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CROSS-SECTIONAL OBSERVATIONAL STUDY ON THE PREVALENCE OF NON-COMMUNICABLE DISEASES IN OFFSHORE WORKFORCE ATTENDING BIENNIAL MEDICAL EXAMINATION AT A PRIVATE HEALTHCARE SETTING IN THE MIDDLE EAST

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Abstract

Background: Non-communicable diseases (NCDs) account for most global deaths as per the WHO (World Health Organization). The burden of NCDs has been steadily increasing over the years, and these diseases are responsible for approximately 71% of all deaths globally. Diabetes, cancer, respiratory diseases, and cardiovascular diseases (stroke and heart disease) are among the leading causes of death worldwide as an invisible pandemic. These conditions contribute significantly to the global healthcare burden. NCDs are also referred to as chronic disease conditions that prolong for a certain duration due to behavioural, psychological, genetic, and environmental factors that result in 74% of all deaths globally. Therefore, this study aims to understand the need to intervene early to prevent the rise in mortality related to non-communicable diseases in the Middle East offshore workforce.

Methods: This study used a cross-sectional design to analyse the prevalence of NCDs at Biennial medical examinations, particularly in the offshore workforce. The offshore workforce who visited a private medical centre for their biennial medical exam were extracted from EHRs (electronic health records) from Dec 2022 to Dec 2023 with a focus on obesity, prediabetes and diabetes, lipid abnormalities, and blood pressure recordings, and aged ≥18 years. descriptive statistics, chi-square test, correlation, and Kolmogorov-Smirnov test were conducted on the recorded physical parameters and laboratory data.

Results: The data analyzed showed the following results: participants' mean age was 44.43 years (SD = 8.799), with a BMI (body mass index) mean of 27.9142 (SD = 4.64731), indicating a prevalence of overweight individuals. Systolic blood pressure (SBP) had a mean of 124.180 mmHg (SD = 14.1437), and diastolic blood pressure (DBP) had a mean of 79.636 mmHg (SD = 8.4288), reflecting a normotensive range overall. The mean fasting blood sugar (FBS) was 95.852 mg/dL (SD = 13.8719), and the mean HbA1c was 6.456% (SD = 1.0736), suggesting a notable presence of prediabetes. Lipid profile analysis showed mean total cholesterol (T. Cholesterol) at 183.91 mg/dL (SD = 39.224), triglycerides (TLG) at 107.862 mg/dL (SD = 68.9641), high-density lipoprotein (HDL) at 41.304 mg/dL (SD = 10.3856), low-density lipoprotein (LDL) at 120.653 mg/dL (SD =

34.7183), and very-low-density lipoprotein (VLDL) at 21.499 mg/dL (SD = 14.2262). The Kolmogorov-Smirnov test indicated that all parameters, except for triglycerides, deviated significantly from normal distribution ($p < 0.01$).

Conclusion: The analysis of the offshore workforce attending biennial medical examinations in the Middle East reveals a significant prevalence of NCDs (non-communicable diseases), particularly obesity, hypertension, hyperlipidemia, and diabetes. The data show that a substantial proportion of the workforce is overweight or obese, with a notable correlation between age and BMI. High rates of prehypertension and hypertension, along with significant associations between obesity and elevated blood pressure, underscore the critical need for targeted health interventions.

Keywords: Obesity, Pre-diabetes, Diabetes, Hypertension, Hyperlipidemia, NCD

Introduction:

The increasing prevalence of non-communicable diseases (NCDs) in the community is a hidden ongoing pandemic. NCDs are diseases that do not transfer from person to person; they are caused due to different factors, including behavioural, environmental, physiological and genetic. As per the WHO they are more commonly seen in middle and low-income countries. Non-communicable disease's global burden is estimated to be about 41 million deaths each year, approximately 74% of all deaths globally. It is estimated that about 17 million people die of a noncommunicable disease every year in middle- and low-income countries due to non-communicable disease [(1)]. The most common forms of NCDs are cerebrovascular disease, cardiovascular diseases, chronic respiratory disease, cancer, and diabetes mellitus. WHO statistics show that the majority of deaths are due to cardiovascular diseases, followed by cancers, chronic respiratory diseases, and diabetes with renal disease. The above diseases are estimated to cause 80% of premature deaths due to non-communicable diseases. A study done in Qatar in 2019 revealed that 16.2% of young age group male individuals belonging to Asian, African, and Western ethnicity had above four NCDs. The research reflects an urgent need for investment in targeted interventions with a multidisciplinary approach for the prevention of NCDs, as it is a substantial challenge in the health sector [(2)]. A high-level United Nations meeting was held in Sept 2018 to overcome the NCDs burden and review the NCDS prevention and control progress at global and national level. It also helped to focus on the reinforcement, renewal, and enforcement policies to address NCDs burden and it was named as NCD countdown 2030[(3)].

NCDs are a non-contagious disease that involves multiple risk factors for a prolonged time. It is not possible to cure completely NCDs associated disability. Other NCDs such as mental health and neurological syndrome (e.g., Parkinson's' Disease, dementia, depression, Alzheimer's disease, schizophrenia), ophthalmological issues (such as glaucoma, ENT such as hearing loss and vertigo), diseases related to the musculoskeletal system (such as rheumatoid arthritis, osteoarthritis, osteoporosis), diseases of the renal system (such as chronic renal failure) and other autoimmune conditions also cause global health burden. Adaptation of "Westernization" as a lifestyle is considered one of the causes of the rise in non-communicable diseases, particularly in middle and low-income nations. The fact is that most morbidity and mortality related to NCDs could be delayed or prevented with early lifestyle changes, leading to longer, healthier, and happier lives [(4)]. In this study collected data was analyzed on offshore workers who follow a different work pattern in which they work 28 days followed by an off period of 28 days to assess the prevalence of NCDs among this workforce.

Materials and Methods:

Study design, population, and sampling

A Cross-sectional descriptive design was used in the study to assess the prevalence of NCDs in the Middle East off-shore workers. The study was conducted on 900 men who are predominantly offshore workers from different parts of the world working in an international drilling company located in the Middle East. The samples selected were from offshore workers who attended their annual medical examination as mandated by the drilling company to assess their offshore work fitness. This included

a complete physical examination including their weight, height, BMI, blood pressure recording, general and systemic examination, and laboratory workup.

Data Collection

The data was collected retrospectively from 1st December 2022 to 31st December 2023, and analysis was done on the various parameters such as physical and laboratory-based values, to study the prevalence of NCDs in this workforce. The data was classified based on the age group of participants. Including participant's BMI, blood pressure recordings of both SBP (systolic blood pressure), DBP (diastolic blood pressure), and Hba1c was done for participants who had an FBS (Fasting Blood Sugar) value above >100 mg/dl, and fasting blood sugar assessment was done. The lipid profile was divided into Triglycerides, Total cholesterol, LDL-cholesterol, HDL-cholesterol, and VLDL (Very Low-Density Lipoprotein) cholesterol. Participants' ethnicity was included and was broadly classified as Asian and Non-Asian.

Data Analysis:

The collected data were organized and analyzed using the SPSS Inc., Chicago, IL, USA version 26 (Statistical Package for Social Sciences). All demographic variables and descriptive statistics (including frequencies, mean, standard deviation, and central tendency measures applied) were used to analyse data. The Chi-square test was applied to test the association between diseases at a 5% significance level. Moreover, correlation analysis was performed using Spearman correlation after checking the normality with the Kolmogorov-Smirnov test. Utilizing proportions for discrete variables. Comparisons were made between the normal and obese, normal versus hypertension, and normal versus diabetic patients.

Results:

Table 1. Demographics representing the frequency and percentage of obesity, hypertension, hyperlipidemia, and Diabetes

Attributes/Categories	N	%
Age (years)		
< 30	46	5.1%
31-40	273	30.3%
41-50	351	39.0%
51-60	193	21.4%
> 60	37	4.1%
Ethnicity		
Asian	671	74.6%
Non-Asian	229	25.4%
BMI		
Normal	204	22.7%
Overweight	479	53.2%
Obese Class-I	172	19.1%
Obese Class-II	38	4.2%
Obese Class-III	7	0.8%
SBP		
Normal	542	60.2%
Prehypertension	256	28.4%

Hypertension Stage-I	92	10.2%
Hypertension Stage-II	10	1.1%
FBS		
Normal	658	73.1%
Prediabetes	215	23.9%
Diabetes	27	3.0%
T. Cholesterol		
Desirable	602	66.9%
Borderline	217	24.1%
High	81	9.0%
TLG		
Desirable	746	82.9%
Borderline	90	10.0%
High	64	7.1%
HDL		
Low	732	81.3%
Desirable	168	18.7%
LDL		
Optimal	240	26.7%
Near-optimal	320	35.6%
Borderline	220	24.4%
High	91	10.1%
Very high	29	3.2%
VLDL		
Desirable	871	96.8%
High	29	3.2%

Table 1 represents the study's demographic data, a diverse age distribution among the offshore workforce attending biennial medical examinations, with the majority being in the 41-50 age group (39.0%), followed by those aged 31-40 (30.3%).

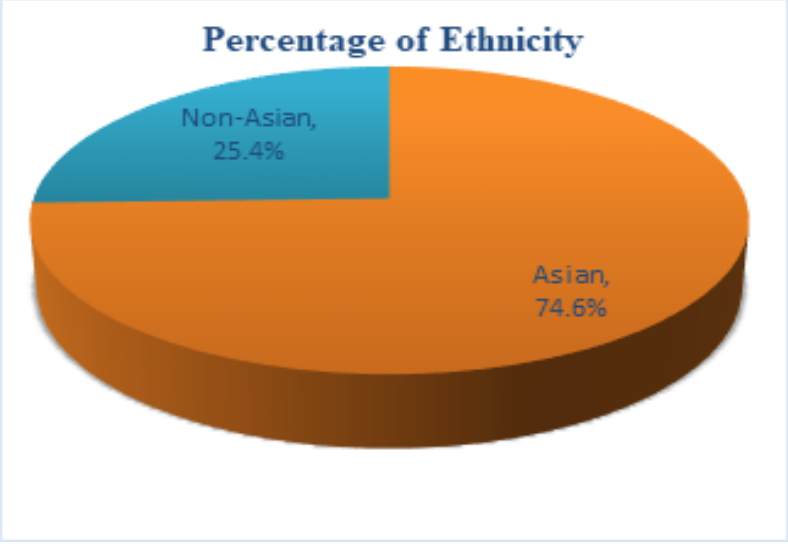

Figure 1: Participant's Ethnicity

Ethnically, a significant portion of the population was Asian (74.6%), with non-Asians comprising 25.4%, as depicted in Figure 1. Body Mass Index (BMI) categories indicated that over half of the workforce (53.2%) were overweight, while 22.7% had a normal BMI. A considerable portion fell into the obesity categories, with 19.1% classified as Obese Class-I, 4.2% as Class-II Obese, and 0.8% as Class-III Obese, as depicted in Table 1.

Systolic Blood Pressure (SBP) measurements showed that 60.2% had normal SBP, whereas 28.4% were in the prehypertension range, and 11.3% had hypertension (10.2% in Stage I and 1.1% in Stage II) (Figure 2).

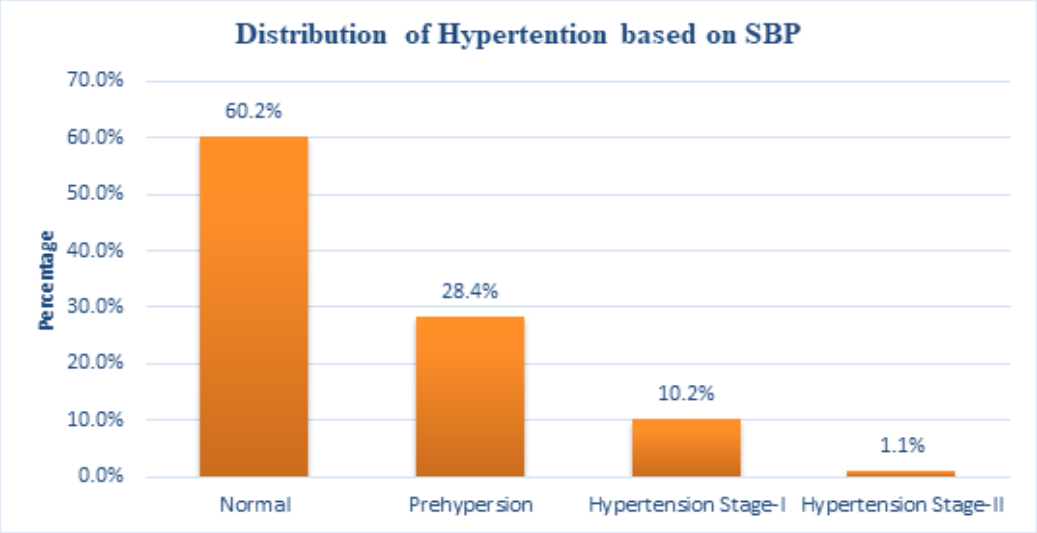

Figure 2: Hypertension Distribution among Participants

Table 1 also demonstrates that for fasting Blood Sugar (FBS) levels, the majority (73.1%) had normal glucose levels. However, 23.9% were prediabetic, and 3.0% were diagnosed with diabetes. Lipid profile analysis showed that 66.9% had desirable total cholesterol levels, 24.1% had borderline levels, and 9.0% had high levels. Triglyceride (TLG) levels were desirable in 82.9% of individuals, borderline in 10.0%, and high in 7.1%. High-density lipoprotein (HDL) levels were low in a substantial portion of the population (81.3%), with only 18.7% having desirable levels. Low-density lipoprotein (LDL) levels were optimal in 26.7% of individuals, near-optimal in 35.6%, borderline in 24.4%, high in 10.1%, and very high in 3.2%. VLDL levels were desirable in 96.8% of the workforce, with only 3.2% having high levels. These results highlight the significant prevalence of obesity, prehypertension, prediabetes, and lipid abnormalities among the offshore workforce, indicating a need for targeted interventions to manage and reduce the NCD burden in this population. The findings show overweight and obesity high rates that suggest a pressing necessity for lifestyle and dietary modifications. The substantial proportions of individuals with low HDL and borderline/high LDL levels further emphasize the risk of cardiovascular diseases within this group. Regular monitoring and preventive measures are crucial for improving the health outcomes of the offshore workforce in Qatar.

Table 2. Testing the association of Obesity with other diseases and hyperlipidemia

Attributes	Categories	BMI				Chi-square
		Normal		**Obese**		
		N	**%**	**N**	**%**	**P-value**
Age	< 30	20	9.8%	26	3.7%	0.002
	31-40	60	29.4%	213	30.6%	
	41-50	85	41.7%	266	38.2%	
	51-60	34	16.7%	159	22.8%	
	> 60	5	2.5%	32	4.6%	

Ethnicity	Asian	167	81.9%	504	72.4%	0.006
	Non-Asian	37	18.1%	192	27.6%	
SBP	Normal	141	69.1%	401	57.6%	0.006
	Pre-hypertension	52	25.5%	204	29.3%	
	Stage-I Hypertension	10	4.9%	82	11.8%	
	Stage-II Hypertension	1	0.5%	9	1.3%	
FBS	Normal	156	76.5%	502	72.1%	0.340
	Prediabetes	41	20.1%	174	25.0%	
	Diabetes	7	3.4%	20	2.9%	
T.Cholesterol	Desirable	140	68.6%	462	66.4%	0.446
	Borderline	43	21.1%	174	25.0%	
	High	21	10.3%	60	8.6%	
TLG	Desirable	173	84.8%	573	82.3%	0.195
	Borderline	14	6.9%	76	10.9%	
	High	17	8.3%	47	6.8%	
HDL	Low	149	73.0%	583	83.8%	0.001
	Desirable	55	27.0%	113	16.2%	
LDL	Optimal	60	29.4%	180	25.9%	0.398
	Near-optimal	75	36.8%	245	35.2%	
	Borderline	43	21.1%	177	25.4%	
	High	17	8.3%	74	10.6%	
	Very high	9	4.4%	20	2.9%	
VLDL	Desirable	198	97.1%	673	96.7%	0.796
	High	6	2.9%	23	3.3%	

***If p-value < 0.01 Highly significant, if p-value < 0.05 Significant, if p-value > 0.05 Nonsignificant**

The analysis of NCDs among an offshore workforce attending biennial medical examinations reveals significant associations between obesity and various health attributes. The data show that age distribution is significantly associated with obesity, with individuals aged 41-50 and 31-40 representing the highest proportions of obese individuals (38.2% and 30.6%, respectively, p = 0.002).

Ethnicity was also found to be significantly associated with obesity, with non-Asian individuals more likely to be obese compared to their Asian counterparts (27.6% vs. 18.1%, p = 0.006). SBP recordings indicate that obese individuals are more likely to have prehypertension and hypertension (29.3% and 13.1%, respectively) compared to those with normal BMI (p = 0.006). While, FBS levels and T. Cholesterol were not found to be significantly associated with obesity (p=0.340 and p=0.446). Subsequently, HDL levels were found to be lower in obese individuals significantly (83.8% with low HDL, p = 0.001).

The study underscores the critical need to address obesity as it increases the risk for hypertension. Low HDL levels within this population highlight the importance of targeted interventions to manage obesity and its associated health risks.

Table 3. Testing the association of Hypertension with other diseases and hyperlipidemia

Attributes	Categories	SBP				Chi-square
		Normal		**Hypertension**		
		N	**%**	**N**	**%**	**P-value**
Age	< 30	35	6.5%	11	3.1%	0.000
	31-40	192	35.4%	81	22.6%	
	41-50	208	38.4%	143	39.9%	
	51-60	87	16.1%	106	29.6%	
	> 60	20	3.7%	17	4.7%	
Ethnicity	Asian	402	74.2%	269	75.1%	0.744
	Non-Asian	140	25.8%	89	24.9%	
SBP	Normal	542	100.0%	0	0.0%	0.000
	Prehypertension	0	0.0%	256	71.5%	
	Hypertension Stage-I	0	0.0%	92	25.7%	
	Hypertension Stage-II	0	0.0%	10	2.8%	
FBS	Normal	397	73.2%	261	72.9%	0.881
	Prediabetes	130	24.0%	85	23.7%	
	Diabetes	15	2.8%	12	3.4%	
T.Cholesterol	Desirable	365	67.3%	237	66.2%	0.938
	Borderline	129	23.8%	88	24.6%	
	High	48	8.9%	33	9.2%	
TLG	Desirable	461	85.1%	285	79.6%	0.046
	Borderline	44	8.1%	46	12.8%	
	High	37	6.8%	27	7.5%	
HDL	Low	431	79.5%	301	84.1%	0.041
	Desirable	111	20.5%	57	15.9%	
LDL	Optimal	138	25.5%	102	28.5%	0.091
	Near-optimal	212	39.1%	108	30.2%	
	Borderline	123	22.7%	97	27.1%	
	High	51	9.4%	40	11.2%	
	Very high	18	3.3%	11	3.1%	
VLDL	Desirable	527	97.2%	344	96.1%	0.342
	High	15	2.8%	14	3.9%	

***If p-value < 0.01 Highly significant, if p-value < 0.05 Significant, if p-value > 0.05 Nonsignificant**

From Table 3, it was found that there is a significant association between age and hypertension, with a higher hypertension prevalence in older age groups ($p < 0.001$). The percentage of individuals with hypertension increased notably in the age groups 41-50 (39.9%) and 51-60 (29.6%). No significant difference was found in hypertension prevalence between Asian and non-Asian ethnicities ($p = 0.744$). Hypertension was strongly associated with higher systolic blood pressure (SBP) categories, with all hypertensive individuals falling into prehypertension or higher stages ($p < 0.001$). FBS levels were not found to be significantly associated with hypertension ($p = 0.881$). Total cholesterol levels association was not found with hypertension, as TCLs insignificant difference found between those with and without hypertension ($p = 0.938$). However, TLG and HDL cholesterol were significantly associated with hypertension. Higher triglyceride levels were more common in hypertensive individuals ($p = 0.046$), and individuals with a high percentage of hypertension had low HDL levels ($p=0.041$). LDL cholesterol and VLDL cholesterol did not show significant associations with hypertension ($p = 0.091$ and $p = 0.342$). These findings highlight the importance of monitoring lipid profiles and managing dyslipidemia in the management of hypertension in the Asian population.

Table 4. Testing the association of Diabetes with other diseases and hyperlipidemia

Attributes	Categories	FSB				Chi-square
		Normal		**Diabetes**		
		N	**%**	**N**	**%**	**P-value**
Age	< 30	39	5.9%	7	2.9%	0.000
	31-40	223	33.9%	50	20.7%	
	41-50	255	38.8%	96	39.7%	
	51-60	117	17.8%	76	31.4%	
	> 60	24	3.6%	13	5.4%	
Ethnicity	Asian	474	72.0%	197	81.4%	0.004
	Non-Asian	184	28.0%	45	18.6%	
SBP	Normal	397	60.3%	145	59.9%	0.024
	Prehypertension	198	30.1%	58	24.0%	
	Hypertension Stage-I	56	8.5%	36	14.9%	
	Hypertension Stage-II	7	1.1%	3	1.2%	
FBS	Normal	658	100.0%	0	0.0%	0.000
	Prediabetes	0	0.0%	215	88.8%	
	Diabetes	0	0.0%	27	11.2%	
T.Cholesterol	Desirable	439	66.7%	163	67.4%	0.896
	Borderline	158	24.0%	59	24.4%	
	High	61	9.3%	20	8.3%	
TLG	Desirable	555	84.3%	191	78.9%	0.145
	Borderline	59	9.0%	31	12.8%	
	High	44	6.7%	20	8.3%	
HDL	Low	535	81.3%	197	81.4%	0.973
	Desirable	123	18.7%	45	18.6%	
LDL	Optimal	170	25.8%	70	28.9%	0.235
	Near-optimal	231	35.1%	89	36.8%	
	Borderline	166	25.2%	54	22.3%	
	High	65	9.9%	26	10.7%	
	Very high	26	4.0%	3	1.2%	
VLDL	Desirable	639	97.1%	232	95.9%	0.348
	High	19	2.9%	10	4.1%	

***If p-value < 0.01 Highly significant, if p-value < 0.05 Significant, if p-value > 0.05 Nonsignificant**

The analysis revealed significant associations between diabetes and age, ethnicity, FBS (fasting blood sugar), and SBP (systolic blood pressure). Specifically, the prevalence of diabetes was significantly higher in individuals aged 41-50 (39.7%) and 51-60 (31.4%) compared to those under 30 years old (2.9%, p = 0.000). Ethnically, diabetes was more prevalent among Asians (81.4%) compared to non-Asians (18.6%, p = 0.004). Regarding SBP, a higher prevalence of hypertension Stage-I was observed in the participants with diabetes (14.9%) than in the normal group (8.5%, p = 0.024). Notably, all diabetic individuals were classified as either prediabetic (88.8%) or diabetic (11.2%) based on their FBS levels (p = 0.000). Although cholesterol levels (T.Cholesterol, TLG, HDL, LDL, VLDL) showed no differences between the diabetic and non-diabetic groups significantly, a trend towards higher borderline and high triglycerides were noted in the diabetic group. These outcomes underscore the necessity of diabetes management targeted intervention in this population, particularly focusing on older age groups, Asian ethnicity, and individuals with hypertension.

Table 5. Descriptive statistics of parameters for obesity, hypertension, hyperlipidemia, and diabetes

Variables	Mean	SD	Minimum	Maximum	Percentiles			K-S Test
					25th	**Median**	**75th**	**P-value**
Age	44.43	8.799	21	65	38.00	44.00	51.00	0.000
BMI	27.9142	4.64731	16.00	91.50	25.2250	27.5000	29.8850	0.000
SBP	124.180	14.1437	90.0	200.0	110.000	120.000	130.000	0.000
DBP	79.636	8.4288	60.0	110.0	72.000	80.000	80.000	0.000
FBS	95.852	13.8719	61.0	240.0	88.000	94.000	100.000	0.000
Hba1c	6.456	1.0736	5.2	12.1	5.700	6.100	6.850	0.000
T.Cholesterol	183.91	39.224	62	344	156.25	182.00	209.00	0.000
TLG	107.862	68.9641	30.0	1185.0	66.000	92.000	131.000	0.090
HDL	41.304	10.3856	15.0	83.0	34.000	41.000	47.000	0.000
LDL	120.653	34.7183	25.0	292.0	98.000	119.000	141.000	0.002
VLDL	21.499	14.2262	3.0	237.0	13.000	18.000	26.000	0.000

***If p-value < 0.01 Highly significant, if p-value < 0.05 Significant, if p-value > 0.05 Nonsignificant. K-S test: Kolmogorov-Smirnov test for normality of the data.**

The descriptive statistics for key parameters related to obesity, hypertension, hyperlipidemia, and diabetes revealed significant findings. Participants mean age was 44.43 years (SD = 8.799), with a BMI (body mass index) mean of 27.9142 (SD = 4.64731), indicating a prevalence of overweight individuals. SBP had a mean of 124.180 mmHg (SD = 14.1437), and DBP had a mean of 79.636 mmHg (SD = 8.4288), reflecting a normotensive range overall. The mean FBS was 95.852 mg/dL (SD = 13.8719), and the mean HbA1c was 6.456% (SD = 1.0736), suggesting a notable presence of prediabetes. Lipid profile analysis showed mean T. Cholesterol at 183.91 mg/dL (SD = 39.224), TLG at 107.862 mg/dL (SD = 68.9641), HDL at 41.304 mg/dL (SD = 10.3856), LDL at 120.653 mg/dL (SD = 34.7183), and VLDL at 21.499 mg/dL (SD = 14.2262). The Kolmogorov-Smirnov test indicated that all parameters, except for triglycerides, deviated significantly from normal distribution ($p < 0.01$), highlighting the need for targeted interventions to address these prevalent non-communicable disease risk factors in this population.

Table 6. Correlation analysis of parameters for obesity, hypertension, hyperlipidemia, and diabetes

Attributes	Coefficients	Age	BMI	SBP	DBP	FBS	Hba1c	T.Cholesterol	TLG	HDL	LDL
BMI	r	.112**									
	P-value	0.001									
SBP	r	.259**	.252**								
	P-value	0.000	0.000								
DBP	r	.142**	.192**	.573**							
	P-value	0.000	0.000	0.000							
FBS	r	.193**	0.043	.112**	.073*						
	P-value	0.000	0.196	0.001	0.029						

Hba1c	r	0.136	0.018	0.114	0.102	.531**				
	P-value	0.070	0.817	0.130	0.176	0.000				
T.Cholesterol	r	-0.011	0.039	0.021	0.015	0.000	-.164*			
	P-value	0.748	0.246	0.531	0.655	0.997	0.030			
TLG	r	0.028	.220**	0.063	.089**	.167**	0.054	.411**		
	P-value	0.407	0.000	0.059	0.008	0.000	0.472	0.000		
HDL	r	0.061	-.175**	0.002	-0.021	0.013	-.199**	.201**	-.304**	
	P-value	0.068	0.000	0.954	0.538	0.694	0.008	0.000	0.000	
LDL	r	-0.054	0.041	0.016	0.019	-0.043	-.181*	.928**	.265**	0.038
	P-value	0.107	0.223	0.627	0.575	0.196	0.016	0.000	0.000	0.252
VLDL	r	0.034	.220**	0.063	.091**	.172**	0.063	.409**	.993**	-.302**	.268**
	P-value	0.311	0.000	0.006	0.006	0.000	0.406	0.000	0.000	0.000	0.000

If p-value < 0.01 Highly significant, if p-value < 0.05 Significant, if p-value > 0.05 Nonsignificant.
r: Spearman's correlation coefficient.

The correlation analysis of parameters related to obesity, hypertension, hyperlipidemia, and diabetes in an offshore workforce attending biennial medical examinations in a private healthcare setting in Qatar reveals several significant relationships. A positive correlation was found between Age and BMI (r = .112, p = .001). Similarly, SBP (r = .259, p = .000), DBP (r = .142, p = .000), FBS (r = .193, p = .000), and TLG (r = .028, p = .000) had a positive correlation with age. BMI shows a positive and strong correlation with SBP (r = .252, p = .000) and DBP (r = .192, p = .000). SBP and DBP are highly correlated (r = .573, p = .000). FBS is significantly correlated with SBP (r = .112, p = .001), DBP (r = .073, p = .029), and TLG (r = .167, p = .000), but not with BMI (r = .043, p = .196). Haemoglobin A1c (Hba1c) correlates strongly with FBS (r = .531, p = .000). T. Cholesterol shows a significant negative correlation with Hba1c (r = -.164, p = .030). TLG is correlated with BMI (r=.220, p=.000), DBP (r = .089, p = .008), and HDL (r = -.175, p = .000). A negative correlation was found between HDL and BMI (r = -.175, p = .000) and positively correlated with T. Cholesterol (r = .201, p = .000) but negatively correlated with VLDL (r = -.302, p = .000). LDL is highly correlated with T. Cholesterol (r = .928, p = .000) and TLG (r = .265, p = .000). VLDL shows strong correlations with T. Cholesterol (r = .409, p = .000), TLG (r = .993, p = .000), and HDL (r = -.302, p = .000). These findings highlight the intricate relationships between these health parameters, indicating the potential impact of obesity, blood pressure, lipid abnormalities, and glycemic control on the health of offshore workers.

Discussion

The study findings revealed the prevalence of a wide range of NCDs among the offshore workforce, including high rates of obesity, hypertension, hyperlipidemia, and diabetes. Chijioke et al. [5] and Francisca et al.[6] supported this study's findings by indicating the increased prevalence of NCDs,

such as cardiovascular disease, among Nigerian offshore workers, which aligns with the observed patterns in the present research. The similarity between the findings of the current study with the reference studies may be subjected to common occupational factors, including the demanding nature of offshore work and stress. However, other factors, including sedentary behaviour and irregular work hours, can be explored in future studies to understand the underlying causes of the high prevalence of NCDs among offshore workers in both regions. Furthermore, the current study underscored that more than half of the workforce was overweight, accounting for 53.2%, where 24.1% had borderline to high cholesterol levels. Considering hypertension, around 11.3% of individuals were diagnosed with the respective condition, and a notable increase was observed in older age groups (41-50 years: 39.9%, 51-60 years: 29.6%). Besides, the diabetes prevalence was found to be higher in individuals aged 41-60 years, with 3.0% diagnosed with diabetes. These findings are in line with the published studies where Mochtar et al. [7] reported that the number of offshore workers in Qatar who were taking anti-hypertensive drugs and had diabetes diagnoses was increasing in a significant proportion, which underscored the risk of increased NCD prevalence among the respective population. However, this study included a small sample size, which might restrict the representation generalization of funding for oil and gas workers.

Furthermore, the study indicated a notable association between age and various health conditions, with individuals aged 41-50 years and 51-60 years exhibiting a higher prevalence of obesity, hypertension, and diabetes. Riethmeister et al.[8] highlighted that offshore workers are considerably overweight, where 21% of them obese. Meanwhile, the prevalence of hypertension was more common in these older age brackets, which accounted for 29.6% and 39.9% in comparison to the diabetes diagnosis, including 38.2% and 30.6%, respectively. These findings align with the findings of Evoy et al.[9], who evaluated the health behaviours and conditions of maritime workers and revealed an increased prevalence of diabetes, obesity, COPD, and cancer among the older population. Similarly, Mannocci et al.[10] demonstrated a higher risk of obesity, hypertension, and high cholesterol among oil and gas energy company employees aged > 45 years in comparison to the younger group (<45 years) that might have occurred due to age-related metabolic changes among the older population that could have contributed to the prevalence rates.

The analysis further explained the occurrence of significant ethnic variations in the health outcomes of non-Asians showing a higher prevalence of obesity (45.7%) and Asians exhibiting an increased prevalence of diabetes (32.1%). Mui et al.[11] reported that other than the Asian population exhibited a higher adjusted prevalence of obesity in comparison to NHW (non-Hispanic White) men. To evaluate the differential disease prevalence among both ethnic groups, future studies should focus on factors that are influenced due to various lifestyle factors (dietary and cultural), such as the consumption of processed foods among non-Asians and a genetic predisposition to insulin resistance among Asians. Similar to the findings, Prakaschandra et al.[12] conducted an evaluation on Asians that showed metabolic disturbance and confirmed the notion that Asians show insulin resistance, which is associated with their tendency to central obesity. A possible explanation of the cause is the tendency of Asians to have total body fat, which causes insulin resistance, thus leading to diabetic prevalence[13.]

Besides the prevalence of NCDs and their association with other factors, the present study underscored a significant association between obesity and elevated health risks by revealing increased rates of prehypertension, hypertension, and lower HDL levels. Guo et al.[14] showed a connection between being overweight or obese with hypertension, as obesity serves as hypertension risk followed by LDL. The hinge between obesity and hypertension can be explained by understanding the association of obesity with the state of insulin resistance and hyperinsulinemia, which can contribute to hypertension following a series of mechanisms[15.] Alongside this, the study also underscored those individuals with obesity had a 64.5% prevalence of prehypertension and 52.8% prevalence of hypertension, compared to lower rates in non-obese individuals. Guo et al.[14] findings further indicated that the conversion rate of prehypertension to hypertension is substantially high among the male population. However, the study holds limitations in its reliance on

observational data, which may not establish causal relationships between prehypertension and risk factors. To understand the causality of progression from the prehypertensive to hypertensive state, future studies should focus on longitudinal studies rather than observational studies. However, the findings hint at the correlation between BMI and other health parameters, such as SBP and DBP blood pressure, underscores the impact of obesity on cardiovascular health. In support of these findings, Zahra et al.[16] reported that the BMI was higher among oil and gas employees, ranging from 24 to 30 kg/m^2. High BMI or obesity was confirmed to play a significant role in NCD prevalence, including CVDs. Additionally, the present study reported that triglyceride levels were significantly higher in obese individuals, contributing to a higher risk of metabolic syndrome. Bibra et al.[17] elucidated that the triglyceride/HDL-C ratio can be considered relevant for predicting the presence of metabolic syndrome and dyslipidemia due to its relevancy in reflecting insulin resistance as a key factor in respective cases. However, the study done by Bibra et al.[17] was based on the European population, and the current study has focused on 75% Asians and 25% non-Asians, which might differ from the findings due to differences in study population and sample. This may limit the generalizability of the findings to the diverse population. Further research is needed to explore these associations across different ethnic groups in different regions.

The study also analyzed levels of cholesterol and triglyceride where the finding unveiled a mix of desirable and borderline/high lipid levels among offshore workers. Besides, obesity and hypertension were strongly associated with unfavorable lipid profiles, with a higher prevalence of borderline/high cholesterol and triglycerides observed in these groups. These clusters of conditions, including obesity, hypertension, diabetes, and dyslipidemia, are termed metabolic syndrome, whose incidence is discussed in the relevant literature. Such as studies conducted by Reiner[18], Farnier et al.[19], Raposeiras-Roubin et al.[20], and Lanktree et al.[21] have confirmed the association of increased LDL or decreased HDL concentrations with the major risks of coronary atherosclerosis where triglycerides are found to be the independent factor. Similarly, Lechner et al.[22] enunciated that dyslipidemia is a major contributor to atherosclerosis and subsequent cardiovascular events. The findings revealed that simple hypercholesterolemia, hyperlipidemia, and low HDL-c were significantly linked with multivessel CAD (coronary artery disease) independent of CVD risk factors. However, Hedayatnia et al.[23] underpinned that the baseline level of total cholesterol in serum serves as a significant risk of incidence of myocardial infarction among the men population. The study's results emphasize the importance of monitoring and managing lipid levels, particularly in individuals with obesity and hypertension, to mitigate overall cardiovascular risk, but it still holds limitations due to its study design. The cohort study design has the potential to exclude residual confounding factors that might have influenced the observed association between the variables.

However, the correlation analysis elaborated that age was positively related to blood pressure and fasting blood sugar level, which indicated that individuals were more likely to experience impaired glycemic control accompanied by elevated blood pressure. Chia et al.[24] and Rodgers et al.[25] validated that age-related changes in glucose metabolism may present individuals at a heightened risk for CVD. Whereas, BMI showed strong correlations with blood pressure and lipid profiles, particularly with systolic and diastolic blood pressure, as well as triglyceride levels. The relationship between blood pressure and BMI is evident in the study by Kotsis et al.[26], who highlighted that obesity was found to be associated with higher blood pressure accompanied by greater blood volume. The relationship between BMI and fasting blood sugar further underscores obesity's role in the development of metabolic conditions like diabetes. These significant relationships between factors have significantly increased the risk of NCDs prevalence among the offshore workforce which requires effective management strategies for managing health parameters to address the multifaceted nature of chronic diseases.

Conclusion and Recommendations

The analysis of the offshore workforce attending biennial medical examinations reveals a significant prevalence of non-communicable diseases, particularly obesity, hypertension, hyperlipidemia, and diabetes. The data show that a substantial proportion of the workforce is overweight or obese, with a notable correlation between age and BMI. High rates of prehypertension and hypertension, along with significant associations between obesity and elevated blood pressure, highlight the critical targeted health interventions needed. Additionally, the study highlights the concerning prevalence of low HDL levels and borderline/high LDL levels, which are significant risk factors for cardiovascular diseases. The presence of prediabetes and diabetes in the workforce further emphasizes the necessity for comprehensive management strategies to address these metabolic disorders. The intricate relationships between obesity, blood pressure, lipid profiles, and glycemic control indicate that multifaceted interventions are required to mitigate the burden of NCDs in this population.

Based on these findings, it is recommended that targeted interventions be implemented to manage and reduce the risk factors associated with NCDs among the offshore workforces. These interventions should include lifestyle and dietary modifications to address obesity and regular physical activity programs. Additionally, routine monitoring of blood pressure, lipid profiles, and glycemic levels should be established to facilitate early detection and management of hypertension, hyperlipidemia, and diabetes. Health education programs focusing on the positive effects of maintaining a balanced diet and regular exercise for healthy weight should be prioritized. Furthermore, providing access to smoking cessation programs and stress management workshops could further enhance the overall health and well-being of the workforce. Collaborative efforts between healthcare providers and employers are essential to creating a supportive environment that promotes healthy behaviours and reduces the prevalence of NCDs in this high-risk population.

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Human and Animal Rights

As per the 2008 revised Helsinki Declaration of 1975, the study followed all procedures and ethical standards of the committee responsible for human experimentation (institutional and national).

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