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Association Between Body Mass Index (BMI) and Symptoms Severity in Patients Affected by Covid-19 in Kaski District, Nepal

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Abstract. Coronavirus disease 2019 (COVID-19), an illness caused by a novel coronavirus called severe acute respiratory syndrome (SARS CoV-2) first broke out from China and speeded globally. The virus so far has spread to almost all countries & caused millions of deaths and infection making it a worst pandemic. The clinical characteristics of Covid-19 vary from asymptomatic to fatal. This case-control study is conducted to examine the association between body mass index (BMI) levels and the Covid-19 disease severity. A total of 400 cases, and 699 controls were taken as the sample population for this study. All the study participants underwent RT-PCR test at Life Care Diagnostics and research center. Ethical consideration for this study was taken from institutional review committee, lifecare diagnostic and research center. Consent was taken from every subject before enrolling in the study. Our findings reveal the association between BMI and Covid-19 symptoms severity in case populations. We also have an impression that individuals with high BMI and comorbidity are even more likely to be in need of a ventilator and had to be admitted in hospital for a longer interval of time with the disease severity.

Introduction

In December 2019, China reported the first human cases of covid-19 in Wuhan city after an outbreak of pneumonia without any obvious cause. Later in January 2020, the virus started spreading to other parts of the world beside China making it a public health emergency of international concern. By now, the outbreak of coronavirus has created panic and fear globally, and the human population is baffled by the mysterious illness. As the virus spread to over 200

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countries and territories across the globe, WHO characterized it as the pandemic on 11 March, 2020 (Royal Pharmaceutical Society, 2020). As of January, 2020, there were approximately 85,553,477 laboratory confirmed cases of coronavirus disease 2019 (Covid-19) infection globally with 1,851,918 reported deaths (Worldometer, 2020).

In Nepal, the first case was reported in a 32 years old young man on 13th January, 2020 (Bastola et al 2020). WHO reported that in Nepal, from 3 January 2020 to 14th July 2021, there have been 658,778 confirmed cases of COVID-19 with 9,412 deaths.

The etiological agent of Covid-19, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), belongs to the betaCoVs category having crown-like appearance. The virus presents the spike glycoprotein on the envelope, and has a round or elliptic and often pleomorphic form. Having a diameter of approximately 60-140 nm, the virus with a single- stranded RNA genome contains 29891 nucleotides, encoding for 9860 amino acids (Cascella et al 2020).

To understand the level of severity caused by Covid-19, and to identify the risk population, multiple research studies have been carried out. For example, the research titled Obesity in patients with COVID-19: a systematic review and meta-analysis did a prospective cohort study of 233 patients hospitalized with covid-19 in Italy. The findings demonstrate that patients with obesity had a 3-fold higher risk of death as compared to those with a BMI<30kg/m2 (Huang et al., 2020). Similarly, the research titled obesity and covid-19: the unseen risks, done by a group of researchers explain that having a high BMI means the greater decline in antibody titers after the 12 months of vaccination, and the impairment of CD8+ T cell activation, leading to the functional response of the ex vivo influenza virus challenges. The research further added that the adults who vaccinated have twice the risk of influenza despite equal serological response as healthy weight adults (Syed et al., 2020).

As many of the research study identified obese as a risk factor for the severe complication during Covid-19, question such as why obesity a risk factor for severe covid-19 was vital to pin down further. The Stephen O'Rahilly, director of the Medical Research Council's Metabolic Diseases Unit at the University of Cambridge explains that when obesity occurs not only the amount of fat increases, but also the fat is put in the wrong order i.e. the fat is put in the liver, and in the skeletal

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muscle which ultimately disturbs metabolism. Rahilly added that the high level of insulin in the blood is the key disturbance which is associated with a range of abnormalities including increases in inflammatory cytokines and a reduction of a molecule called adiponectin, that directly protects the lungs (Mahase 2020).

Like Stephen O'Rahilly, many scientists have uncovered that fat cells play an important role among obese patients to create a higher complication. During the normal stage, ACE2 helps regulate many activities of a protein called angiotensin II (ANG II) that increases blood pressure, inflammation, damage to blood vessel linings, and various types of tissue injury. ACE2 converts ANG II to another molecule that reduces the effect of ANG II (Ni et al., 2020). However, as Coronavirus enters into the body, it binds with an enzyme called Angiotensin-converting enzyme (ACE2), an enzyme attached to the cell membrane of the cells located in the lungs, arteries, heart, kidney, and intestine (Sriram et al., 2020). The higher level of ACE2 is believed to be found in adipose tissue, or fatty tissue which means obese people have this molecule under the skin, and around their organs (BBC News, 2020).

A team of researchers at the university of Texas Southwestern (UTSW) in their research study stated that people under age 50 are more likely to be hospitalized, need a ventilator, and die from Covid-19 if they are severely obese. In comparison to the normal weight, study highlighted that people with age 50 and younger with severe obesity depicts a 36 percent increased risk of dying with Covid-19. Overall, severely obese adult patients had a 26 percent higher risk of dying with Covid-19. The study has also explained that the virus uses an enzyme called ACE2 to enter and infect human cells, and this ACE2 is abundant in fat tissue (Lemos et al 2020).

In reference to the above evidence, the present study is focused on whether high body mass index (BMI) brings severity among Nepalese Covid-19 positive patients. Additionally, the study has further identified the relationship between BMI and the Covid-19 disease severity. Patients in this study are enrolled from life care diagnostics and research centers, and further research is also carried out in life care diagnostics and research centers.

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Research Methodology

This research study is a case-control study with *n* = 400 cases and n= 699 controls which makes a total n=1099. The study was conducted between November 2020 to April 2021. Patients included in the study had undergone the swab collection, and RT-PCR test in life care diagnostic and research center in newroad, Pokhara. At present, all of their RT-PCR tests are negative. To understand whether or not being obese brings higher complication during Covid-19 positive, and after the negative report, patients BMI is measured. Their clinical data was collected from the Life Care Diagnostic, and Research Center. A semi-structured questionnaire was used for collecting data. The food, drinking and sleeping habits, disease history, post Covid-19 complication, anxiety, and working difficulties were identified through the interview questionnaires. Additionally, anthropometric measurements, body weight (in kilograms), height (in meters), body mass index (BMI) were also included in the interview questionnaires. To ensure the anonymity of the participants, they were randomly assigned with id numbers. In order to maintain the same level of complexity and reduce the chances of confounding the results, all of the participants followed the same questionnaires for an interview. Populations older than 25 years were able to take part in this study. These participants were chosen after their willingness to participate in the study and their written informed consent. Those participants unwilling to sign the consent form were excluded from the study. The weight of an individual was measured in kilograms and height in inches. Later, we converted the acquired height into meters. Ethical consideration for this study was taken from institutional review committee, lifecare diagnostic and research center.

Diagnosis of COVID-19 was established by detecting SARS-CoV-2 RNA in Nasopharyngeal, oropharyngeal specimens by real time RT-PCR amplification of SARS-CoV-2 ORF1AB and N Gene fragments using a SARSCoV-2 nucleic acid diagnostic kit. BMI was categorized into 4 groups: <18.5 kg/m2 (underweight), 18.5– 22.9 kg/m2 (normal weight), 23.0–24.9 kg/m2 (overweight), and 25.0 kg/m2 (obese) (shrestha et al., 2020), following Asia-Pacific cut-off for underweight, overweight and obesity

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Results

We recruited 400 total cases and 699 controls. Of those, 100 cases were excluded from our study as they were patients with comorbidities. After adjusting for comorbidities, we found patients having a BMI <18.5, 18.5–22.9, 23.0–24.9, and ≥25.0 kg/m2 were 7.33%, 44%, 17.66%, and 31.01% respectively. Similarly, in the control group, patients having a BMI <18.5, 18.5–22.9, 23.0–24.9, and ≥25.0 kg/m2 were 17.88 %, 45.77%, 22.317%, and 14.02% respectively.

The rate of pneumonia and severe pneumonia tended to be higher in patients with higher BMI, whereas the rates of ICU stay were higher in patients with BMI ≥ 25 kg/m2, when compared to patients with normal BMI. Calculating the odd ratio, we found that the odds ratio is 1.83, 95% CI 1.3-3.0. This means the likelihood of having the Covid-19 severity among patients with higher BMI is 83% higher compared to the patients with normal BMI. Moreover, running the chi-square test, the p value we calculated is 0.0000038 which is very less than 0.05. This means we reject the null hypothesis that there are no significant differences between the mean. We accept the alternative hypothesis and conclude that there is a significant difference between obesity and the severity of Covid-19. We further found that the majority of the population develop loss of smell and taste (30%), cough (28.57%)body ache (25.42%) and fever (24%) as the symptoms of Covid-19 while some also suffer from chest infection (16.85%), breathing difficulties (15.42%), headache (12.85%), unwilling to eat (11.42%), joint pain (8.85%), and common cold (7.42%).

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Table 1.0

	Covid-19	**No Covid-19**
Overweight & Obese	146	142
No Obese	254	445

Table 1.1

Table of Observed Value					
BMI	Severe	Mild	Moderate	Asymptomatic	Total
obese	47	19	24	3	93
overweight	24	6	17	6	53
Normal	22	45	48	17	132
Below normal	9	4	9	0	22
	102	74	98	26	300

Table 1.2

Table of Expected value					
BMI	Severe	Mild	Moderate	Asymptomatic	Total
obese	31.62	22.94	30.38	8.06	93.00
overweight	18.02	13.07	17.31	4.59	53.00
Normal	44.88	32.56	43.12	11.44	132.00
Below normal	7.48	5.43	7.19	1.91	22.00
	102.00	74.00	98.00	26.00	300.00

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Table 1.3

	Calculation of chi square			
Observed (0)	Expected (E)	O-E	(O-E) ^2	(O-E) ^2/E
47	31.62	15.38	236.5444	7.480847565
24	18.02	5.98	35.7604	1.984483907
22	44.88	-22.88	523.4944	11.66431373
9	7.48	1.52	2.3104	0.3088770053
19	22.94	-3.94	15.5236	0.6767044464
6	13.07	-7.07	49.9849	3.824399388
45	32.56	12.44	154.7536	4.752874693
4	5.42	-1.42	2.0164	0.3720295203
24	30.38	-6.38	40.7044	1.339842001
17	17.31	-0.31	0.0961	0.005551704217
48	43.12	4.88	23.8144	0.5522820037
9	7.18	1.82	3.3124	0.4613370474
3	8.06	-5.06	25.6036	3.17662531
6	4.59	1.41	1.9881	0.4331372549
17	11.44	5.56	30.9136	2.702237762
0	1.9	-1.9	3.61	1.9
				41.63554333

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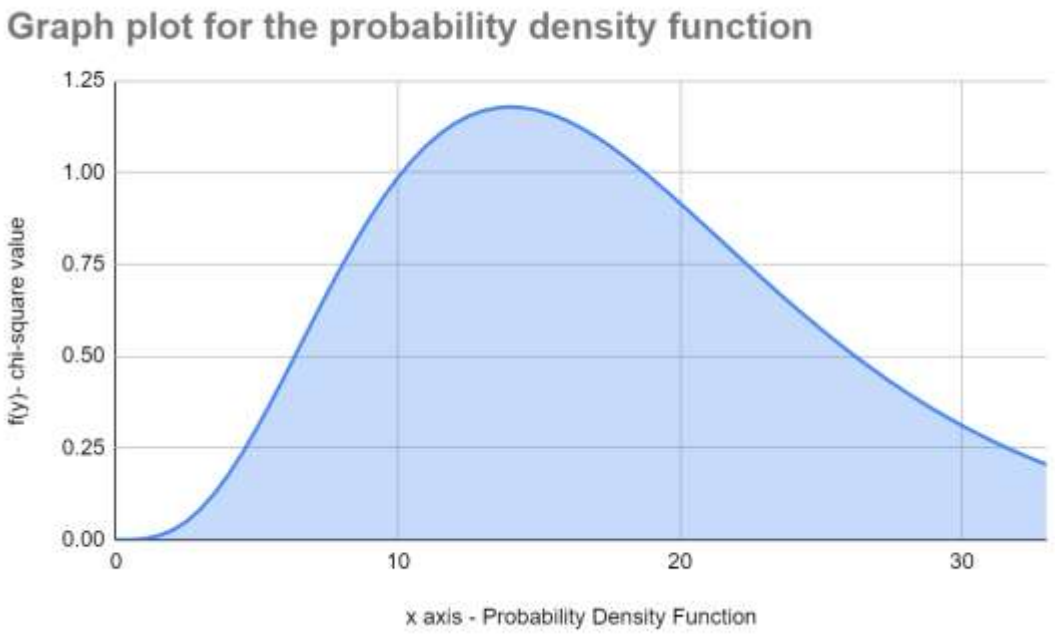
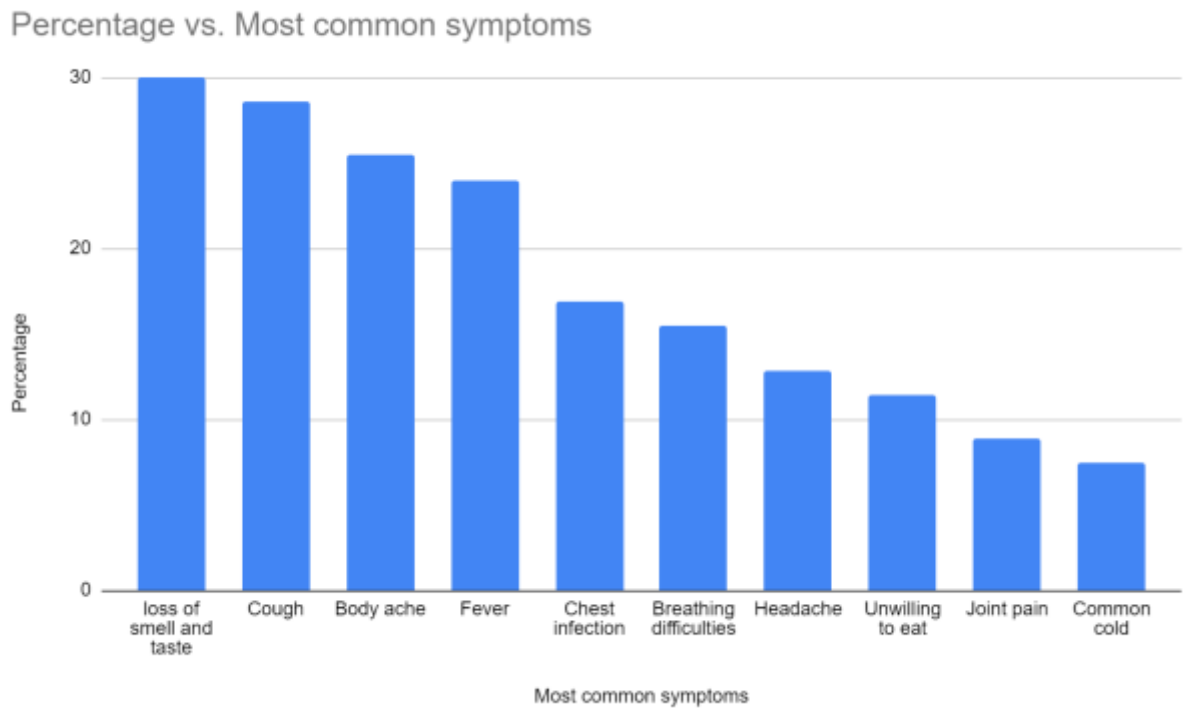
Fig 1.1 Graphical representation of chi-square results





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Discussion:

In this case-control study titled "Association Between Body Mass Index (BMI) and Symptoms Severity in Patients Affected by Covid-19 in Kaski, Nepal" we found that obesity and overweight increases the risk of Covid-19 disease severity. As we compare patients with normal weight with those with obese, we found obese were at increased odds of progressing to severe disease, and the association remained significant after adjusting for comorbidities and other risk factors. Moreover, obese patients despite the most common symptoms shown by infected patients, also seems to have upper respiratory tract infection symptoms, such as fever and cough. No significant differences were found in terms of the duration of disease progression and drugs used for treatment between the different BMI groups. About 80% of the patients in our study were found to receive antiviral medication like zinc tablet, paracetamol, Flexon, vitamin D & C supplement, and multivitamin.

Although we found the association between BMI and Covid-19 disease severity, our study has few limitations. The sample size we took is very small which is why we cannot generalize this study all over Nepal. Moreover, we did phone interviews with patients to collect the responses on their covid-19 cases, and the current situation. In doing so, these patients had revived their memory back even if that is for a very short period of time. We believe that these might have affected our responses.

In summary, obesity has a significant association with Covid-19. As COVID-19 may continue to spread worldwide, clinicians should pay close attention to obese patients. Careful monitoring and management with prompt and supportive treatment should be made for obese patients.

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