Advances in Medicine and Engineering Interdisciplinary Research, 2024, Volume 2, Issue 2
DOI: 10.32629/ameir.v2i2.2027
ISSN Online: 2972-3825
ISSN Print: 2972-3833

Comparative Study of the Control of Type 2 Diabetic Patients Before and After the Confinement Caused by the COVID-19 Pandemic

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Abstract: Objective: To assess the impact of the alterations of continuity of care on diabetic patients in our health department during the confinement that caused the pandemic. To check whether or not confinement entailed an alteration in the degree of control of our type 2 diabetic patients. To know whether our diabetic patients were adequately controlled before the pandemic began. To know if the pandemic has led to a deterioration in its degree of control. Subject and method: Retrospective study between the years 2019 and 2020 of type 2 diabetic patients in our health area. Through the "Alumbra" application of our health area, a random sample of our patients diagnosed with type 2 diabetes from 18 to 100 years of age was obtained. The patients were informed if they wanted to enter the study, and after express consent, the patients were asked about their lifestyle, habits and a review of the medical history was carried out with the data recorded before the confinement (year 2019) and during the months of confinement of 2020. Results: There were 882 patients (88.28%) with HbA1c determinations in 2019 with a mean of 708. There were 800 patients (88.98%) with HbA1c determinations in 2020 with a mean of 702. There was a reduction in alcohol, tobacco and soft drink consumption habits, but there was also a reduction in physical exercise (33% to 22%) and is following a diabetic diet (34% to 24%). In the sample analyzed, there was a reduction in a alcohol consumption from the data obtained in 2019 to those obtained in 2020 (22% to 13%). There was an increase in obesity, which goes from 77.7% to 90.4% in 2020. It is observed that there is no change in the percentages in pathologies such as dyslipidemia, atrial fibrillation, osteoarthritis, and stroke. Conclusion: The consequences associated with the pandemic on health are worrying, the decrease in acute consultation, preventive activities and the delay in controls of chronic patients will have a profound impact on the psychological and socioeconomic well being of populations. The holistic view of the Primary Care (PC) and the need to strengthen and rethink the system to increase its efficiency are of particular importance.

Key words: primary care; type 2 diabetes control; confinement; teleconsultation

1. Introduction

Type 2 diabetes mellitus (DM) is a very prevalent disease with serious consequences for the patient and high health

care costs. Adequate control would prevent or slow the onset of complications. The estimated incidence of DM adjusted for age and sex in the Spanish population is 11.6 cases/1,000 person-years (95% CI = 11.1-12.1). According to the study di@bet.es [1], 13.8% of Spaniards over 18 years of age have type 2 DM (equivalent to more than 5.3 million). Of these, 2.3 million (43% of the total) do not know they have diabetes. Between 61 and 75 years of age, 29.8% of women and 42.4% of men have diabetes, a percentage that rises to 41.3% of women and 37.4% of men over 75 years of age. The delay in its discovery means that when the disease is diagnosed, 50% have some complication. Treatment is more effective at an earlier stage, since diabetes affects important organs such as the kidneys, eyesight, heart and nervous system. The prevalence of obesity is 36.6% in men and 34.9% in women, which increases with age [2]. In patients with DM, weight loss improves blood glucose and HbA1c levels [3]; for every kg of weight lost, HbA1c is reduced by 0.1%. There is a close relationship between obesity and type 2 DM. It is essential to modify lifestyles and poor dietary habits to reduce the increase of this disease [1].

The general control target is HbA1c less than 7%, healthy and young people with diabetes HbA1c less than 6.5% and in the case of the elderly with comorbidities and hypoglycemia the control target would be HbA1c less than 7.8-8% [4, 5]. Control of glucose levels will prevent acute crises of hyperglycemia or hypoglycemia and their complications such as diabetic foot, retinopathy or renal dysfunction. Starting treatment early and adherence to treatment reduces morbidity and mortality [5, 6]. Maintaining good glycemic control would help to reduce the risk of infections and the severity of the disease due to COVID-19. Attention to nutrition and adequate protein intake is important. Any mineral and vitamin deficiencies should be addressed [7, 8, 9]. A patient-centered approach should be used to guide the choice of medications. Considerations include age, comorbidities, and risk of hypoglycemia. Since exercise enhances immunity, physical activity should be encouraged indoors and crowded places such as gyms and swimming pools should be avoided. Influenza and pneumococcal vaccination should be encouraged to decrease the likelihood of developing secondary bacterial pneumonia after a respiratory viral infection [10].

In December 2019, an outbreak of a new coronavirus emerged in Wuhan, China, generating SARS, for which SARS-CoV-2 (causing the COVID-19 pandemic) was named. The COVID-19 pandemic and the enforced confinement during the months of March to June 2020, as well as the containment measures put in place to prevent the spread of the disease, have meant fewer face-to-face visits to the nurse or doctor, more telephone contact with the nurse or doctor, etc., in short, a modification of lifestyles and a change in the management of diabetes. It is the seventh member of the coronavirus family to infect humans. It can originate from horseshoe bats or pangolins, which are the natural reservoirs and can be transmitted between humans causing the disease [11].

The spread of COVID-19 worldwide has led to the collapse of many healthcare systems and increased mortality in patients with cardiovascular disease, obesity and diabetes. COVID-19 is now a worldwide health problem [12, 13]. Potential mechanisms that may increase susceptibility to COVID-19 in patients with DM include increased cell binding affinity and efficient virus entry, decreased viral clearance, decreased T-cell function, increased susceptibility to hyperinflammation and cytokine storm syndrome, and the presence of cardiovascular disease. Increased expression of ACE-2 in AT2 alveolar cells, myocardium, kidney, and pancreas may favor increased cellular binding of SARS-CoV-2 [14, 15].

The main publications on COVID-19 have focused on the hospital management of the most severe patients, with little information on the situation of patients in primary care (PC). Family physicians treating people with diabetes need to be aware of the consequences of the impact of quarantine isolation measures on patients' glycemic control. The call for the population to remain confined to the home may have led to a reduction in daily physical exercise. Although there are no

empirical data on this aspect, an increase in glycemia in patients with diabetes may be expected to have occurred because of an imbalance in caloric expenditure due to reduced physical exercise [7]. The control level of our patients with diabetes prior to the onset of the pandemic is unknown. There are studies that demonstrate the difficulty in achieving optimal control of the diabetic patient, under clinical practice conditions, in terms of glycemic control and management of the rest of the associated risk factors [15]. Our study emphasizes the evaluation of the change that the pandemic has brought about in the control of diabetes by PC. We want to know the consequences that the pandemic has had on the follow-up, treatment and control of diabetes, whether telephone care has reduced the control of this type of patients who require glycemic control, and whether there has been a worsening of metabolic control, clinical worsening, weight gain, etc. The comparisons of these data were made for those patients who had them in 2019 and 2020, forming a sample that varied between 756 and 999 patients depending on the indicator considered.

2. Material and Method

A retrospective longitudinal observational study was performed in our health area including in the study approximately 1,000 diabetic patients over 18 years of age. The patients included in the study signed the informed consent to participate. Patients with gestational diabetes or type 1 DM were excluded from the study. Sociodemographic data were collected (sex, age, level of education, sector in which they work, marital status, whether or not they live with another person, employment status), clinical characteristics or comorbidities (obesity, hypertension, neuropathy, heart disease, nephropathy, vascular disease, retinopathy, vasculopathy, diabetic foot, dyslipidemia, valvulopathy, atrial fibrillation, depression, arthrosis, asthma/EPOC, ACVA) and habits or lifestyles (alcohol consumption, smoking, consumption of sugary soft drinks, physical exercise, diabetic diet). The treatment received for diabetes (metformin, glinides, sulfonylurea, pioglitazone, DPP4 inhibitors, GLP1 agonists, SGLT2 inhibitors and insulin) was also taken into account. The following variables were assessed: body mass index (BMI), whether the diabetic patient smoked or had stopped smoking, whether he/she followed the recommended diabetic diet, whether he/she did the recommended physical exercise, and whether HDL or LDL cholesterol levels were within the parameters recommended for the adequate control of the diabetic patient. The average number of visits made per year to both the physician and the PC nurse was also assessed. The statistical analysis consisted of a description of the sample and comparison of the prognostic groups. Patients were selected by drawing lots from the computerized list in sufficient number to achieve a sample with a power of at least 90% in the comparisons to be made. The year 2019 was taken as a pre-pandemic year compared to 2020, when the anti-COVID-19 measures were implemented. The study was approved by the Bioethics Committee of the Vega Baja Hospital (Orihuela) (code MC-2022-028) and the Orihuela PA Management (Vega Baja), guaranteeing the protection and confidentiality of personal data.

Through the review of computerized medical records, data were collected: 1) sociodemographic data (sex, age, marital status, occupation); 2) follow-up activities: BMI, lifestyles (smoking, diet, physical exercise), blood pressure (BP), HbA1c analysis, lipid profile, ECG, ethnography; 3) frequentation (annual visits to MF (family medicine) and/or EC (community nursing), visits to endocrinologist, visits to cardiology, visits to ophthalmology, remote consultation; 4) pharmacological (drug consumption, consumption of antidiabetic drugs, etc.).

The prevalence of type 2 DM diagnosed in the Orihuela health area is 7.52% (total population: 165,316 and diabetic population: 12,441), 54.40% are men and 45.50% are women (data measured in September 2017, source: Alumbra) [13].

3. Results

The sample for 2019 consisted of 999 patients (584 males), with age 67.8 ± 13 years in a range of 23 to 99 years. The age distribution was as follows: 18 to 40 years old, 24 patients (2.4% of the sample); 41 to 60 years old, 268 patients (26.8% of the sample); 61 to 80 years old, 535 patients (53.5% of the sample); 81 to 100 years old, 173 patients (17.3% of

the sample). In 2020, the sample was reduced to 899 patients (480 males), with age 68.4 ± 12 years in a range of 24 to 100 years, with 550 persons (61.1%) aged 65 years or older. There was an increase in patients living unaccompanied from 2019 to 2020, from 9.1% to 11%. There was also a high number of pensioner patients (> 50%) (Table 1).

Table 1. Sociodemographic descriptors of the sample

Sociodemographic values	2019	2020
Sex		
Female/male	413/584	419/480
Level of education n (%)		
No education	272 (27.1)	198 (22.02)
Primary education	365 (36.4)	321 (35.7)
Secondary education	103 (10.3)	81 (9.01)
Tertiary education	82 (8.2)	71 (7.89)
Profession n (%)		
Primary Sector	200 (20)	197 (22)
Secondary sector	413 (41.2)	359 (40)
Tertiary sector	133 (13.3)	125 (14)
Marital status n (%)		
Single	71 (7.1)	72 (8)
Married	546 (54.5)	483 (53.8)
Divorced	46 (4.6)	55 (6.2)
Widower	142 (14.2)	145 (16.2)
Coexistence n (%)		
Lives alone	91 (9.1)	97 (11)
Lives accompanied	732 (73.1)	802 (89)
Employment status n (%)		
Active/employed	167 (16.7)	161 (18)
Inactive/unemployed	153 (15.3)	152 (17)
Pensioner	510 (50.9)	584 (65)
Average age of the sample	67.8 years	
18 to 40 years (%)	2.4	
41 to 60 years (%)	26.8	
61 to 80 years (%)	53.5	
81 to 100 years (%)	17.3	

In 2019, of the sample analyzed, 882 patients (88.28%) had HbA1c determination with a mean of 7.08. In 2020 patients who had HbA1c done were 800 patients (88.98%) with a mean of 7.02.

There is a reduction in the consumption habits of alcohol, tobacco and soft drinks, but there is also a reduction in

physical exercise (33% vs. 22%) and in the realization of a diabetic diet (34 to 24%). In the sample analyzed, there is a reduction in alcohol consumption from the data obtained in 2019 to those obtained in 2020 (22% vs. 13%). Something similar also occurs with tobacco consumption, which drops from 25% in 2019 to 8% in 2020. Conversely, there is also a reduction in physical exercise (33% vs. 22%) and diabetic diet (34% vs. 24%) from the data obtained in 2019 to 2020 (Table 2).

Table 2. Habits of the patients included in the study

Habit n (%)	2019	2020
Alcohol	225 (22.5)	121 (13.71)
Tobacco	150 (25)	71 (8.04)
Consumption of soft drinks	167 (16.7)	141 (15.9)
Physical exercise	334 (33.3)	200 (22.67)
Diabetic diet	342 (34.1)	219 (24.82)

We see an increase in obesity, from 77.7% to 90.4% in 2020, which may be clearly related to the decrease in exercise as we have seen in Table 2. We observe that there is no change in the percentages for diseases such as dyslipidemia (65.6% vs. 67.8%), atrial fibrillation (10.5% vs. 10.77%), osteoarthritis (26.2% vs. 27.32%), stroke (6.9% vs. 6.3%). However, there was an increase in mental health-related problems such as depression, from 12% to 17% (Table 3). Type 2 diabetic patients analyzed in the study are pluripathological patients as shown in Table 3. There is an increase in insulin treatments (22.9% vs. 24.6%), ISGLT2 (43.2% vs. 44%), GLP1 agonists (10.7% vs. 13.2%) as shown in Table 4. It is observed that they present polymedication and that there are no major changes in prescribed treatments from 2019 to 2020 (Table 5).

Table 3. Comorbidities of the diabetic patients included in the study

Comorbidities n (%)	2019	2020
Obesity	779 (77.7)	798 (90.47)
Arterial hypertension	643 (64.2)	756 (85.71)
Neuropathy	137 (13.7)	150 (1.7)
Heart disease	248 (24.8)	121 (13.71)
Nephropathy	161 (16.1)	98 (11.11)
Vasculopathy	164 (16.4)	56 (6.34)
Retinopathy	104 (10.4)	98 (11.11)
Diabetic foot	18 (1.8)	10 (1.13)
Dyslipidemia	657 (65.6)	598 (67.80)
Valvulopathy	23 (2.3)	17 (1.92)
Atrial fibrillation	105 (10.5)	95 (10.77)
Depression	127 (12.7)	158 (17.91)
Arthrosis	263 (26.2)	241 (27.32)
Asthma/EPOC	95 (9.5)	131 (14.85)
Stroke	69 (6.9)	56 (6.3)

Table 4. Antidiabetic drugs

Pharmacotherapy n (%)	2019	2020
Metformin	668 (66.7)	629 (70)
Glinidas	150 (15)	116 (13)
Sulfonylureas	23 (2.3)	13 (1.5)
Pioglitazone	2 (0.2)	0
DPP4 inhibitors	278 (27.7)	224 (25)
GLP1 agonists	107 (10.7)	118 (13.2)
SGLT2 Inhibitors	433 (43.2)	395 (44)
Insulin	229 (22.9)	221 (24.6)

Table 5. Control results of diabetic patients included in the study

Indicator result	2019	Remain 2020	Change 2020
Control objective n (%)			
Obese according to BMI	779 (77.7)	798 (90.47)	19 (2.11)
Active smokers	150 (15)	71 (8.04)	79 (8.78)
Follow a diet	342 (34.1)	219 (24.82)	123 (13.68)
Physical exercise	334 (33.3)	200 (22.67)	134 (13.4)
HDL off target	277 (27.6)	308 (30.7)	31 (3.44)
LDL off target	749 (74.8)	728 (72.7)	21 (2,3)
Uncontrolled TA	269 (26.8)	260 (29)	9 (1)
Follow-up n (%)			
With ECG performed	321 (32.2)	178 (19.87)	143 (15.9)
Frequency			
Face-to-face visits/year to family medicine	11 (0-45)	4 (0-11)	7
Face-to-face nursing visits	8 (0-59)	5 (0-80)	3
Pharmacology			
Consume 10 or more drugs n (%)	579 (57.95)	423 (47.05)	156 (17.35)
Consume more than 2 antidiabetic drugs n (%)	429 (43)	431(48)	2 (0.2)
Analytical (%)	85.7	68.8	
Blood pressure measurement (%)	90.46	72.08	
Cardiology visit (%)	10.7	8.7	
Endocrinology visit (%)	13.1	12.6	
Telephone consultations		51.4 (1-17)	

ECG: electrocardiogram; IMC: body mass index; TA: blood pressure.

We analyzed the immune status of diabetic patients included in the study and highlights the low coverage of vaccination against influenza (13.7%) in 2019 in this type of pluripathological diabetic patients. It has a tetanus vaccination coverage of 40% of diabetic patients included in the study.

With regard to the results of the management of diabetic patients during the pandemic, there was a reduction in the mean number of consultations with the PC physician (from 11 to 4) and visits to the community nurse (EC) (from 8 to 5). There was also a reduction in the number of analyses performed (85.7% vs. 68.8%), in the number of ECGs performed (32.2% vs. 19.87%), and in visits to specialists such as endocrinology (13.1% vs. 12.6%), cardiology (10.7% vs. 8.7%) and blood pressure determination (90.46% vs. 72%).

There are significant differences in the comparison of HDL cholesterol results between 2019 before the pandemic and after the onset of the pandemic. Statistical significance is also observed for glomerular filtration rate and creatinine parameters in 2019 and 2020. For the other parameters analyzed, no significant changes were observed after the onset of the pandemic.

4. Discussion

Diabetic patients are vulnerable and their immune status at the beginning of the pandemic was suboptimal, with only 13% vaccination coverage against influenza virus in the sample analyzed in 2019 (Table 6). Diabetic patients are seen by the PC physician and their follow-up is performed by the EC. Type 2 DM is a disease that is often associated with other comorbidities that the patient also has. Diabetic patients usually present polypharmacy, not only to control their glycemia, but also to control their other comorbidities (Table 4, Table 5).

Table 6. Analytical results for 2019 compared to those obtained in 2020

Analytical determination	2019	2020	Wilcoxon test
HbA1c	7.08	7.02	0.272
Blood glucose mg/dl	132	132.8	0.096
Cholesterol mg/dl	175.9	172.4	0.086
HDL cholesterol mg/dl	48.51	46.73	0.000
LDL cholesterol mg/dl	99.6	96	0.171
Triglycerides mg/dl	155	152.8	0.169
Glomerular filtration rate	73.91	57.99	0.012
Creatinine dl	1.2	0.99	0.000
Pro BNP pg/ml	795	706	0.000
N° Leukocytes × 10^9/l	7.62	7.53	0.09

The COVID-19 pandemic affected the Spanish population from the beginning of 2020. The health authority had to adopt drastic measures such as population containment from mid-March to early May 2020, enhancing telephone health care. The disease and the healthcare response caused a great overload of care and work in the hospital and PC settings. The overload of care due to the need to attend to the population affected by COVID-19 and the modification of the organization of work, in the case of PC, has resulted in a lack of attention to chronic patients. A reduction in face-to-face consultations with the PC physician and the EC is observed. There is also a reduction in visits to specialists such as cardiologists, ophthalmologists and endocrinologists. The number of face-to-face appointments was reduced and more telephone

attention was provided due to the confinement measures. Temporary measures were taken according to the local evolution of the pandemic, such as the suspension of scheduled consultations with the EC and family physician (FM), retinography and electrocardiograms (ECG), or the limitation of analytical tests to cases considered not to be delayed. The main reason for these measures has been the need to dedicate PC health professionals to tasks such as performing COVID-19 diagnostic tests, population screening, tracking and follow-up of cases and close contacts, or vaccination. We observed a decrease in the number of analytical tests, number of electrocardiograms, and a reduction in the mean number of consultations with the PC physician and the EC. However, we did not observe a significant change in the results of HbA1c control in the sample analyzed. We did observe a significant change in the glycemic profile as shown by the Wilcoxon test. We also observed a significant change in renal function control parameters (glomerular filtration rate and creatinine).

The mandatory confinement during the months of March to June 2020, as well as the containment measures established to prevent the spread of the disease (social distancing, quarantine, isolation), have led to less outdoor physical exercise, limited access to tobacco, greater consumption of home-cooked meals, less consumption of food in restaurants or bars, fewer visits to the infirmary or doctor, etc. In short, a modification of lifestyles and a change in diabetes control [16, 17].

5. Conclusion

Confinement during the months of March to June 2020 did not lead to a change in the control of diabetic patients in HbA1c parameters, but a change in the lipid profile was observed. Significant changes in renal function were also observed. There was a reduction in the number of face-to-face visits to PC health professionals (physician and EC). There was also a reduction in the number of analyses performed and other complementary tests such as ECG. There was also a reduction in the number of visits and controls of diabetic patients by ophthalmology, cardiology and endocrinology.

Telematic care by PC physicians for patients with diabetes is particularly relevant, both because of the high prevalence of the disease and the specific follow-up needs of these patients (detection and treatment of complications, medication adjustment, etc.). Telematic follow-up of chronic patients is associated with better control of diseases such as diabetes, hypertension and dyslipidemia. However, technological and procedural changes must take place, which implies reconfiguring medical practices and physician-patient relationships. No significant changes were observed in the antidiabetic treatments of the sample analyzed. Nor have there been changes in the treatments and polypharmacy that the diabetic patient presented. At the beginning of the pandemic, diabetic patients had low influenza vaccination coverage.

Teleconsultation can complement face-to-face consultation. The COVID-19 pandemic has led to significant improvements in the development of teleconsultation, not only with patients, but also between levels of care. Telemedicine is defined as the use of telecommunications to facilitate the remote provision of health-related services and clinical information. Telemedicine is a growing field that can facilitate accessibility to health care for patients with diabetes.

The decrease in exercise, the reduction of the diabetic diet and the increase in the consumption of soft drinks produce a decrease in the control of the lipid profile and renal function. There are no significant changes in the antidiabetic drugs used and this is probably due to therapeutic inertia.

Knowledge of the disease burden is of paramount importance at this level of care, since it is the gateway to the system and plays a key role in the prevention, protection, promotion and treatment of individuals and communities. The consequences associated with the pandemic in health are worrying, the decrease in acute consultations, preventive activities and the delay in the control of chronic patients will have a profound impact on the psychological and socioeconomic well-being of the populations. The holistic view of PC and the need to reinforce and rethink the system in order to increase its efficiency are of particular importance.

A limitation of this study is the way in which lifestyle data is obtained through patient reporting, which is a typical limitation of this type of information, and even if it is not impossible, it is difficult to generate this information in any other way. Another limitation of the study is its restriction to a single basic health area; however, this area presents the typical characteristics of the PA area in the province of Alicante. The study also has some strengths, such as the availability of the indicators studied in the pre-pandemic and pandemic periods, which allows comparison. Another limitation of the study was that the sample was obtained from the lists of diabetic patients registered in the Alumbra database. It was not possible to perform an analysis of the data of diabetic patients who died during the period analyzed in our area. These histories were not provided to us by the clinical documentation.

Acknowledgments

Funded by the II Convocatoria 2020 ayudas I+D+i en atención primaria Fisabio UGP-21-138.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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