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Characterization of Morbidity and Mortality due to COVID-19 Associated with Diabesity in Rural Areas

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ABSTRACT
Purpose: Identify the morbidity and mortality factors due to COVID-19 in patients with diabesity according to the records of two pharmaceutical offices in the La Venta sector, Ica.
Methodology: An observational, longitudinal, and prospective descriptive study was carried out, with a quantitative data recording technique in the pharmaceutical care file corresponding to two community pharmacies in the village of La Venta, district of Santiago in the city of Ica; In the research the Santiago district has a population as 11,594 in the age range of 30 to 65 years, of which 330 people registered in the period from July 2020 to June 2021, of which 118 agreed to be study subjects; between 30 to 65 years. People with obesity and type 2 diabetes were considered, as was the onset of symptoms, evolution, and treatment. To assess the evolution of the disease, monitoring was carried out through telephone calls.
Results: It was observed that 62% of the people with diabetes who presented with fever over 38 °C, back pain, and severe respiratory symptoms; where the severity of the respiratory condition determined whether they were hospitalized. No statistically significant differences ($p \leq 0.05$) were found between the study subjects of the two community pharmacies.
Applications / Originality / Value: The results made it possible to indicate that diabesity is a vulnerable condition to coronavirus infection (COVID-19); likewise, 42% died as a consequence of the severity of the respiratory condition.
Conclusion: COVID-19 / diabesity affects older men more frequently (48 to 65 years), the most prevalent symptoms were; headache, cough and fever, with a percentage of 72.9%, 67.8% and 56.8% respectively; the mortality rate was statistically higher in the male group with 16%, likewise, the cumulative death rate was 27%, demonstrating that diabesity is a risk factor for mortality in patients with COVID-19. COVID-19 generally attacks elderly patients with frequent comorbidities, however, there is a greater risk of morbidity and mortality in people with diabetes.

Keywords: *Diabesity, COVID-19, Obesity, Type 2 diabetes.*

1. INTRODUCTION

The infectious disease COVID-19 is caused by the SARSCoV2 coronavirus, which causes the pandemic facing humanity. Given the social, economic, and health consequences of COVID-19, the impacts of animal exploitation and human intrusion into the environment of the reservoir of identified unknown pathogens give rise to the disease, which is fatal to man. In particular, urban areas are the areas most affected by COVID-19 due to the concentrated population density that leads to a higher number of infections.

In Peru, according to the 2019 Demographic and Family Health Survey, 22.3% of people aged 15 and over suffer from obesity; In addition, 13% of those surveyed in rural areas suffer from obesity [1]. Type 2 diabetes mellitus (DM2) is considered an important risk factor in the mortality of patients infected by respiratory viruses, including SARS-CoV-2. The interaction of both diseases called diabesity can be considered as a syndemic [2]. From a clinical perspective, it has been suggested that both fasting hyperglycemia and DM2 are independent predictors of morbidity and mortality in patients with acute respiratory distress syndrome [3].

The new coronavirus may be the cause of transient beta cell dysfunction, causing acute hyperglycemia and, in turn, a decrease in insulin in the pancreas.

In a validated study conducted on 39 users with SARS without a history of any type of diabetes, it was reported that twenty of them, after having suffered from COVID-19, developed diabetes, as they identified the angiotensin-converting enzyme 2 (ACE2) in the pancreas, which directly affects the islets and decreases insulin release in users who presented with SARS, which would cause a feedback chain between SARS-CoV-2, causing severe hyperglycemia and increased ACE2 at the level of various organs, which gives way to the entry of the virus and greater infections in vulnerable patients [4].

The first data from observational studies, which have subsequently been corroborated both in systematic reviews and in several meta-analyzes, show that arterial hypertension, type 2 diabetes mellitus (DM2), obesity, and coronary heart disease are the main comorbidities in COVID-19 infection.

In the Chinese population, a recent meta-analysis that included a large number of patients (n=76,993) demonstrated a prevalence of DM2 of 7.87% (95% CI 3.83–12.43) [5], while another with 1,576 patients presented figures of 9.7% (95% CI 7.2–12.2) [4].

In Italy, a randomized analysis of fatal cases of COVID-19 infection in elderly patients revealed a prevalence of DM2 of 35% [6], while in a retrospective study of 1,591 hospitalized patients in intensive care units in the Lombardy region (Italy), a prevalence of 17% was observed [7].

In data collected in the USA (n = 7,162), the incidence of diabetes was 6% in non-hospitalized patients, 24% in hospitalized patients, and 32% in those admitted to intensive care units, see Table 1.

Table 1. Prevalence of DM2 in patients infected by Coronavirus SARS-CoV2.

	DM2
China	7.87%
Italy	35%
United States	6%

Source: Spanish Society of Internal Medicine (SEMI).

Along these lines, the data that we now have indicates that the risk of a fatal outcome from COVID-19 is up to 50% higher in patients with DM2 [4].

There are several hypotheses that could explain why these patients have a higher incidence and severity. It is well known that a person with DM2, per se, has a higher risk of infection, mainly due to a defect in innate immunity that affects phagocytosis, neutrophil chemotaxis, and cellular immunity, which makes them especially vulnerable [8].

It is also true that the high frequency of DM2, in severe cases of COVID-19, could simply reflect the higher prevalence of DM2 in the elderly, in addition to the fact that these patients also have more comorbidities, including cardiovascular disease. Therefore, despite the fact that respiratory symptoms are predominant in COVID-19 infection, DM2 takes a special interest in this disease because both the risk of virus infection and its severity increase in these patients [4].

A first mechanism that could explain the relationship between COVID-19 and DM2 involves the enzyme dipeptidyl peptidase 4 (DPP-4), which acts by degrading the incretin hormones GLP-1 and GIP. The DPP-4 enzyme was identified as a functional receptor for the Middle East respiratory syndrome coronavirus in cell studies. Antibodies directed against DPP-4 have been shown to inhibit infection by this virus at the cellular level [9]. There are several reasons why the interaction between DM and SARS-CoV-2 may be associated with the risk of severe COVID-19.

One of the first reasons is that hyperinsulinemia and high glucose levels in patients with poorly controlled diabetes can increase the expression of ACE2 (Angiotensin-converting enzyme 2), a receptor that facilitates the cellular entry of the SARS-CoV-2 [10].

Although the available evidence is limited, one hypothesis suggests that incretin drugs may produce a beneficial effect through the activation of the non-classical pathway of the renin-angiotensin system, enhancing the ACE axis with a consequent increase in angiotensin (1–7), which favors anti-inflammatory, antifibrotic, natriuretic, and antiproliferative phenomena [11]. Through this route, GLP-1 analogs would improve blood pressure and glycemic control, reducing vascular damage. These drugs could compete with the virus itself for the ECA2 receptor, exerting their beneficial effect through the combination of several mechanisms: improvement of the metabolic, anti-inflammatory, and antiviral profile [4].

Finally, we would like to highlight that the content of this document is based on the limited publications that exist on the subject to date and that, on many occasions, are hypotheses in the absence of firm scientific evidence. Therefore, this information is susceptible to changes as knowledge about COVID-19 infection evolves [4].

In general, mortality from COVID-19 worldwide responds to diverse sources, so they are structured according to the socio-economic and political developments of the peoples and countries in which they occur. In those countries whose population censuses and death registries have been more transparent, the analytical comparison of mortality has been allowed in short periods, allowing the evolution of the phenomenon to be observed with greater precision and, above all, its behavior according to sociodemographic factors and clinicians with whom they are related [12], see Table 2.

Table 2. Number of cases and deaths per 100,000 inhabitants according to selected countries in Latin America, December 15, 2020.

	Confirmed Cases		Deaths	
Country	Totals	Per 100,000 inhabitants	Totals	Per 100,000 inhabitants
Argentina	1’510.203	3.394	41.204	93
Brazil	7’040.608	3.353	183.735	87
Chile	575.329	3.028	15.949	84
Colombia	1’444.646	2.872	39.356	78
Ecuador	202.356	1.190	13.896	82
México	1’267.202	975	115.099	89
Perú	986.130	3.082	36.754	155

Source: https://coronavirus.jhu.edu/map.html

In Peru, the National Death Information System (SINADEF) reports that 85.5% of all patients who died as a result of COVID-19 suffered from obesity [13]. This pattern is similar in other Latin American countries where deaths are the consequence of confirmed cases, for example, in Mexico there were 89 deaths per 100,000 inhabitants [14], seven out of ten deaths of people related to COVID-19 are linked to cases of diabetes [15].

In China, studies have already been developed that support the theory of COVID-19 as a producer of free radicals in the molecular atoms of oxygen. They have also found evidence that it is capable of mutating in the DNA of aging mitochondria that generate energy in human cells. Logically, its role as a producer of free radicals at this level is also being demonstrated here [16].

2. METHODS AND ANALYSIS

Type of study: An observational longitudinal study was carried out. Descriptive: the results obtained were described to verify the possible existence of the variables. Longitudinal studies are studies that collect data at different points in time, to make inferences about evolution, its causes, and its effects. Observational: variables were not manipulated and those defined in the study were measured.

Population: A quantitative data recording technique was used in the study subject's information record sheet, corresponding to two community pharmacies in the village of La Venta, district of Santiago in the city of Ica; The estimated population of the district of Santiago is 11,594 in the age range of 30 to 65 years [17].

Two years before the COVID 19 pandemic, a pharmaceutical care module was implemented, it is an office where the pharmaceutical chemist interacts with the patient to know their needs, sensitizes them about chronic non-communicable diseases, compliance with therapy, and possible problems related to their medication. Completing a registry of 330 people, where the high prevalence of obesity and type 2 diabetes were observed.

Sample: In June 2020, an influx of people with positive tests for COVID-19 was observed in two community pharmacies in the hamlet of La Venta in the district of Santiago - Ica. The database was taken and it was decided to characterize COVID-19 with the diabesity of the data registered in 2019. The study began with a random sample of 118 people aged 30 to 65 years old who agreed to be study subjects; those who met the inclusion criteria signed the informed consent.

Inclusion criteria: having obesity, type 2 diabetes mellitus, COVID-19, and having no associated pathology.

Exclusion Criteria: having associated pathologies.

Data collection: A self-administered questionnaire was used, validated by the judgment of two experts; one in internal medicine and the other in public health.

Anthropometry: To record the body weight of each person, a portable digital scale by the Ray-Scale brand with a maximum capacity of 180 kg was used. To lighten the weight, shoes, bags, straps, and coins were removed, until the weight was as light as possible.

The carving was obtained with a wooden height rod and a standardized measuring tape, fixed to the wall; the maximum measurement was recorded from the upper point in the sagittal plane of the skull to the surface where the subject was standing barefoot. Height is measured with the person standing, without shoes. To make the measurement, the subject must have their head and shoulders together.

They must be close to the height rod under the line of the stadiometer. The arms must hang. The view must be in front of a fixed point. A firm surface perpendicular to the floor was sought. The WHO Body Mass Index (BMI) formula was used, calculated by weight in kilograms over height measured in meters squared (BMI = Weight in kg / Height in m2). BMI less than 18.5 as a weight deficit; 18.5 to 24.9 suitable weight; from 25 to 29.9 overweight and over 30 obesity, see Table 3.

Table 3. Body Mass Index.

Body Mass Index	Category
under 18.5	underweight
18.5 a 24.9	Healthy
25 a 29.9	Overweight
30 a 39.9	Obesity
Over 40	Extreme or high-risk obesity

Source: World Health Organization, 2020.

Data analysis: It was carried out using a database in a Microsoft Excel spreadsheet. Diabetic people were included with a history of the disease. By means of telephone calls, the symptoms and evolution of the disease were monitored. The results were recorded in a Microsoft Excel spreadsheet, maintaining confidentiality. The data was analyzed using descriptive and inferential statistics.

Ethical aspects: Informed consent was given with the endorsement of the study subject

3. RESULTS

The people included in the study were 63 female and 55 male, representing 53.4% and 46.6% respectively, see Table 4.

Table 4. Frequency per gender.

	Frequency	Percentage
F	63	53.4
M	55	46.6
Total	118	100.0

Source: owner of authors

The quantitative variables were described to assess the nutritional status from the minimum and maximum weight in kilograms of 60kg and 88kg respectively. And regarding the qualitative variables by means of absolute and relative frequencies, mean 76.5678, deviation of 6.09116, see Table 5.

Table 5. Minime and maxime weight.

	N	Min.	Max.	Middle	Desviation
weight (Kg)	118	60.00	88.00	76.57	6.09

Source: owner of authors

The range of study subjects is between the ages of 30 to 65 years, observing a marked difference in the female sex of 29.66% in the range of 30 to 47 years, compared to the male sex of 98.18% in the ages of 48 to 65 years, with a predominance of males in the older age ranges, see Figure 1.

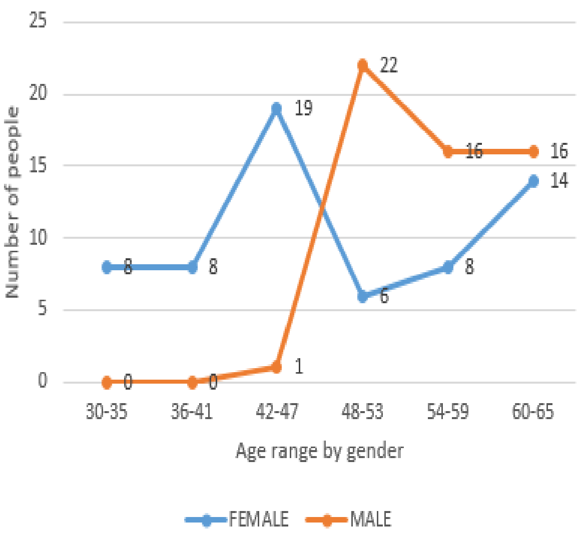

Figure 1 Age range by gender.

Based on the analysis of patients with overweight and diabetes, it should be mentioned that the results obtained through the data collection instruments are frequent, such as obesity in women (29) and men (46), and high blood glucose levels in women (35) and men (55).

Dietary treatment together with lifestyle modifications, exercise, behavioral therapy, and drug treatment are the best recommendations for this type of patient. With this, a decrease in body weight is achieved and, therefore, a decrease in BMI, an improvement and even disappearance of comorbidities, see Figure 2.

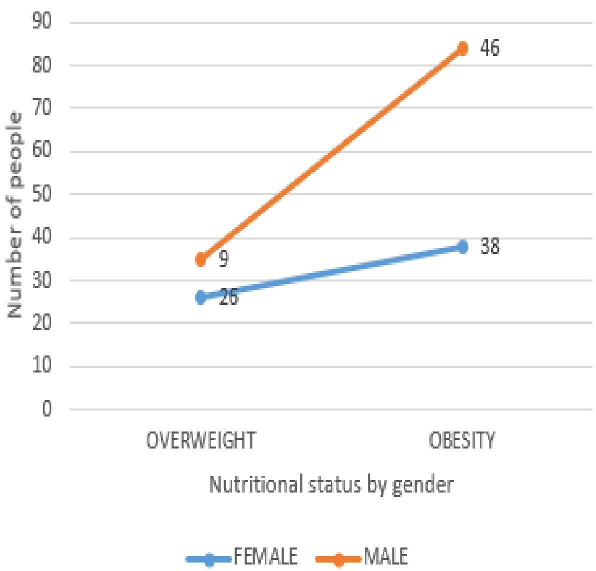

Figure 2 Nutritional status by gender

HT was the comorbidity with a percentage of 13.5% associated with diabesity.

The associated comorbidity in the highest percentage was hypertension in a 13.5%, see Figure 3.

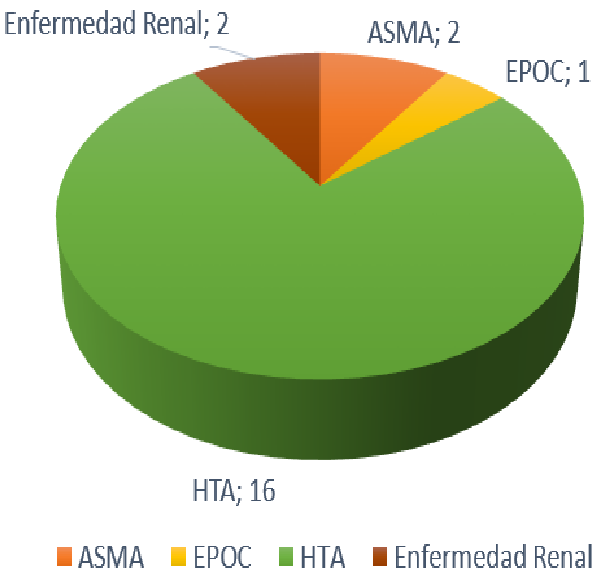

Figure 3 Comorbidities associated with diabesity.

A higher prevalence of symptoms is observed: headache, cough and fever, with a percentage of 72.9%, 67.8% and 56.8% respectively, and a lower prevalence of 15.3% and 11% of chest pain and anosmia respectively, see Figure 4.

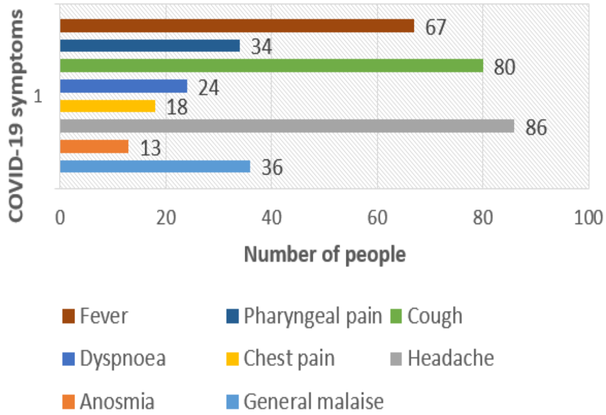

Figure 4 Percentage: COVID-19 symptoms / diabesity.

In the COVID-19 / diabesity evolution, 46.61% and 53.39% correspond to male and female sex respectively, presenting a total mortality of 27.11%, with a prevalence of 16.10% of males, 72.03% of total recovered , 41.53% is evidenced in the female sex, see Table 6.

Table 6. Evolution COVID-19/diabesity.

	Male	%Male	Female	%Female	TOTAL	%Total
Recovered	36	31	49	42	85	72
Death	19	16	14	12	32	27
Total	55	47	63	53	118	100

Source: World Health Organization, 2020.

4. CONCLUSIONS

- COVID-19 / diabesity affects older men more frequently (48 to 65 years), the most prevalent symptoms were; headache, cough and fever, with a percentage of 72.9%, 67.8% and 56.8% respectively; the mortality rate was statistically higher in the male group with 16%, likewise, the cumulative death rate was 27%, demonstrating that diabesity is a risk factor for mortality in patients with COVID-19.
- COVID-19 generally attacks elderly patients with frequent comorbidities, however, there is a greater risk of morbidity and mortality in people with diabetes.
- The level of obesity is directly proportional to the number of registered cases, the higher the level of obesity, the greater the number of registered cases.

AUTHORS' CONTRIBUTIONS

All the author contributed in the develop of the article, in the health knowledge and methodology.

All the authors are agree with the participation of each one.

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