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Prevalence and risk factors of Anaemia among Pregnant Women Consulted to the Reproductive Health Care unit of H.Dh. Regional Hospital, Maldives

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Abstract

Background: Anaemia is one of the common nutritional disorders during pregnancy and a major cause of maternal death. The World Health Organization (WHO) estimates that over 30% of the world's population are anaemic. The prevalence in developed countries is 14% and in developing countries is 51%. In the Maldives, the prevalence of anaemia among pregnant women is 48.5% in 2016. This study aims to determine the prevalence and risk factors of anaemia in pregnant women of a community in the Maldives. **Method**: This is a quantitative, cross-sectional survey conducted among 53 pregnant women selected by a simple random sampling method. Data were collected through structured questionnaire forms. Data analysis was conducted using SPSS version 25.0. The P-value <0.05 was considered statistically significant. **Results**: Haemoglobin classification showed 60.40% normal, 39.60% anaemic. 33.96% of participants were known thalassaemia carriers, amongst them, 61.11% were found to be anaemic with P <0.026. Other factors studied showed no statistically significant association with anaemia. **Conclusion**: The prevalence of anaemia in pregnant women is 39.60%. Thalassaemia carrier encountered in the population was found to be the main factor associated with the prevalence of maternal anaemia.

Keywords: Anaemia, Pregnancy, Prevalence, Risk factors.

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1. Introduction

1.1 Prevalence and factors of Anaemia

Anaemia is one of the common nutritional disorders during pregnancy. Anaemia is defined as lower haemoglobin (Hb) level than the normal range in the body, which reduce the oxygen-carrying capacity of red blood cells to the tissues (Berhe et al., 2019). The prevalence, aetiology and severity depend on the socioeconomic status of the population. The World Health Organization (WHO) estimates that over 30% of the world's population are anaemic. It is considered a major cause of maternal death, contributing 20 to 40% of maternal death (Singal et al., 2018). The prevalence in developed countries is 14% and in developing countries is 51% (Suryanarayana et al., 2017). The prevalence rates may depend on the socio-economic conditions, lifestyles, food habits and communicable and non-communicable diseases. In the Maldives, the prevalence of anaemia among pregnant women is 48.5% in 2016 (W.H.O, 2021). Although these statistics show a lower percentage, it remained high with an average of 52.5% from December 1990 to 2016, (W.H.O, 2017). According to these data, almost half of the population of pregnant women is anaemic in the Maldives.

Anaemia in pregnancy refers to haemoglobin (Hb) level below 11g/dL (W.H O, 2011). Low haemoglobin (Hb) level decreases the number of functioning red blood cells (RBC) reducing the oxygen-carrying capacity of the blood. RBCs are produced in the bone marrow. Iron, folic acid and vitamin B12 are essential components for erythropoiesis.

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Lack of any of these components results in developing anaemia (Beckman et al., 2010). At the beginning of pregnancy, blood is diluted due to plasma volume expansion. This is a physiological process that starts at the eighth week and progress until 32 to 34 weeks of pregnancy (Chowdhury et al., 2014). The increase of plasma volume more than red blood cells results in a low Hb concentration which will lead to a decrease in blood viscosity that enhances placental perfusion.

Many factors can cause anaemia in pregnancy. These include deficiency of iron, folate, vitamins (A and B12) and infections (Malaria, Hookworm, Tuberculosis and HIV). Such factors causing anaemia during pregnancy vary with the geographical location and socioeconomic status of the community (Okube et al., 2016). The most common cause of anaemia in pregnancy is iron deficiency. Studies have shown that the aetiology of anaemia is attributed to iron deficiency in 50% of cases (Stevens et al., 2013). An adult woman has 2000 mg of iron, 60 to 70% of this iron is present in erythrocytes and the rest is stored in bone marrow, liver and spleen. During pregnancy the demand for iron is increased for the growth of the foetus, hence additional iron ingestion is required (Prakash & Yadav, 2015). Pregnancy requires approximately 630 mg of extra iron for the mother. This requirement is for the foetus, erythrocytes and iron storage for lactation and future pregnancy. To prevent the imbalance of iron during pregnancy a woman needs 300 mg of iron stores at the beginning of pregnancy and will require supplementation. The average daily requirement of iron is 0.8 mg/day in the first trimester and increases to 7.5 mg/day in the third trimester (Tandon et al., 2018). Folic acid (vitamin B9) is an important nutrient needed for DNA replication. Due to the increasing demand for folate during pregnancy for growth and development of the foetus, the folate becomes deficient resulting in maternal anaemia. Supplementation of folic acid reduces the risk of maternal anaemia and neural tube defects (NTDs) in the offspring (Greenberg et al, 2011).

The anaemia in pregnancy occurs when the haemoglobin (Hb) concentration of a pregnant woman falls below 11g/dL (W.H.O, 2011). Based on the concentration of the Hb, W.H.O classifies anaemia into three levels. This classification includes mild anaemia (Hb levels 9 - 10.9g/dL), moderate anaemia (Hb levels 7 - 8.9g/dL), and severe anaemia (Hb levels < 7g/dL) (Goonewardene et al., 2012).

Anaemia in pregnancy presents similar symptoms to the other types of anaemia. This may include fatigue, general weakness and reduced attention and concentration (Black et al., 2013). It can also result in poor work capacity, impaired immune function, increased risk of cardiac diseases and mortality. Furthermore, it is associated with preterm births, low birth weight (LBW), Intrauterine growth restriction (IUGR) and Intrauterine foetal death (IUFD) (Stephen et al., 2018).

Many countries and international health agencies have adopted various plans to decrease the prevalence of maternal anaemia. These strategies include iron supplementation, fortification of food with iron, malaria control, and deworming (Peña-Rosas et al., 2012). However, the prevalence of anaemia remains a challenge for health care providers.

The most essential aspect of the prevention of anaemia in pregnancy is the awareness and education of patients. Studies have demonstrated that awareness programs and educational activities have successfully improved the knowledge and attitude of pregnant women to consume medication, which led to a reduction in the prevalence of anaemia (Nagata et al., 2012). Additionally, effective communication to educate all pregnant women about their diet and nutrition is an integral aspect of prevention. The other modality of prevention is the supplementation of iron and folic acid. Iron supplementation vary from region to region, it is recommended that all pregnant women should be prescribed 30-60 mg per day of iron supplement from the first prenatal visit (W.H.O, 2016). In populations, where the prevalence is less than 20% WHO recommends, intermittent oral iron of 120mg and folic acid of 2.8 mg supplementation once weekly for pregnant women to improve maternal and neonatal outcomes. Similarly, in the Maldives iron and folic acid supplementation begins with the first Antenatal care (ANC) visit in all cases.

ANC programs are widely conducted with free access to all. Ministry of Health (MOH) has a special strategy to ensure that ANC is covered in all regions of the country. The strategic plan of the public health in preventing anaemia in pregnancy follows the guidelines of W.H.O. Despite the wide coverage of ANC and the programs conducted to the public, the prevalence of anaemia in pregnancy remains high (Ministry of Health, Maldives, 2016).

The Maldivian community is known to have one of the highest known incidences of Thalassaemia in the world. It estimates that one in every six individuals is a thalassaemia carrier in our community and approximately 60-70 children are born with thalassaemia annually in the Maldives (Ministry of Health, Maldives, 2016). The study conducted by Waheed et al. (2016) to demonstrate carrier screening for beta-thalassaemia in the Maldives showed 16-18 % of the Maldivians are β-thalassaemia carriers.

Thalassaemia is defined as anaemia due to inherited autosomal recessive disorders characterized by a reduced rate of haemoglobin synthesis due to a defect in α or β-globin chain synthesis (Chiruka & Darbyshire, 2011). The high percentage of thalassaemia carriers in the country may be a factor associated with the high prevalence of anaemia among the pregnant population. However, there are no researches done in the Maldives to identify the link of this risk factor with anaemia in pregnancy. Thus, warrant research in this area for further understanding.

The statistics obtained from the database in the Public Health Unit of MOH shows a general figure. The literature review has clearly shown that the statistics vary with the socioeconomic status of the communities. The literature was searched thoroughly for the prevalence and associated risk factors in the Maldivian community. The differences in socioeconomic status, lifestyle and geographical distribution of islands, the general figure for the prevalence may not represent the prevalence of anaemia among pregnant women found in different communities in the Maldives. Despite this, the studies are lacking and there is limited information on anaemia among pregnant women in this community. Hence, this research is conducted to determine the prevalence of anaemia and associated factors in the pregnant population of a rural community in the northern atolls of the Maldives. Consequently, revealing the prevalence and associated factors of anaemia among pregnant women in the study community would help in making the evidence-based decision and develop plans to improve the health condition of pregnant women.

1.2 Significance of the study

The geographical structure of the Maldives divides the population into small island communities. Some of these communities are isolated. In recent years due to the development of transportation and wealth in the country, there is an ongoing change in the lifestyle. However, each one maintains its tradition. Therefore, each one of these communities has some differences in their socioeconomic level, food habits and lifestyle. Thus, factors affecting them to have anaemia during pregnancy may be different from the general population. The prevalence of anaemia in these communities may vary from the identified statistics for the country. By determining the prevalence rate and associated factors for the community studied would enable health care services to redesign and strengthen the prevention programs specifically for this community. Furthermore, it can help medical professionals to concentrate on the findings for early diagnosis and treatment. It will also enable further research opportunities on such factors in this community.

1.3. Aim

The purpose of the study is to determine the prevalence and risk factors of anaemia in pregnant women of a community in the Maldives.

1.4. Research question

1. In pregnant mothers consulting to Reproductive Health Care (RHC), what is the prevalence of anaemia and what risk factors are associated with anaemia?
2. In pregnant mothers consulting to RHC, do the prevalence of anaemia and risk factors associated corresponds to the general population?

2. Materials and Methods

2.1 Research method and Study design

The reliability and validity of a study depend on the design and methodology of the study. Thereby, understanding and using proper methodology is essential for the research to be more acceptable in the scientific community (Garg, 2016). This research was carried out through quantitative approaches, where it emphasizes objective measurements and observational, analytical, or numerical analysis of data obtained by interviews, questionnaires and using computerized techniques to find statistical significance.

Quantitative research focuses on collecting and generalizing numerical data across groups of people, or explaining a specific phenomenon. The main goal of this type of study is to build accurate and reliable quantities that allow for statistical analysis (Goertzen, 2017). Besides, this type of research focuses on values that can be measured and it is very effective in answering questions that are direct and quantifiable.

This study is a quantitative, cross-sectional survey. A Cross-sectional study was decided because it is inexpensive, can be used for estimating the prevalence and can be conducted relatively faster.

2.2 Sample

Sampling is the process of selecting participants for research. A sample is defined as a part or group of participants selected from the target population (Martínez-Mesa et al., 2016). The main factor which affects the generalizability of the research is the sampling method. Pregnant women attending ANC care were selected randomly. The simple random sampling method was used to select the participants for this study. Random selection of participants was carried out from the list of pregnant women attending their first ANC consultation. Each participant in the list had an order number. By using the lottery method random selection, these numbers were selected to reach the sample size. This technique is more convenient and ensures that each one has an equal probability of inclusion in the sample (Peregrin, 2018). Raosoft online software was used to calculate the sample size for this study. At a 95% confidence interval with a response rate of 50% the sample size obtained from this software was 53 participants.

2.2.1 Tools

The data collection was carried out by the researcher and staff of ANC (nurses and public health officers) who volunteered to support this research. All data were collected from the primary source. This primary data collection would enable the validity of data gathering. Similarly, participants were explained well about the research, their confidentiality and the importance of honest participation to make data more reliable. Structured questionnaire form was used. The questionnaire form was explained and discussed with interviewers and was instructed to follow the best practice guidelines. Apart from this, they were encouraged and prepared to accept and respect the autonomy of the participants. For this community-based survey, data were collected primarily by using face-to-face structured interviews with the patients. Additionally, laboratory reports and ANC record cards of the participants were used.

2.3. Data collection

Staff at the ANC services were provided with a structured questionnaire. All pregnant women selected were informed about the objective of the study and were evaluated in their first ANC visit. No further follow up was scheduled. The average duration of the interview was 20 to 30 minutes. The information obtained included demographic characteristics, socioeconomic status, reproductive health history, food habits, lifestyle, and living environment. Followed by the interview, the participant was examined by the gynaecologist and a request form was given for routine laboratory investigation. The level of Hb was recorded from the laboratory report. Other measurable variables such as height and weight were measured before the physical examination by the nurse.

2.4. Data analysis

In this study, various statistical procedures were used to analyze data. In this regard, descriptive statistics of frequencies and percentages were used to demonstrate the prevalence of anaemia and potential risk factors. The same statistics were also used to elicit the socio-demographic profile of the participants. Moreover, the Chi-square test of independence was used to test the association between variables. Data analysis was conducted using SPSS version 25.0. The P-value of less than 0.05 was considered as a statistically significant result. However, Microsoft Excel was also used for the graphical representation of certain results.

2.5. Ethical considerations

The approval to conduct this research was obtained from the National Health Research Council, Ministry of Health Maldives (Approval Registration number NHRC/2021/030). Additionally, it was approved by the Centre for Postgraduate Studies and the management of Kulhudhuffushi Regional Hospital. The study was carried out according to the ethical rules of the Hospital. The Declaration of Helsinki on the basis for Good Clinical Practices was followed throughout the research." All human beings are born free and equal in dignity and rights; it is the duty of every man related or unrelated to science to treat their fellow beings with love and respect" (Mandal et al., 2011).

A detailed information sheet was given to each participant and a consent form written in Dhivehi (local Language) was given to all participants of the study. The data collected was handled confidentially. Confidentiality and anonymity were assured to the participants. Data collected was used for the purpose of the research and no data was provided to the third party. This assurance was also written in the consent form. Researchers must protect the confidentiality of information shared by the participants (Wolf et al., 2015). Informed consent is a process in which the participant endorses his/her willingness to join in the research. This process protects their freedom of choice and autonomy. It also ensures the safety of the participant legally and ethically (Bhaskar & Manjuladevi, 2016).

3. Results

3.1. Socio demographic characters.

Table: 1

variables	Category	Frequency	Percent
Age	<18	0	0
	18-28	24	45.28
	29-39	26	49.06
	>40	3	5.66
Married	53		100
Occupation	Employed	12	22.66
	Unemployed	1	1.89
	House wife	38	71.70
	Retired	2	3.77
Housing	Own house	17	32.08
	Rented place	1	1.89
	Family House	35	66.04
Educational level	Primary	6	11.32
	Secondary	36	67.92
	Higher Secondary	3	5.66
	Degree	8	15.09
Smoking	Smokers	0	0
	Non Smokers	53	100
Alcohol	Abusers	0	0
	Non-users	53	100
Food Habit	Regular Diet	30	56.60
	Balanced diet	23	43.40

Table-1 demonstrates socio-demographic data of the participants. The age of participants was categorized into 4 groups (<18years, 18 to 28 years, 29 to 39 years and > 40 years). Marital status was categorized as married, unmarried and divorced. The occupation was categorized into an employed, unemployed, housewife and retired. Housing condition was categorized as living in their own house, living in a rented place and living in a family house. The educational level was categorized to primary level, secondary level, higher secondary level and degree level. Smoking was categorized into smokers and non-smokers. Alcohol and drug use were categorized into users and non-users. Nutrition was categorized into a balanced diet and a regular Maldivian diet.

The age of 53 pregnant women ranged from 21 to 42 years with mean age of 29.34 years and a standard deviation (SD) of 1.28. Age was categorized into 4 groups which showed 49.06 % was between 29 to 39 years, followed by 45.28% of the participant was in the age group between 18 to24 years. Only 5.66% of the participants were 40 years and above. 100% of the participants were married. The majority of the participants (71.70%) were housewives, 22.66% were employed and 3.77% were already retired from the job. Only 1.89% of the participants were unemployed. The majority of the participants (66.04%) live in the family house, 32.08% of participants have their own house and only 1.89% lives in rented places.

Most of the participants (67.92%) have completed secondary level of education, 15.09% had a university degree, 11.32% of the participants only had the level of primary education and 5.66% completed higher secondary level of education. Among the participants in the study, none of them smokes or uses alcohol. Among the 53 participants, 56.6% were taking a regular Maldivian diet and 43.40% of them were using a balanced diet.

3.1.1. Socio-demographic characteristic and Anaemia

Table: 2

		Occupation		housing		Educational level			Food Habit	
		employed	house wife	Own house	Family house	Primary	Secondary	Higher secondary and degree	RMD	BD
Normal	Count	8	23	9	23	3	20	9	18	32
	%	66.67%	60.53%	52.94%	65.71 %	50.00%	55.56%	81.82%	60.00 %	60.87 %
Anaemic	Count	4	15	8	12	3	16	2	12	9
	%	33.33%	39.47%	47.06%	34.29	50.00%	44.44%	18.18%	40.00 %	23%
Total	Count	12	38	17	35	6	36	11	30	23
	%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table- 2 reveals the relationship between occupation, housing, education level and food habit with anaemia. In the character of occupation, 33.33% of employed participants were found to be anaemic, while 39.47% of housewives were found to be anaemic. These differences do not show an association between employment and anaemia. The living condition of the participants was determined by the housing. The categorization of this character was described above. However, rented places were excluded in this analysis due to the small number (1 case). Of those who lived in their own house, 8 (47.06%) were found to be anaemic whereas of those who lived in the family house, 20 (38.46%) were known to be anaemic. From the character of food habit of the participants, 12 (40.00%) among those who had regular Maldivian diet were found to be anaemic while of those who had a balanced diet, 9 (39.13%) were known to be anaemic. P values calculated from the Chi-square test for the housing and food habit were 0.559 and 1.00 respectively. This result indicated that housing status and food habits did not show a statistically significant association with anaemia. In the education level of the participants, those who completed up to primary education, 3 (50.00%) were found to be anaemic while those who completed up to secondary education 16 (44.44%) were known to be anaemic. Additionally, those who had a level of education higher secondary and above 2 (18.18%) were found to be anaemic. This result indicated that a lower prevalence of anaemia was seen in the higher education level of the participants.

3.2. Maternal Characteristics

Table: 3

Variable	Category	Frequency	Percent
Number of Pregnancies	1.00	15	28.30
	2.00	18	33.96
	3.00	8	15.09
	4.00	9	16.98
	5.00	3	5.66
	Total	53	100.00
Average inter-pregnancy interval	< 1 year	1	2.63
	1 to 3 years	20	52.63
	3 to 5 years	7	18.42
	> 5 years	10	26.32
	Total	38	100.00

Table-3 shows the maternal characteristics of the sample. Maternal characteristics were categorized into a number of pregnancies, Inter-pregnancy interval and previous pregnancy complications. Participants were distributed according to the number of pregnancies they had in the past. Inter-pregnancy interval was categorized further into 4 groups (<1year, 1-3years, 3-5 years and >5 years). Among the participants, 28.3% were pregnant for the first time, 5.66% of them had 5 pregnancies, 16.98 % had 4 pregnancies, 15.09 % had 3 pregnancies and 33.96% had 2 pregnancies. Therefore, the majority of the participants were having second pregnancies. The interval between pregnancies ranged from 6 months to 18 years with a mean interval of between pregnancies was

3.5 years. A total of 38 pregnant women had previous pregnancies, among them majority (52.63%) had 1 to 3 years of the interval between pregnancies.

3.2.1. Number of pregnancies and anaemia

Table: 4

		No. of Pregnancies		Total
		Nulliparous	Multiparous	
Normal	Count	8	24	32
	%	53.33%	63.16%	60.38%
Anaemic	Count	7	14	21
	%	46.67%	36.84%	39.62%
Total	Count	15	38	53
	%	100.00%	100.00%	100.00%
$X^2 = .120$, $p = .729$				

Table-4 demonstrates the association between the number of pregnancies and anaemia. The participants were categorized into nulliparous (participants who were pregnant for the first time) and multiparous participants who had more than 1 pregnancy). From the nulliparous group 7 (46.67%) were found to be anaemic whereas, in the multiparous group, 14 (36.84%) were known to be anaemic. The results indicated that no statistically significant association between a number of pregnancies and anaemia ($X^2 = .120$, $p = .729$).

3.2.2. Association between average inter-pregnancy interval and Anaemia

Table: 5

		average inter-pregnancy interval categorized		Total
		less than 3 years	3 or more years	
Normal	Count	15	9	24
	%	71.43%	52.94%	63.16%
Anaemic	Count	6	8	14
	%	28.57%	47.06%	36.84%
Total	Count	21	17	38
	%	100.00%	100.00%	100.00%
$X^2 = .700$, $p = .403$				

Table-5 shows the association between average inter-pregnancy interval and anaemia. Of those who had an average of less than 3 years between pregnancies, 6 (28.57%) were found to be anaemic whereas of those who had an average of more than three years between pregnancies, 8 (47.06%) were found to be anaemic. The results of the Chi-square test indicated no statistically significant association between the average inter-pregnancy interval and anaemia ($X^2 = .700$, $p = 0.403$).

3.2.3. Complications in previous pregnancies

Figure: 1

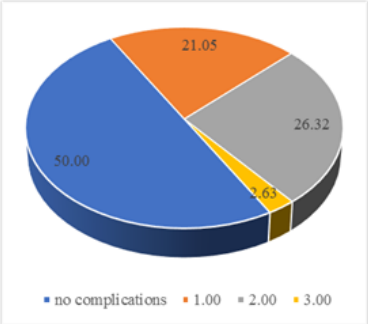

Figure-1 demonstrates the distribution of participants who had previous pregnancies and complications. From the 38 cases, 19 (50.00%) had no complications during previous pregnancies while 8 (21.05%) had just one complication. Likewise, 10 (26.32%) cases had 2 complications and there was 1 (2.63%) case with 3 complications.

3.2.4. Frequency of past pregnancy complications

Figure: 2

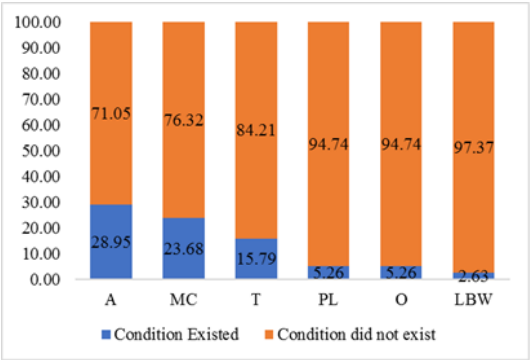

Figure-2 demonstrates the percentage of previous complications. From the complications identified in past pregnancies, anaemia (A) was the most common complication (28.95%). Followed by miscarriage (MC) 23.68%, blood transfusion (T) 15.79%), others (O) such as GDM and GHTN 5.26%, preterm labour (PL) 5.26% and low birth weight (LBW) 2.63%.

3.2.5. Complications in previous pregnancies and anaemia

Table: 6

		no complications	complications	Total
Normal	Count	15	9	24
	%	78.95%	47.37%	63.16%
Anaemic	Count	4	10	14
	%	21.05%	52.63%	36.84%
Total	Count	19	19	38
	%	100.00%	100.00%	100.00%
$X^2 = 2.827$, p = 0.093				

Table-6 shows an association between previous pregnancy complications and anaemia. Of those who had no complications, 4 (21.05%) were found to be anaemic whereas of those who had complications, 10 (52.63%) were known to be anaemic. The results of the Chi-square test of independence indicated that there is no statistically significant association between a number of complications during previous pregnancies and anaemia ($X^2 = 2.827$, p =0 .093).

3.3. Characteristics of Hemoglobin

Table: 7

Classification (W.H.O)	Hb	Frequency	%
Normal	>11g/dL	32	60.40
Anaemia	<11g/dL	21	39.62
Mild	9 - 10.9g/dL	19	35.80
Moderate	7 - 8.9g/dL	2	3.80
Severe	< 7g/dL	0	0

Figure: 3

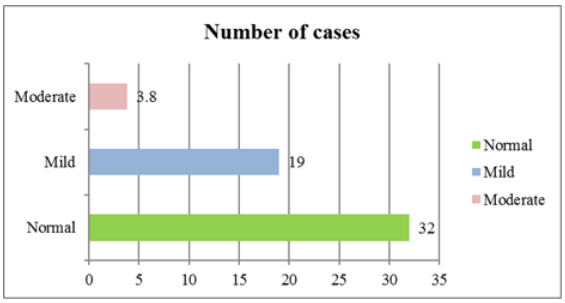

Table-7 demonstrates the distribution of participants according to WHO classification of Hb level and Figure-3 shows bar graph presentation of this distribution. Participants were grouped into normal, mild anaemia, moderate anaemia and severe anaemia. Out of the 53 cases, 32 (60.40%) were found to be normal while the rest (39.60%) was considered anaemic. Those that were anaemic was composed of two groups; 19 (35.80%) cases had mild anaemic conditions and 2 (3.80%) had moderate anaemic conditions. None of the participants presented severe anaemic conditions. This result indicated the prevalence of anaemia in pregnant women was 39.60%.

3.4. Thalassaemia carriers, BMI and Iron supplementation

Table: 8

Variable		Frequency	Percentage
Thalassaemia Carriers	carrier	18	33.96
	non- carrier	32	60.38
	not known	3	5.66
	Total	53	100.00
BMI classification	underweight	2	3.77
	normal weight	10	18.87
	overweight	14	26.42
	obese	27	50.94
	Total	53	100.00
Current Pregnancy Iron Supplementation	yes	42	79.25
	no	11	20.75
	Total	53	100.00
Previous Pregnancy Iron Supplementation	yes	37	97.37
	no	1	2.63
	Total	38	100.00

Table-8 determines the distribution of thalassaemia carriers, BMI grouping and use of iron supplementation in current and past pregnancies. It was found that 33.96% of participants were known thalassaemia carriers, 60.38% was non-carriers and 5.66% has not undergone thalassaemia screening.

Body Mass Index (BMI) was categorized according to BMI categories in Asian populations: underweight <18.5, normal weight 18.5-23, overweight 23-27.5 and obese ≥ 27.5 (Liabsuetrakul et al., 2011). The mean height of the participants was 156.42 with an SD of 7.35 and the mean weight of the participants was 68.97kg with an SD of 16. The Mean BMI of the participants was 28.24 with an SD of 6.59. The majority of the participants (50.94%) had BMI more than 27.5 Kg/m2 (obese), followed 26.42% presented BMI in overweight category (23 to 27.5 kg/m2), 18.87% had BMI range between 18.5 to 23 kg/m2 (normal). Only 3.77% was in underweight category (<18.5kg/m2). Out of 53 participants, 42% of them are consuming iron supplementation in the present pregnancy. Out of 38 participants who had previous pregnancies 97.37% consumed iron supplementation in past pregnancies.

3.4.1. Thalassaemia carrier status and Anaemia

Table: 9

		Thalassaemia Carriers		Total
		carrier	Non-carriers	
Normal	Count	7	24	31
	%	38.89%	75.00%	62.00%
Anaemic	Count	11	8	19
	%	61.11%	25.00%	38.00%
Total	Count	18	32	50
	%	100.00%	100.00%	100.00%
Note: The 3 cases that did not have Thalassaemia screening were excluded. $X^2 = 4.936$, p =0.026				

Table-9 shows the association between Thalassaemia carrier status and anaemia. Among Thalassaemia carriers, 11 (61.11%) were found to be anaemic whereas, from those who were not Thalassaemia carriers, only 8 (25.00%) were found to be anaemic. The results of the Chi-square test indicated that there is a statistically significant association between the status of Thalassaemia carrier and anaemia ($X^2 = 4.936$, p = 0.026).

3.4.2. BMI and Anaemia

Table: 10

		BMI Classification			Total
		normal weight	overweight	obese	
Normal	Count	5	7	19	31
	%	50.00%	50.00%	70.37%	60.78%
Anaemic	Count	5	7	8	20
	%	50.00%	50.00%	29.63%	39.22%
Total	Count	10	14	27	51
	%	100.00%	100.00%	100.00%	100.00%
Note: The 2 cases that were in the underweight category were excluded due to a small number of cases. $X^2 = 2.212$, p = 0.331					

Table-10 illustrates the association between BMI and anaemia. Of those who had normal weight, 5 (50.00%) were found to be anaemic. Additionally, of those who were overweight, 7 (50.00%) were found to be anaemic while of those who were obese, 8 (29.63%) were found to be anaemic. The results of the Chi-square test indicated that no statistically significant association between BMI and anaemia ($X^2 = 2.212$, p = 0.331).

4. Discussion

This study results showed that the prevalence of anaemia among pregnant women in the community selected was 39.60%. The prevalence of anaemia among pregnant women in the Maldives was reported to be 48.5% in 2016 (W.H.O, 2021). Another study conducted among women of reproductive age in three South-Asian countries revealed that the prevalence of anaemia was 41.8% in Bangladesh, 58.5% in the Maldives, and 40.60% in Nepal (Rahman et al., 2021). Global data showed that the prevalence in developed countries is 14% and 51% in developing countries (Suryanarayana et al., 2017).

This study in the selected community from the north of Maldives showed a lower prevalence than the values reported for the Maldives and neighbouring countries. The lower prevalence in this community may be due to the improvement of health care for pregnant women and the development of awareness in reproductive health in the community. The government of Maldives provides free access to health care and over the years it has established ANC care services in all rural communities. Community health services are established in each atoll and the overall coverage of ANC is 97%, and 90% of women have their first ANC visit in the first trimester of pregnancy (Ministry of Health, Maldives, 2014).

All pregnant women were married and the minimum age of pregnant women found in the sample was 21 years. Hence, no participant was categorized in the age group below 18 years. According to Maldivian law, it prohibits matrimonies below 18 years of age. Therefore, underage pregnancy may not be seen as seen in other societies. Teenage pregnancy is a risk factor for preventing anaemia in pregnant women. The prevalence of anaemia in teenage pregnancy was 61% in Western Kenya (Shipala et al., 2013) and 53% in Malaysia (Jusoh et al., 2013).

In this study, it was found that in the selected sample none of the participants had a habit of smoking and alcohol use. Studies conducted among pregnant women in India reported that tobacco use was strongly, positively and independently associated with iron deficiency anaemia (Mistry et al., 2018). Brazilian studies showed that smoking had a 79% risk of developing anaemia compared with nonsmokers and consumption of alcohol during pregnancy was significantly associated with anaemia (Lucas dos et al., 2020). Hence, these behavioural factors are not concerns in the community studied due to religious prohibition of alcohol consumption and the low social value of smoking women.

Social factors such as occupation, level of education and household conditions are factors associated with anaemia in developing countries (Mekonnen et al., 2018). However, this study could not identify the association of anaemia with occupation and household conditions. (Table: 2) This association is not observed because all cases were married and the majority (71.70%) of the participants were housewives, participants were well protected and cared for by their families in the community. Additionally, the educational level of the participants has not shown a statistically significant association. However, a decreasing trend in the prevalence of anaemia with an increased level of education was observed in the sample studied. This aligns with the Turkish study that showed women with low educational levels were significantly more vulnerable to anaemia than others (Taner et al., 2015).

Diet and the nutritional status of a woman before, during and after pregnancy are important for effective outcomes. Inadequate diet and nutritional status have shown a significant association with anaemia in pregnancy (Ayensu et al., 2020). In this study, the diet was categorized as Regular Maldivian diet and Balanced diet. Anaemia was found in 40% and 39% of participants in the Regular Maldivian diet category and Balanced diet category respectively. Hence, the association between food habits and anaemia was not statistically significant. Additionally, 50.94% of the participants were found to be obese according to the BMI status of the participants. Only 3.77% of participants were underweight. A study from China showed that overweight and obese women had higher iron consumption when compared with women having lower BMI (Qin et al., 2013). Another study conducted in Saudi Arabia found that the risk of developing anaemia is less in women with higher BMI (AlQuaiz et al., 2013). The under-nutrition has not been found in the community probably due to the better living standard in the Maldives compared with many developing countries. However, further studies are needed to find out the micronutrients that exist in the diet to understand the real association of anaemia and nutritional factors in the Maldives.

In this study, 46.67 % of nulliparous were found to be anaemic while only 36.84% of multiparous participants presented anaemia. This result is contrary to studies encountered. Single centred research conducted in Japan showed that the prevalence of anaemia and iron deficiency was higher in multiparous than in nulliparous women (Imai, 2020). Similarly, pregnant women having birth intervals of less than two years were found to be at higher risk of becoming anaemic (Kassahun et al., 2016). Nevertheless, this study, it showed anaemia prevalence was 28.57 % among participants who had an average inter-pregnancy interval less than 3 years and 47.06% among average inter-pregnancy interval more than 3 years with p-value of 0.403. Therefore, contrary to these studies in this community association between inter-pregnancy interval and anaemia was not statistically significant. This could be because 97.00% of multiparous consumed iron supplementation in their past pregnancies. In the current pregnancy, 79.25% of participants were using iron supplementation. Similarly, this study showed that the mean interval between the pregnancies was 3.5 years.

This study did not aim to identify complications and pregnancy outcomes. However, complications of previous pregnancies were counted in this study. 50% of the multiparous participants presented complications in their past pregnancies and 52.63% of them were found to be anaemic in this study. Although P-value calculated was 0.093 and statistically not significant when compared with the multiparous group without complications, a high percentage suggests that complications presented in previous pregnancies may influence the prevalence of anaemia in this study.

It estimates that one in every six Maldivian is a thalassaemia carrier and approximately 60-70 children are born with Thalassaemia annually in the Maldives (Ministry of Health, Maldives, 2016). A study to demonstrate carrier screening for beta-thalassaemia in the Maldives revealed 16–18 % of the Maldivians are β-thalassaemia carriers (Waheed et al, 2016). However, there are no researches done in the Maldives to identify the link of this risk factor with anaemia in pregnancy. Haemodilution caused by pregnancy is added to pre-existing hypochromic microcytic anaemia in thalassaemia carrier's results in more prominent anaemia. However, pregnancy outcomes and complications were found to be the same as in the general population. Hence, no specific therapy is recommended during pregnancy in thalassaemia carriers (Tsatalas et al., 2013).

In this study, 61.11% of participants in the thalassaemia carrier group was found to be anaemic with P-value < 0.026 compare to the prevalence of anaemia in the normal category of participants. This is consistent with studies done in countries with a high prevalence of thalassaemia. A study conducted in Maharaj Nakorn Chiang Mai Hospital**,** Thailand showed that the prevalence of anaemia in pregnant women was 20.1%. The main causes of anaemia were thalassaemia carriers and iron deficiency anaemia (Sukrat & Sirichotiyakul, 2006). Another study from Thailand revealed that the prevalence of thalassaemia carriers in anaemic pregnant women was 39.70% and the non-anaemic group was 24.4% (Sukrat et al., 2010). Therefore, the high percentage of thalassaemia carriers is the major factor associated with the high prevalence of anaemia among the pregnant population in the Maldives. Advance research is required in this area for further understanding.

5. Limitations

This study was planned to conduct among the participants attending ANC services from the northern atolls of Maldives. Unfortunately, due to the restrictions on travelling during Covid 19 pandemic, the majority of the participants in the sample were from the main island (Kulhudhufushi). This limits the participation of communities from different islands. Additionally, time duration had to be shortened due to the implementation of lockdown rules and limited OPD services. However, the sample size calculated was reached by lot of effort. This study is also limited to prevalence and risk factors. Complications and pregnancy outcomes were not measured. Similarly, the lack of recent researches in pregnancy complications and recent data on gestational anaemia in the Maldives were limitations to compare results of this research.

6. Conclusion

This study showed the prevalence of anaemia in pregnant women of this community is 39.60%. This prevalence calculated is lower than the prevalence of anaemia in pregnant women reported for the country. Additionally, this value is lower than the prevalence of anaemia in pregnant women from other countries of South Asia. The high incidence of thalassaemia carriers encountered in the population was found to be the main factor associated with the prevalence of maternal anaemia in the community. However, further researches are required to investigate the association of other factors independently with anaemia.

7. Recommendations

Based on the findings of this study the following recommendations are suggested:

1. Strengthening and maintaining established ANC services in atolls by providing health education and adequate information about their pregnancy.
2. Ensure sustainability of iron supplementation during pregnancy.
3. Establish preconception care (PCC) in island communities.
4. Strengthen thalassaemia screening programs and provide information on pregnancy care in thalassaemia carriers.
5. Provide training opportunities to health care professionals to deliver effective ANC.
6. Explore limitations that may affect the capacity of health care in rural communities to achieve high-quality ANC and establish better transport services in between islands.
7. Conduct further researches to determine the association of nutrition and prevalence of maternal anaemia in the Maldives.

8. Conflict of interest

The author declares no conflict of interest.

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