.6% (95% UI was 26.6% to 32.5%) in non-pregnant women of reproductive age, and 36.5% (95% UI was 34.0% to 39.1%) in pregnant women [5 – 8]. Reducing the prevalence of anaemia is a crucial part of achieving the Sustainable Development Goals (SDG) Target 2.2 as it directly impacts the health and well-being of women of reproductive age and their children [5].

Several authors have indicated that anaemia can have a significant impact on the health, academic performances, work productivity and physical activity levels among female university or adolescent students [9 – 15]. Findings in a recent study revealed that most female university students had an appropriate level of knowledge about anaemia, but showed a lack of positive attitude and good practices towards preventing it [12]. Other studies reported variation in the attitudes among female students towards anaemia [9 – 15]. They reported that most female students had appropriate knowledge but lacked positive attitudes and good practices towards preventing anaemia.

These reports underscore the importance of implementing awareness and educational programs to improve the knowledge of female students regarding consumption of adequate nutrition including micronutrients to enhance their haemoglobin level and reduce the prevalence of anaemia [13 – 15].

Recent findings indicated that poor knowledge, attitude and practices (KAP) regarding anaemia prevention can be classified as risk factors, because they contribute toward poor dietary habits and negligence in prevention activities [14, 15].

Available data on the prevalence of anaemia in Papua New Guinea (PNG) is very scanty. The limited data on anaemia among women were mainly from studies on women attending clinics [16 – 22]. One of the major reasons was because of the difficulty of obtaining blood from “apparently healthy” women in the households. Reports from most of the studies indicated a high prevalence of anaemia among women.

The report from the 2005 National Nutrition Survey (NNS 2005) indicated that the national mean Hb level was 12.6 ± 1.9 g/dL. Just over one-third of the women were anaemic [23]. Age and education were not significantly associated with anaemia prevalence or mean haemoglobin levels among non-pregnant women of childbearing age. Furthermore, using the WHO criteria for defining anaemia as a public health problem, the public health significance of the prevalence of anaemia among non-pregnant women of child bearing age was regarded as moderate [23]. The report also stated that more research is needed to assess the prevalence of anaemia among non-pregnant women of childbearing in PNG.

In a recent study carried out in the National Capital District (NCD) PNG, the authors reported that mild to moderate anaemia was prevalent among 28% of the non-pregnant women. This indicates moderate public health significance among the non-pregnant women at the time of the study [24].

Currently, there are no published data on the prevalence of anaemia among female university students in Papua New Guinea. The current proposal of the WHO is to significantly reduce the prevalence of anaemia among women and children by 2025 [25]. The PNG National Health Plan also indicated the need to reduce the prevalence of anaemia among vulnerable groups in the population [26]. Therefore, the need to assess the prevalence of anaemia among the women of childbearing age cannot be overemphasized.

This study was prompted by the apparent lack of data on the prevalence of anaemia and the knowledge, attitude, practices and concerns (KAPC) about anaemia among female students in the University of Papua New Guinea (UPNG).

Aims and Objectives:

The aims of this study were to determine the prevalence of anaemia and to evaluate the Knowledge, Attitudes, Practices and Concerns (KAPC) about anaemia among female students in the University of PNG (UPNG). The objectives were to use the data obtained to answer the questions: What is the level of knowledge and awareness about anaemia as a public health problem among female students in UPNG? What are the attitudes and practices of these students towards anaemia and how concerned are they about the consequences of anaemia?

METHODOLOGY:

Study sites: This study was carried out in the University of Papua New Guinea (UPNG), which is the premier university in Papua New Guinea (PNG). The UPNG is made up of five schools. Four of the five schools (School of Natural and Physical Sciences, School of Humanities and Social Sciences, School of Business and Public Policy and School of Law) are located in the Waigani campus; the School of Medicine and Health Sciences is located in the Taurama

campus. Students in the Taurama campus complete their foundation year in the Waigani campus before moving over to Taurama to pursue the degree in medicine, dentistry or the health sciences. Post-basic nurses from various hospitals around the country are also enrolled in the Taurama campus to complete the nursing degree.

The study subjects were consented female students registered in both UPNG campuses. The subjects were randomly selected among participants that volunteered. The study was conducted from May to September 2023.

Study design and sampling: This was an institution-based cross-sectional observational descriptive study. The target population consisted of registered female students, whether residential or non-residential, in both UPNG campuses. All subjects were selected randomly through a convenient selection of participants that volunteered.

Sample size: The sample size was calculated based on the assumption that the probability of having a good knowledge, positive attitudes, good practices and concerns about anaemia was about 50% at confidence level of 95%, with 5% precision and predicted non-response rate of 15%. The calculated sample size obtained was 300 female students. This sample size was considered adequate for a mini-survey with limited resources.

Inclusion criteria: The students were informed about the nature of the study and that their participation was entirely voluntary. All consenting female students were eligible to participate in the study.

Determination of Hb level: The Point-of-Care HemoCue® Hb 301 was used to determine the haemoglobin levels of consented female students. The standardized procedure involved ensuring warm and relaxed hands, selecting appropriate fingers for sampling, cleaning and puncturing the fingertip with a single use disposable lancet, then filling the HemoCue 301 microcuvette with a drop of whole blood. The process, which adhered to stringent hygiene and quality control was used to determine the Hb level for each of the consented participants.

Exclusion criteria for assay of Hb level: Students that do not give consent and those that have been sick with malaria or having high fever in the last five days were excluded from the study.

Data collection using a questionnaire: A self-designed pretested questionnaire was used for data collection. The self-administered questionnaire was designed to assess the Knowledge, Attitude, Practices, and Concerns (KAPC) of female students about anaemia. The questionnaire contained two sections (A and B). Section-A contained the respondents' socio-demographic profile. Section-B was to elicit

information about the respondent's Knowledge of anaemia and explored their Attitude, Practices and Concerns regarding anaemia.
The questionnaire was pre-tested among 20 randomly selected students. Feedback and suggested changes were provided orally and in writing. The feedback was used to improve the questionnaire.

Ethical Clearance: Approval for this project was obtained from the Ethical and Research Grant Committee of the SMHS, UPNG. Hb level was obtained by finger stick of participants after obtaining their informed consent. Informed consent was obtained from each of the female students. Participant consent was documented on each participant interview form. This consent procedure was approved by the ethics committees.

Statistical analysis and interpretation of the data: Before the statistical analysis, completeness of the data was evaluated. The completed questionnaires were collected, coded and entered into Microsoft Excel Spreadsheets (version 2016) for analysis. Further statistical data analysis was performed using IBM Statistical Package for the Social Sciences (IBM SPSS) version 22. Descriptive and inferential statistics were used to analyse the data obtained and make inferences about the study population. Descriptive statistics were used to analyse demographic and anthropometric characteristics such as age, height and weight. The mean, standard deviation (SD), range and median, were calculated for quantitative parameters.

Assessment of Anaemia: Anaemia was indicated when the Hb concentration falls below the WHO recommended cut-off values for Hb concentration for non-pregnant women of child-bearing age. Thus, the WHO guidelines and cut-off points were used for the interpretation of the data [1 – 3]. For non-pregnant women, Hb levels below 12.0 g/dl indicate anaemia. Hb levels of 11.0 to 11.9 g/dl, 8.0 to 10.9 g/dl and below 8.0 g/dl indicate mild, moderate and severe anaemia, respectively. Anaemia was classified as a mild, moderate or severe public health problem when the prevalence was 5.0 to 19.9%, 20.0 to 39.9% and greater than or equal to 40.0%, respectively [1 – 3].

Interpretation of the KAPC scores: The number of correct answers for Q 6 to Q 15, Q 16 to Q 25, Q 26 to Q 35, and Q 36 to Q 45 were used to calculate the Knowledge, Attitude, Practices and Concerns scores, respectively. The knowledge score for each participant was determined by allotting a score of '1' to correct responses and '0' (zero) to incorrect and 'don't know' responses. The attitude, practices, and concern scores were obtained by assigning points to responses on the modified 3-point Likert scale (Agree, Disagree, Neither agree nor disagree).

To obtain the score for each of the sections (KAPC), the number of correct answers obtained was expressed as percentage of the total number of correct answers for the section. The questions in each of the sections (KAPC) used for calculating the scores are highlighted on the questionnaires.

The criteria proposed by Hasan et al [27] were used for the categorization of the KAPC levels of the respondents. Score ≥ 75% was categorized as Good. Scores between 74 – 65% were categorized as Fair. Scores below 64% were categorized as Poor.

RESULTS:

Demographic characteristic of the female students:

Of the 250 questionnaires distributed among the female students, 217 were completed and used for analysis (response rate of 86.8%). They were all full time students resident in the National Capital District (NCD) at the time of this study. The mean age (Mean ± STD) of all the students was 23.5 ± 4.45 years, age range was 18.0 to 45.0 years and the 95% confidence interval (95% CI) was 23.0 to 25.0 years and their median age was 22.0 years.

Distribution of the students according to age groups shows that 6.9% (15/217) were in the 15 to 19.9 years age group, 76.0% (165/217) were in the 20 to 24.9 years age group, 8.3% (18/217) in the 25 to 29.9 years age group and 8.8% (19/217) in the over 30 years age group.

The mean height of the students was 1.60 ± 0.07 meters, range was 1.46 to 1.80 meters and median height was 1.60 meters. The mean weight was 62.0 ± 11.3 kg, range was 40.0 to 105.0 kg and median weight was 62.0 kg. The mean BMI was 24.2 ± 4.3 kg/m2, the range was 18.8 to 32.4 kg/m2 and the median was 25.6 kg/m2.

Haemoglobin (Hb) levels of female students:

Of the 217 students only 169 (77.9%) gave consent for measurement of their Hb level. The mean Hb level for the consented students was 11.7 ± 1.92 g/dL, the range was 8.3 to 15.4 g/dL, the 95% CI was 11.3 to 12.1 g/dL, and the median was 12.0 g/dL.

According to the WHO guidelines and cut-off points for interpretation of the Hb data, the results show that Hb level was normal (Hb ≥ 12.0 g/dL) among 54.4% (92/169) of students, mild anaemia (Hb: 11.0 to 11.9 g/dL) was prevalent among 16.0% (27/169), moderate anaemia (Hb: 8.0 to 10.9 g/dL) was prevalent among 24.9% (42/169) and severe anaemia (Hb < 8.0 g/dL) was prevalent among 4.7% (8/169) of the students that participated in this study.

Thus, of the 169 female students that participated in this study 45.6% (77/169) were anaemic. This indicates severe public health significance.

For further analysis of the data, the 169 students were separated into two groups. Those that were anaemic (45.6%) and those that were not anaemic (54.4%) at the time of the study. The

mean height of the anaemic group was 1.59 ± 0.08 meters and median height was 1.6 meters. The mean weight was 61.1 ± 12.21 kg and the median weight was 63.0 kg. For those in the non-anaemic group, the mean height was 1.59 ± 0.06 meters and median height was 1.58 meters. The mean weight was 64.54 ± 12.42 kg and median weight was 62.35 kg. There was not statistically significant difference between the corresponding heights and weights of the students in both groups.

Analysis of the questionnaires:

In response to the question 4 (Q 4) "*Have you been ever diagnosed with anaemia?*" A total of 81.1% (176/217) of all the students said "No". The students were then asked Q 5 "*Does anyone in your family have anaemia?* 60.4% (131/217) of the students responded in the negative and 32.2% (70/217) said "don't know". The results indicate low prevalence of anaemia among the family members of the students that participated in this study.

Knowledge (K): The questions in this section (Q 6 to Q 15) were to assess the knowledge and awareness of the students about anaemia and the associated problems. The questions and responses are presented in Table 1. The modified 3-point Likert Scale was used to interpret the responses: Agree, Disagree, Neither agree nor disagree.

When asked if they know about anaemia (Q 6), 84.8% of the students answered in the affirmative. In response to the next question (Q 7) "*Is anaemia a serious health problem?*" 77.4% responded in the affirmative.

In Q 8, the students were asked to indicate if they agree or disagree with each of the five options listed that represents the common meanings of anaemia. A total of 92.6% agreed with "decrease of iron in blood"; 86.2% agreed with "lack of red blood cells"; 67.7% agreed with "Hb levels below 12 g/L".

The next question (Q 9) listed some of the common causes of anaemia. The students were requested to indicate if they agree or disagree with each of the options listed. A total of 93.5% agreed with "Iron deficiency"; 90.8% agreed with "Decreased dietary Iron intake"; 70.1% agreed with "Folic acid deficiency"; 77.4% agreed with "Heavy menstrual bleeding". The other results are presented in Table 1.

The follow up question (Q 10) listed the common types of anaemia. Students were asked to indicate if they agree or disagree with each of the options. 88.9% agreed with "Iron deficiency anaemia"; 59.9% agreed with "Vitamin deficiency anaemia"; 60.8% agreed with "Megaloblastic anaemia"; 74.6% agreed with "Sickle cell anaemia'; 57.1% agreed with "Thalassemia". The other results are presented in Table 1.

Some common symptoms of anaemia were listed in Q 11 and students were asked to indicate if they agree or disagree with each of the symptoms. 94.0% agree that "Pale skin colour" was a symptom; 95.4% agreed that "Fatigue or Weakness" was a symptom; 58.5%

agreed that "Decreased appetite" was a symptom. Q 12 listed some of the effects of anaemia. Students were requested to state if they agree or disagree with each of the options listed. The responses are presented in Table 1. 72.4% agreed that anaemia can cause "Decrease in growth and development". 90.3% agreed that anaemia can cause "Decrease in working capacity". 76.5% agreed that anaemia causes "Poor cognitive and motor development outcomes in children". The responses to the other knowledge questions (Q 13 to Q 15) are presented in Table 1.

Table 1: Knowledge (K): Responses to knowledge questions.

				RESPONDENTS (N = 217)
Q 6	Do you know about anaemia?		Yes	84.8% (184)
			No	6.9% (15)
			Don't know	8.3% (18)
Q 7	Is anaemia a serious health problem?		Yes	77.4% (168)
			No	3.7% (8)
			Don't know	18.9% (41)
Q 8	**We have listed some of the common meanings of anaemia. Please indicate, in each case, if you agree or disagree with the statement below about anaemia.**			
	i.	Decrease of Iron in blood	Agree	92.6% (201)
			Disagree	1.4% (3)
			Neither agree nor disagree	6.0% (13)
	ii.	Increase of Iron in blood	Agree	1.8% (4)
			Disagree	83.4% (181)
			Neither agree nor disagree	14.7% (32)
	iii.	Lack of red blood cells	Agree	86.2% (187)
			Disagree	6.9% (15)
			Neither agree nor disagree	6.9% (15)
	iv.	Hb levels <12 g/dL	Agree	67.7% (147)
			Disagree	8.3% (18)
			Neither agree nor disagree	24.0% (52)
	v.	Hb level below WHO recommended cut-off point	Agree	67.7% (147)
			Disagree	2.8% (6)
			Neither agree nor disagree	29.5% (64)
Q 9	**We have listed some of the common causes of anaemia. Please indicate, in each case, if you agree or disagree.**			
	(i) Iron deficiency		Agree	93.5% (203)
			Disagree	1.8% (4)
			Neither agree nor disagree	4.6% (10)
	(ii) Decreased dietary iron intake		Agree	90.8% (197)

		Disagree	2.3% (5)
		Neither agree nor disagree	6.9% (15)
	(iii) Folic acid deficiency	Agree	70.1% (152)
		Disagree	5.5% (12)
		Neither agree nor disagree	24.4% (53)
	(iv) Infections	Agree	67.3% (146)
		Disagree	12.9% (28)
		Neither agree nor disagree	19.8% (43)
	(v) Heavy menstrual bleeding	Agree	77.4% (168)
		Disagree	10.1% (22)
		Neither agree nor disagree	12.4% (27)
	(vi) Worm infestation	Agree	49.3% (107)
		Disagree	16.6% (36)
		Neither agree nor disagree	34.1% (74)
	(vii) Genetic	Agree	67.3% (146)
		Disagree	10.1% (22)
		Neither agree nor disagree	22.6% (49)
	(viii) Toxic effects of some heavy metals like lead in the diet	Agree	51.1% (111)
		Disagree	9.7% (21)
		Neither agree nor disagree	39.2% (85)
	(ix) Poor knowledge about the causes of anaemia	Agree	62.7% (136)
		Disagree	13.8% (30)
		Neither agree nor disagree	23.5% (51)
	(x) Lack of proper healthcare	Agree	63.6% (138)
		Disagree	10.1% (22)
		Neither agree nor disagree	26.3% (57)
Q 10	**We have listed the common types of anaemia. Please indicate in each case, if you agree or disagree.**		
	(i) Iron deficiency anaemia	Agree	88.9% (193)
		Disagree	0.5% (1)
		Neither agree nor disagree	10.6% (23)
	(ii) Vitamin deficiency anaemia	Agree	59.9% (130)
		Disagree	14.3% (31)
		Neither agree nor disagree	25.8% (56)
	(iii) Aplastic anaemia	Agree	57.1% (124)
		Disagree	3.2% (7)
		Neither agree nor disagree	39.6% (86)
	(iv) Non-responsive iron deficiency anaemia	Agree	39.6% (86)
		Disagree	12.4% (27)
		Neither agree nor disagree	47.9% (104)

	(v) Megaloblastic anaemia	Agree	60.8% (132)
		Disagree	2.8% (6)
		Neither agree nor disagree	36.4% (79)
	(vi) Sickle cell anaemia	Agree	74.6% (162)
		Disagree	2.8% (6)
		Neither agree nor disagree	22.6% (49)
	(vii) Thalassemia	Agree	57.1% (124)
		Disagree	5.1% (11)
		Neither agree nor disagree	37.8% (82)
	(viii) Pernicious anaemia	Agree	54.3% (118)
		Disagree	2.8% (6)
		Neither agree nor disagree	42.9% (93)
	(ix) Haemolytic anaemia	Agree	71.9% (156)
		Disagree	1.4% (3)
		Neither agree nor disagree	26.7% (58)
	(x) Anaemia of chronic disease	Agree	68.6% (149)
		Disagree	0.5% (1)
		Neither agree nor disagree	30.9% (67)
Q 11	**We have listed some common symptoms of anaemia. Please indicate if you agree or disagree.**		
	(i) Pallor	Agree	73.3% (159)
		Disagree	1.8% (4)
		Neither agree nor disagree	24.9% (54)
	(ii) Pale skin color	Agree	94.0% (204)
		Disagree	1.8% (4)
		Neither agree nor disagree	4.2% (9)
	(iii) Fatigue or Weakness	Agree	95.4% (207)
		Disagree	1.4% (3)
		Neither agree nor disagree	3.2% (7)
	(iv) Irritability	Agree	52.5% (114)
		Disagree	13.4% (29)
		Neither agree nor disagree	34.1% (74)
	(v) Shortness of breath	Agree	74.2% (161)
		Disagree	9.2% (20)
		Neither agree nor disagree	16.6% (36)
	(vi) Decreased appetite	Agree	58.5% (127)
		Disagree	11.5% (25)
		Neither agree nor disagree	30.0% (65)
Q 12	**We have listed some of the effects of anaemia. Please indicate if you agree or disagree.**		
	(i) Decreases growth and development	Agree	72.4% (157)
		Disagree	6.9% (15)

		Neither agree nor disagree	20.7% (45)
	(ii) Decreases working capacity	Agree	90.3% (196)
		Disagree	1.8% (4)
		Neither agree nor disagree	7.8% (17)
	(iii) Decreases learning abilities	Agree	72.3% (157)
		Disagree	9.7% (21)
		Neither agree nor disagree	18.0% (39)
	(iv) Poor cognitive and motor development outcomes in children	Agree	76.5% (166)
		Disagree	4.1% (9)
		Neither agree nor disagree	19.4% (42)
	(v) Causes fatigue and low productivity	Agree	91.7% (199)
		Disagree	2.3% (5)
		Neither agree nor disagree	6.0% (13)
	(vi) Shortness of breath	Agree	74.7% (162)
		Disagree	6.0% (13)
		Neither agree nor disagree	19.3% (42)
	(vii) Poor birth outcomes (including low birth weight and prematurity)	Agree	77.9% (169)
		Disagree	1.8% (4)
		Neither agree nor disagree	20.3% (44)
	(viii) Increased maternal and perinatal mortality	Agree	72.4% (157)
		Disagree	3.2% (7)
		Neither agree nor disagree	24.4% (53)
Q 13	**Some ways of preventing / reducing anaemia are listed below. Please indicate if you agree or disagree**		
	(i) Eat iron-rich foods / Increase intake of dietary iron	Agree	97.7% (212)
		Disagree	0
		Neither agree nor disagree	2.3% (5)
	(ii) Consume vitamin C-rich fruits or drinks during/after meals	Agree	71.4% (155)
		Disagree	7.4% (16)
		Neither agree nor disagree	21.2% (46)
	(iii) Use appropriate supplementation regularly	Agree	77.4% (168)
		Disagree	1.8% (4)
		Neither agree nor disagree	20.7% (45)
	(iv) Give proper attention to other causes of anaemia	Agree	85.7% (186)
		Disagree	2.8% (6)
		Neither agree nor disagree	11.5% (25)
	(v) Avoid drinking strong tea or coffee after meals	Agree	45.6% (99)
		Disagree	14.3% (31)
		Neither agree nor disagree	40.1% (87)
	(vi) Pay more attention to personal hygiene	Agree	58.0% (126)

		Disagree	13.4% (29)
		Neither agree nor disagree	28.6% (62)
	(vii) Reduce intake of vegetables with high fibre content	Agree	30.4% (66)
		Disagree	33.2% (72)
		Neither agree nor disagree	36.4% (79)
	(viii) Treat parasitic infections (particularly helminths)	Agree	74.2% (161)
		Disagree	1.8% (4)
		Neither agree nor disagree	24.0% (52)
	(ix) Avoid cigarette smoking	Agree	77.0% (167)
		Disagree	3.7% (8)
		Neither agree nor disagree	19.3% (42)
	(x) Avoid excessive consumption of alcohol	Agree	77.9% (169)
		Disagree	2.8% (6)
		Neither agree nor disagree	19.3% (42)
Q 14	Adolescent girls are at high risk of anaemia because of their rapid growth and increased loss of iron during menstruation	Agree	74.7% (162)
		Disagree	4.1% (9)
		Neither agree nor disagree	21.2% (46)
Q 15	**There are many sources of information on all issues. Please indicate if you agree or disagree that the following sources of information may influence your opinion about anaemia.**		
	(i) News on National TV / Radio	Agree	71.9% (156)
		Disagree	10.1% (22)
		Neither agree nor disagree	18.0% (39)
	(ii) Government agencies	Agree	72.3% (157)
		Disagree	10.6% (23)
		Neither agree nor disagree	17.1% (37)
	(iii) Social media (Facebook, Instagram, WhatsApp)	Agree	62.2% (135)
		Disagree	17.1% (37)
		Neither agree nor disagree	20.7% (45)
	(iv) Friends and family	Agree	75.6% (164)
		Disagree	6.4% (14)
		Neither agree nor disagree	18.0% (39)
	(v) Health care providers (Doctors, Nurses, others)	Agree	96.3% (209)
		Disagree	0.5% (1)
		Neither agree nor disagree	3.2% (7)

Attitude (A): A total of 10 questions / statements (Q 16 to Q 25) were used to assess the attitude of the students towards anaemia. The modified 3-point Likert Scale was used to interpret the responses. In response to Q 16 "*Do you agree it is likely that you are anemic*?" 34.1% of the

students said "Agree", compared to 39.6% that "Disagree". The following up statement (Q 17) was "*Females are at greater risk of developing anaemia than males*", 84.3% "agreed". The other responses in this section are presented in Table 2. Notably, 93.1% agreed with the statement "*Awareness campaigns about anaemia should be carried out among female students regularly*".

Table 2: Attitude (A): This section is designed to assess the attitude / feelings of the students towards anaemia.

			RESPONDENTS (N = 217)
Q 16	Do you agree it is likely that you are anaemic?	Agree	34.1% (74)
		Disagree	39.6% (86)
		Neither agree nor disagree	26.3% (57)
Q 17	Females are at greater risk of developing anaemia than males	Agree	84.3% (183)
		Disagree	3.2% (7)
		Neither agree nor disagree	12.4% (27)
Q 18	UPNG should give you iron and folate supplements daily	Agree	66.8% (145)
		Disagree	8.3% (18)
		Neither agree nor disagree	24.9% (54)
Q 19	UPNG should give iron and folate to female students	Agree	68.7% (149)
		Disagree	6.9% (15)
		Neither agree nor disagree	24.4% (53)
Q 20	Anaemia is a serious public health problem among female students	Agree	69.1% (150)
		Disagree	3.2% (7)
		Neither agree nor disagree	27.7% (60)
Q 21	It is beneficial to prepare meals for students with iron-rich products	Agree	94.5% (205)
		Disagree	0
		Neither agree nor disagree	5.5% (12)
Q 22	Female students should receive fresh citrus fruits with meals daily	Agree	83.4% (181)
		Disagree	0.9% (2)
		Neither agree nor disagree	15.7% (34)
Q 23	Iron fortified rice should be used to prepare meals for students	Agree	77.0% (167)
		Disagree	0.5% (1)
		Neither agree nor disagree	22.5% (49)
Q 24	University clinic should test Hb level of female students regularly	Agree	92.2% (200)
		Disagree	1.8% (4)
		Neither agree nor disagree	6.0% (13)
Q 25	Awareness campaigns about anaemia should be carried out among female students regularly	Agree	93.1% (202)
		Disagree	0.9% (2)
		Neither agree nor disagree	6.0% (13)

Practices (P): In this section a total of 10 statements /questions (Q 26 to Q 35) were used to assess the dietary habits of the students. The results are presented in Table 3.

In response to the first statement (Q 26) "*Female students should consume food containing Heam Iron daily*", 84.8% of the students agreed. 73.7% of the students agreed with the statement (Q 27) that "*Female students should avoid skipping meals*". The next statement (Q 27) was "*It is important for a female student to seek medical attention as early as possible if she suspects that she has anaemia*". A total of 95.4% of the students agreed. The responses to the other statements (Q 28 to Q 35) are presented in Table 3.

Table 3: Practices (P): This section is to assess the dietary habits of female students

			RESPONDENTS (N = 217)
Q 26	Female students should consume food containing haem iron daily	Agree	84.8% (184)
		Disagree	1.4% (3)
		Neither agree nor disagree	13.8% (30)
Q 27	Female students should avoid skipping meals	Agree	73.7% (160)
		Disagree	5.1% (11)
		Neither agree nor disagree	21.2% (46)
Q 28	It is important for a female student to seek medical attention as early as possible if she suspects that she has anaemia	Agree	95.4% (207)
		Disagree	0
		Neither agree nor disagree	4.6% (10)
Q 29	It is important to check your Hb level once or twice a year	Agree	89.4% (194)
		Disagree	4.1% (9)
		Neither agree nor disagree	6.5% (14)
Q 30	Female students should take vitamin supplements regularly	Agree	69.1% (150)
		Disagree	2.8% (6)
		Neither agree nor disagree	28.1% (61)
Q 31	Female students should take deworming tablets once or twice a year.	Agree	64.1% (139)
		Disagree	3.2% (7)
		Neither agree nor disagree	32.7% (71)
Q 32	Female students should avoid drinking strong tea / coffee regularly.	Agree	54.8% (119)
		Disagree	12.0% (26)
		Neither agree nor disagree	33.2% (72)
Q 33		Agree	87.1% (189)

	You need to minimize exposure to tobacco smoking and alcohol;	Disagree	1.8% (4)
		Neither agree nor disagree	11.1% (24)
Q 34	It is very important to maintain good personal hygiene	Agree	91.7% (199)
		Disagree	1.4% (3)
		Neither agree nor disagree	6.9% (15)
Q 35	Inappropriate lifestyle can cause anaemia	Agree	75.6% (164)
		Disagree	2.8% (6)
		Neither agree nor disagree	21.6% (47)

Concerns (C): A total of 10 questions / statements (Q 36 to Q 45) were used to assess the concerns of the students about anaemia. The responses are presented in Table 4. The students were asked to state if they agree or disagree to each of the 10 statements in this section. A total of 85.7% of the students agreed with the statement (Q 36) "*You need to always wash your hands with soap after defecation*". Most of the students (92.2%) agreed to Q 38, that "*You need to wash fruits and vegetables before eating them*". Furthermore, 83.4% agreed to Q 39, that "*You need to trim your fingernails regularly*". In response to the statement (Q 45) "*You need to do regular exercise and ensure adequate nutrition*", 93.1% said that they agree. The responses to the other statements are presented in Table 4.

Table 4: Concerns (C): There are still some general concerns people have regarding anaemia that may creating doubt in your mind about the consequences of anaemia. Do you agree/disagree that the statements below may influence your efforts to avoid developing anaemia?

			RESPONDENTS (N = 217)
Q 36	You need to always wash your hands with soap after defecation;	Agree	85.7% (186)
		Disagree	4.6% (10)
		Neither agree nor disagree	9.7% (21)
Q 37	You need to wash your hands with soap before eating	Agree	90.3% (196)
		Disagree	2.8% (6)
		Neither agree nor disagree	6.9% (15)
Q 38	You need to wash fruits and vegetables before eating them;	Agree	92.2% (200)
		Disagree	2.3% (5)
		Neither agree nor disagree	5.5% (12)
Q 39	You need to trim your fingernails regularly;	Agree	83.4% (181)
		Disagree	5.1% (11)

		Neither agree nor disagree	11.5% (25)
Q 40	You should not walk barefoot outside the home;	Agree	73.7% (160)
		Disagree	10.6% (23)
		Neither agree nor disagree	15.7% (34)
Q 41	You need to take Iron-Folic acid (IFA) tablets regularly	Agree	55.8% (121)
		Disagree	8.3% (18)
		Neither agree nor disagree	35.9% (78)
Q 42	You must take deworming medications once or twice a year	Agree	74.7% (162)
		Disagree	1.8% (4)
		Neither agree nor disagree	23.5% (51)
Q 43	You should check your Hb level regularly	Agree	85.3% (185)
		Disagree	4.6% (10)
		Neither agree nor disagree	10.1% (22)
Q 44	Taking the Iron-Folic acid tablets and other supplements does not prevent one from developing anaemia.	Agree	42.4% (92)
		Disagree	22.1% (48)
		Neither agree nor disagree	35.5% (77)
Q 45	You need to do regular exercise and ensure adequate nutrition	Agree	93.1% (202)
		Disagree	0.9% (2)
		Neither agree nor disagree	6.0% (13)

Interpretation of KAPC scores using the Hasan et al. criteria [27]:

The Knowledge score was 74.4%, which indicated Fair knowledge about anaemia. The Attitude score was 85.0%, which indicated good attitude towards anaemia. The Practice score was 77.8%, indicating good practices, which implies low risk of developing anaemia among the female students that participated in this study. The Concern score was 81.4%, indicating good level of concern regarding anaemia which creates less doubt in their minds about the negative consequences of anaemia. The results indicated that their fair Knowledge about anaemia might be one of the main causes of anaemia among some of the female students. The fair knowledge does not seem to have affected the good attitudes and practices of the students, as well as their concerns in the present study.

Further analysis of the data shows positive correlation between Knowledge and Attitude (spearman's rho=0.402, p<0.001). Positive correlation between Knowledge and Practice (spearman's rho=0.537, p<0.001). Positive correlation between Knowledge and Concern (spearman's rho=0.525, p<0.001). Positive correlation between Attitude and Practice (spearman's rho=0.522, p<0.001). Positive

correlation between Attitude and Concern (spearman's rho=0.411, p<0.001). Positive correlation between Practice and Concern (spearman's rho=0.605, p<0.001).

Table 5: Calculated KAPC scores in percent for all the students and for students with and without anaemia

	Total number of students (n = 169)			
	All the students (n = 217)	Non-anaemic students (n = 92)	Anaemic (n = 77)	
Knowledge scores	74.4	74.6	73.7	Fair
Attitude scores	85.0	84.4	87.9	Good
Practices scores	77.8	79.3	79.2	Good
Concerns scores	81.4	82.1	82.6	Good

Most students correctly answered questions about the general characteristics of anaemia, such as its symptoms, causes, and effects. There was a statistically significant (p-value <0.05) association between Knowledge and Attitude; Knowledge and Concerns; Attitude and Practices and also Practices and Concerns. There was also a statistical significance (p = 0.003) difference between levels of Knowledge and the Hb status among the students showing a negative (R = 0.001) coefficient of correlation. However, there was no statistical significant association between Attitude and Hb (p-value 0.186) and between Practice and Hb level (p-value 0.163).

The KAPC scores for the students in the anaemic and non-anaemic groups were calculated. The results are presented in Table 5. No statistically significant differences were observed when the corresponding KAPC scores for both groups were compared. The trend in the KAPC scores was similar to that observed for the KAPC scores for all the students.

DISCUSSION:

A total of 217 female students consented to participate in this study. However, consent for the measurement of Hb level was obtained from 169 students. This gave a consent rate of 77.9% (169/217). The non-consent rate of 22% obtained in the present study may be due to the reluctance of apparently healthy individuals to donate blood for research purposes. This has been reported by other researchers in PNG [22, 24].

The mean haemoglobin level of 11.7 ± 1.92 g/dL for the 169 consented students was lower than the 12.4 ± 1.1 g/dL reported for non-pregnant women in the National Capital District in PNG [24], mean Hb level of 12.19 ± 2.1 g/dL for female students in Sri Lanka [10], mean Hb level of 19.7 ± 3.01 g/dL for female students in India

[29], and mean hemoglobin (Hb) level of 11.97 g/dL for female students in Indonesia [29].

The 45.6% prevalence of anaemia in the present study was higher than the 28.0% obtained for non-pregnant women in NCD [24], the 44.2% prevalence among non-pregnant women in the Southern Region of PNG [23], the 44.0% for adolescent girls in Indonesia [29], the 38.9% for non-pregnant women in the Solomon Islands, 31.3% for non-pregnant women in Samoa, and 31.0% in Fiji, reported in the WHO global health observatory repository [28].

The 16.0%, 24.9% and 4.7% mild, moderate and severe anaemia status among the students in the present study are similar to the values reported for female students in some universities by other authors [10, 11, 29]. A study conducted among female students in Sri Lanka, found that 17.5% had mild anaemia and 7.9% had moderate anaemia [10]. Another study by Agusina et al. [29] found that nearly half of the female students in the study were anaemic, with 23% having mild anemia, 19.4% having moderate anemia, and 1.8% having severe anemia [29].

The authors indicated that one of the major factors for the cause of anaemia among the female students was lack of awareness and poor practices. In a recent study, Waghray et al [11] reported that 86.5% of female students were anaemic. Mild, moderate, and severe anaemia were observed in 22%, 55%, and 10% of the students, respectively [11]. The authors reported that lack of knowledge about nutrition and long menstrual duration were significant reasons for the high prevalence of anaemia among the female students [11].

Huong et al [12] reported high prevalence of anaemia among female university students in Malaysia. According to the authors less iron-rich foods were consumed by 52.9% of the female students and meals were skipped by 81.7% of them [12]. The same study also noted poor nutritional status, extended menstrual duration, and vegetarianism among the female students [12]. In a similar study, Ganasegeran et al. [14], reported that poor eating habits, such as skipping meals and consuming fast food, are a major public health concern among female university students. These habits make them vulnerable to nutritional deficiencies leading to development of anaemia [14]. The authors observed that most of the female students seem to have appropriate level of knowledge about anaemia, but lack of positive attitude and good practices towards preventing it was evident [14].

KAPC scores:

In our present study, the Knowledge, Attitudes, Practices and Concerns (KAPC) scores were calculated and used for the categorization of the students. The criteria proposed by Hasan et al [27] were used for the categorization of the KAPC scores. Score ≥ 75% was categorized as Good. Scores between 74 – 65% were

categorized as Fair. Scores below 64% were categorized as Poor.

The Knowledge score of 74.4% was higher than the 54.0% in a study conducted among female students in a college in Pakistan [33]. This shows a reasonable level of understanding about anaemia among the students in the present study.

When asked if they knew about anaemia, 84.8% of the students answered affirmatively. Similarly, most of students (77.4%) agreed that anaemia is a serious health problem. When asked about the common meanings of anaemia, most students agreed with "*decrease of iron in blood*", "*lack of red blood cells*", but only 67.7% agreed with the response "*Hb levels below 12.0 g/dL*". When asked about the common causes of anaemia, over 70% of the students agreed with "*Iron deficiency*", "*Decreased dietary Iron intake*", "*Heavy menstrual bleeding*". These findings are consistent with other studies in different countries [12, 29]. One such study found that 60% of the female students had an appropriate level of knowledge about anaemia [12].

The findings about Attitude show a good level of understanding about anaemia among the students. Most students agreed with the statements that "*Females are at greater risk of developing anaemia than males*" and that "*Awareness campaigns about anaemia should be carried out among female students regularly*". However, only around a third (34.1%) of the students agreed with the question "*Do you agree it is likely that you are anemic?*". These findings are similar to a study conducted among female university students in Malaysia, which showed that the participants had an appropriate level of attitude about anaemia [12]. On the contrary, female students' attitudes towards anaemia varies across several studies [13]. A study by Koeryaman et al. [13] reported that a significant proportion of female students had suboptimal attitudes, with 47.2 % exhibiting a low attitude towards anaemia. The authors concluded that most of the students showed a lack of positive attitude but good practices towards preventing anaemia.

In the section on Practice in the present study, dietary habits of the students were assessed. The findings revealed that 84.8% of the students agreed with the statement that "*Female students should consume food containing Heam Iron daily*". In response to the statement "*Female students should avoid skipping meals*", 73.7% of the students agreed. Furthermore, 95.4% of the students supported the statement that "*It is important for a female student to seek medical attention as early as possible if she suspects that she has anaemia*".

There are similar findings in other studies from different countries that show similar results [12, 13, 14, 30]. A study in Indonesia highlighted the importance of iron supplementation in reducing anaemia and improving the overall health of

adolescent girls [30]. These studies also reported that students' poor eating behaviour is strongly associated with stress and low self-esteem [12, 13, 14].

One such study found that 52.9% of the participants consumed less iron-rich foods and 81.7% reported skipping meals [12].

The tendency to skip meals was found in 60% of female student in Bangladesh [34]. Skipping meals and having an imbalanced diet is common among college students, as observed in Bangladesh, and this may contribute to the development of anaemia. Low nutritional status is a significant risk factor for anaemia, especially in underweight and overweight populations [34].

A study conducted at the Winneba Campus of University of Education in Ghana found that students moderately consumed fish, meat, eggs, and dairy products but had a low intake of fruits and vegetables. They also had a high consumption of energy-dense foods and fast foods [30]. Another study conducted in Ranchi, India, found that anemia was more common among female students that were vegetarians than non-vegetarians and among vegetarians that consumed predominantly rice-based diet [31]. There was increased anaemia among female students consuming tea and coffee post meals [31].

The authors reported that the female university students had an appropriate level of knowledge about anaemia, but showed a lack of positive attitude and good practices towards preventing it [12, 30, 31].

In the section of Concerns, an exploration of feelings and issues of importance regarding anaemia was conducted. A total of 10 questions were utilized to assess the Concerns of the students. The results found that 85.7% of the students concurred with the statement "*You need to always wash your hands with soap after defecation*". The results also found that 90.3% agreed with the statement "*You need to wash your hands with soap before eating*". The assertion "*You need to do regular exercise and ensure adequate nutrition*" was supported by 93.1% of the students.

The results obtained in some of the other studies seems to align with the findings in our present study, highlighting the awareness and understanding of some of the practices and concerns related to maintaining good health and preventing anaemia. It is important, however, to note that lack of appropriate practices towards preventing anaemia and the lack of attitude regardless of good knowledge may lead to high prevalence in anaemia among female students.

The knowledge scores for the students in the anaemia (73.7%) and non-anaemic (74.6%) groups indicated fair awareness of some of the issues related to anaemia. The attitude scores for both groups (87.9% and 84.4% respectively) indicate good attitude towards some of the risk

factors related to anaemia. The practice scores (79.2% and 79.3%) obtained for the anaemic and non-anaemic groups were also similar. Our results show that the female students that participated in this study have reasonable knowledge, good attitude, practices and concerns to reduce the prevalence of anaemia. The current analysis did not show any significant difference between KAPC of the students with anaemia and those without anaemia. This suggests that education alone did not guarantee a direct association with lower anemia prevalence. Thus, education and improved nutrition, such as micronutrient supplementation should be considered along with education related to anemia. The trends in the results were similar to those reported by some authors for female university students in Malaysia [12]. The authors concluded that both anemic and non-anemic students were knowledgeable and aware of the risk factors, symptoms, causes, and prevention of anaemia. The findings in our present study support the conclusion of these authors.

CONCLUSION:

The mean Hb level of the 169 female students that participated in the study was 11.7 ± 1.92 g/dL, the range was 8.3 to 15.4 g/dL. Mild to moderate status of anaemia was prevalent among 45.6% of the students. This indicates severe public health significance. The knowledge, attitudes, practices and concerns scores for all the 217 students were 74.4%, 85.0%, 77.8% and 81.4% respectively. The scores indicated fair knowledge, good attitudes, practices and concerns about anaemia. The knowledge scores for the students in the anaemia (73.7%) and non-anaemic (74.6%) groups indicated fair awareness of some of the issues related to anaemia. The attitude scores for both groups (87.9% and 84.4% respectively) indicate good attitude towards some of the risk factors related to anaemia. The practice scores (79.2% and 79.3%) obtained for the anaemic and non-anaemic groups were also similar. Our results show that the female students that participated in this study have reasonable knowledge, good attitude, practices and concerns to reduce the prevalence of anaemia. Improving their knowledge, attitude and practices, may result in reducing the prevalence of anaemia among the students. More research should be conducted to raise awareness that will promote changes in the KAPC among the female students to combat anaemia in the University of Papua New Guinea.

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