INVESTIGACIÓN ORIGINAL

IMPACT OF THE COVID-19 PANDEMIC ON HBA1C LEVELS IN PRIMARY HEALTH CARE PATIENTS

IMPACTO DA PANDEMIA DE COVID-19 NOS NÍVEIS DE HBA1C EM PACIENTES DE ATENÇÃO PRIMÁRIA À SAÚDE

IMPACTO DE LA PANDEMIA DE COVID-19 EN LOS NIVELES DE HBA1C EN PACIENTES DE ATENCIÓN PRIMARIA DE SALUD

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ABSTRACT

Objective: To determine the impact of the pandemic on the behavior of HbA1c levels in patients attending the Primary Health Care network in the municipality of Talca (Chile). Material and Method: An observational descriptive analysis of the population controlled with HbA1c was performed in 2019, 2020, and 2021. Laboratory data were obtained from a community database in an Excel file and statistical analysis was performed using the SPSS program. Results: 42% decrease in control visits was observed in 2020; significant increase in HbA1c in 2020 compared to the other years; HbA1c levels were higher in primary care centers with smaller populations. Conclusions: The COVID-19 pandemic had a significant impact on increasing HbA1c levels in diabetic patients.

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RESUMEN

Objetivo: Determinar el impacto de la pandemia en el comportamiento de los niveles de HbA1c en pacientes que asisten a la red de Atención Primaria de Salud de la comuna de Talca. Material y Métodos: Se realizó un análisis descriptivo observacional de la población controlada con HbA1c durante los años 2019, 2020 y 2021. Los datos de laboratorio se obtuvieron de una base de datos comunitaria en un archivo Excel y se sometieron a análisis estadístico con el programa SPSS. Resultados: En 2020 se observó una disminución del 42% en la asistencia a los controles; un aumento significativo de la HbA1c en 2020 en comparación con los demás años; los centros de atención primaria con menor población atendida tuvieron niveles más altos de HbA1c. Conclusiones: La pandemia de COVID-19 tuvo un impacto significativo en el aumento de los valores de HbA1c en pacientes diabéticos.

RESUMO

Objetivo: Determinar o impacto da pandemia no comportamento dos níveis de HbA1c em pacientes atendidos na rede de Atenção Primária à Saúde do município de Talca (Chile). Materiais e métodos: Foi realizada uma análise descritiva observacional da população controlada com HbA1c durante os anos de 2019, 2020 e 2021. Os dados laboratoriais foram obtidos de um banco de dados comunitário em um arquivo Excel e submetidos à análise estatística com o software SPSS. Resultados: Em 2020, foi observada uma diminuição de 42% no comparecimento aos controles; um aumento significativo da HbA1c em 2020 em comparação com outros anos; os centros de cuidados primários com uma população menor atendida apresentaram níveis mais elevados de HbA1c. Conclusões: A pandemia de COVID-19 teve um impacto significativo no aumento dos níveis de HbA1c em pacientes diabéticos.

INTRODUCTION

According to the World Health Organization (WHO), in the last three decades, there has been an exponential increase in the number of diabetic patients. This increase is due to unhealthy lifestyles, a sedentary lifestyle, elevated consumption of ultra-processed foods, and genetic load[1]. It is estimated that 1 in 11 adults worldwide currently suffer from the disease, with China being the country that contributes the most significant number of affected patients. Diabetes Mellitus 2 (DM2) is the most common variant of the disease[2] and represents the ninth leading cause of death worldwide, and it is estimated that by 2030 it will be in seventh place among these causes[3]. According to data from the Organization for Economic Cooperation and Development (OECD), in its report "Panorama of Health 2021," Chile is sixth among the countries with the highest number of diabetic patients[4]. The Chilean Ministry of Health (MINSAL) indicates that the main risk factors for the development of DM2 include obesity and aging. The 2016-2017 national health survey carried out by this Ministry, evidenced that the highest percentage of respondents who met the profile of an obese person had a higher average age, and a higher rate were women. And a more significant number of obese people lived in rural areas[5]. Likewise, the MINSAL indicates that the most appropriate test to diagnose diabetes (together with the patient's symptoms and physical examination) is fasting blood glucose, in doubtful cases, it recommends complementing the oral glucose tolerance test and glycated hemoglobin (HbA1c). The latter is the reference test for monitoring the pathology since it is a representation of the blood glucose levels of the last 120 days, as well as a predictive indicator of disease complications such as diabetic foot lesions, chronic kidney disease, and diabetic retinopathies, exponentially increasing their condition for each point that the percentage of glycated hemoglobin increases[6, 7].

HbA1c is the most abundant of the minor hemoglobin components in human erythrocytes (80% of HbA1). It is defined as the condensation of glucose in the N-terminal portion of the beta chain of hemoglobin A[8]. The values taken into consideration for this parameter are average HbA1c < 5.7%; prediabetes ≥ 5.7% and < 6.5%; diabetes ≥ 6.5%[9]. Since the test can be performed at any time of day, the American Diabetes Association (ADA) has recommended the use of HbA1c to diagnose diabetes and to define the category of highest risk of complications[10]. In

Chile, the MINSAL recommends using HbA1c only as a complementary test in the diagnosis of DM, given that not all clinical laboratories have adequate equipment (high-performance liquid chromatography [HPLC] and immunoassay methodologies) for its measurement, which provides great variability in the results of the same sample. However, he supports using this parameter to monitor patients diagnosed with diabetes[7]. As a result of the COVID-19 pandemic, many patients stopped attending their medical check-ups. Various studies indicate that the diabetic population worsened their HbA1c levels compared to how they maintained this parameter before the pandemic, along with the decrease in their medical check-ups[11–13]. In Chile, 2019 there were still no known cases of patients infected by the Sars Cov 2 virus. In 2020, the highest number of infected patients was recorded, while 2021 the pandemic was in remission. In this regard, no studies are showing that diabetic patients have changed their frequency of medical care and that their HbA1c levels have changed trend.

In the commune of Talca, the strategy used to care for diabetic patients during the pandemic focused on telemedicine, specifically phone consultations, as healthcare teams were primarily dedicated to managing the health emergency. Under these circumstances, it was assumed that previously controlled diabetic patients could become destabilized, and those already destabilized would experience a worsening of their condition. Nursing staff played a crucial role during the COVID-19 pandemic, and their role remains essential, as they are the healthcare professionals closest to the community, with the ability to identify early alterations in HbA1c levels, educate patients on self-care and treatment adherence, and design interventions to minimize the risk of complications associated with this disease. The pandemic significantly disrupted care dynamics, prompting a re-evaluation of follow-up and care strategies. This study aims to determine the impact of the pandemic on the behavior of HbA1c levels in patients attending the Primary Health Care (PHC) network in the commune of Talca. Understanding this reality is crucial for nursing staff, as it will provide them with valuable tools to address future pandemics more effectively like the one recently experienced. This way, they will be able to optimize the care of chronic patients and ensure better allocation of resources and care.

MATERIAL AND METHOD

Type of Study: The study was designed as a descriptive observational study with a quantitative approach.

Population and unit of analysis: The population considered in this study includes patients who attended one of the 12 PHC units in the commune of Talca, whose HbA1c levels were measured using the HPLC technique. The unit of analysis was any person who underwent HbA1c measurement, regardless of whether they had a diagnosis of DM2, as no data were provided to differentiate between individuals with or without this diagnosis.

Data collection: The data were obtained from the Community Clinical Laboratory of Talca, located in the Magisterio Family Health Center (CESFAM), which processes samples from the entire PHC network in the municipality. This laboratory maintains rigorous quality control, reporting a variation of 1.7% for normal samples (level 1) and 1.8% for pathological samples (level 2) in HbA1c measurements, ensuring precision and consistency in the results. Out of 99077 samples analyzed between January 2019 and December 2021, 64268 were selected that met all inclusion criteria. Inclusion criteria considered data encompassing the variables sex (nominal variable), age (ratio variable), PHC service where the sample was taken (nominal variable), and HbA1c value (ratio variable). Data from PHC services that came into operation after 2019 were excluded. Incomplete or missing data were excluded. Given the large number of people who attended in the municipality, it was impractical to obtain informed consent from each patient.

To measure the impact of the COVID-19 pandemic on HbA1c levels, HbA1c measurements were compared before, during, and after the critical period of the pandemic (2019, 2020, and 2021). The impact was defined as any significant variation in average HbA1c levels between these three years. The average HbA1c values

considered were normal < 5.7%; prediabetes ≥ 5.7% and < 6.5%; diabetes ≥ 6.5%.

Data processing and analysis: Were automated using SPSS software to minimize potential sources of bias, reducing subjective influence from the researchers. Regular equipment calibration and quality control procedures were implemented in the laboratory to ensure measurement accuracy. Additionally, the database was cleaned thoroughly to eliminate incomplete or inconsistent records.

Data analysis was conducted using SPSS version 29.0. Normality tests, such as the Kolmogorov-Smirnov test, and descriptive analyses were performed. Comparisons between men and women were made using the Mann-Whitney U test, and comparisons between HbA1c, year, and origin were conducted using the Kruskal-Wallis test.

Ethical aspects: The use of data was authorized by the Scientific Ethics Committee of the Universidad Santo Tomás under code Exp-23-01, following the Helsinki guidelines.

RESULTS

Of the samples processed at the Community Clinical Laboratory of Talca, 64268 HbA1c results were analyzed (60.45% women), including data on age (66.53 ± 12.69 for men and 64.90 ± 13.55 for women), sex, and PHC service where the sample was taken (a total of 11 PHC services). Of the total samples in which the HbA1c% parameter was measured, 24842 (38.7%) were processed in 2019, 14465 in 2020 (22.5%), and 24961 (38.8%) in 2021.

Table 1 shows the mean HbA1c and respective percentiles (P25, P50, and P75), classified by sex and year. The mean HbA1c in the total population was 7.67% in 2019, 8.01% in 2020, and 7.82% in 2021. A significant increase is observed in the mean HbA1c% value in 2020 compared to 2019, corroborated by observing the P75. These values tend to decrease during 2021 but remain above the 2019 mean. There is a significant difference in the mean HbA1c% value of the total sample when comparing 2019 with 2020 ($p = 0.000$) and comparing 2020 with 2021 ($p = 0.000$). A significant increase in the HbA1c% value of men and women is observed when comparing 2019 with 2020, with the average HbA1c% of men being higher in all years of comparison. In the case of women, HbA1c% levels in 2021 reached values like those recorded before the COVID-19 pandemic. There is a significant difference when comparing the average HbA1c% value between men and women, in all years ($p < 0.001$).

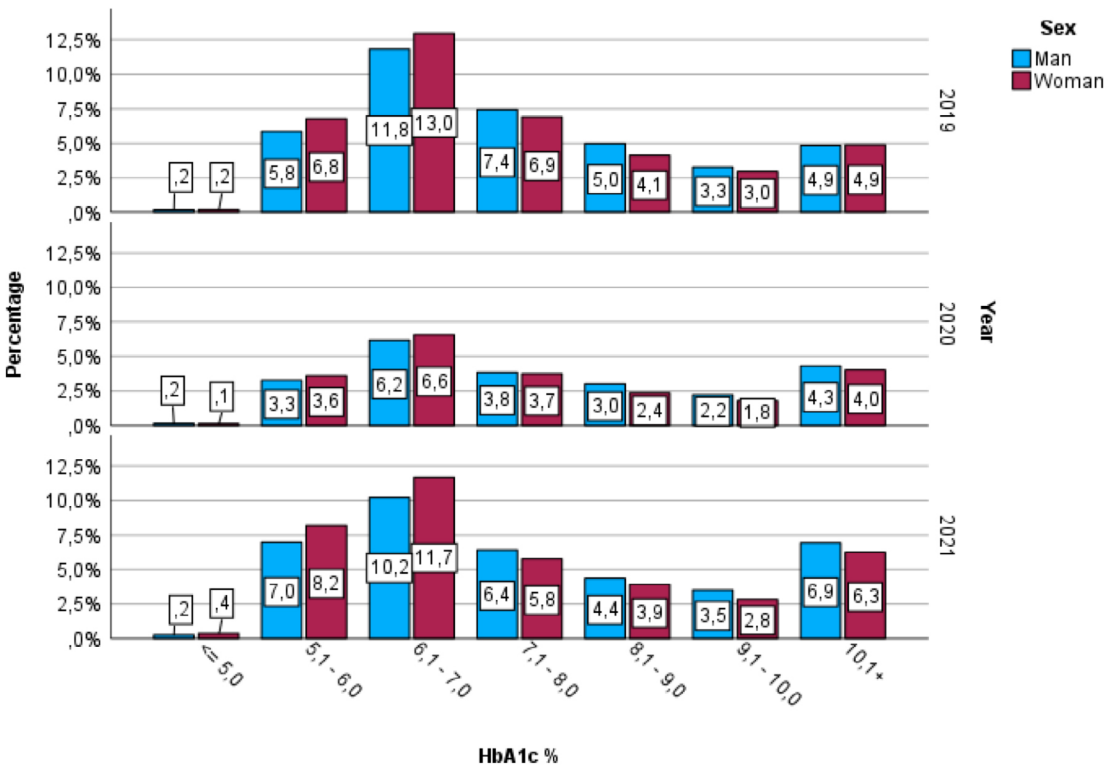
Graph 1 indicates the percentage of samples in which the HbA1c parameter was analyzed, separated by HbA1c range, sex, and year. The number in the center of the bar indicates the percentage of subjects, male or female, who are classified in a specific HbA1c range in a specific year. The percentages are separated according to sex, for example, 100% of women is obtained by adding the numbers inside all red bars. In all years, the highest rate of samples is in the HbA1c range between 6.1% and 7%, and in this same HbA1c range the percentage

Table 1. Number of patients analyzed in the Talca Community Clinical Laboratory who had HbA1c measured, period 2019 to 2021 (n= 64.268).

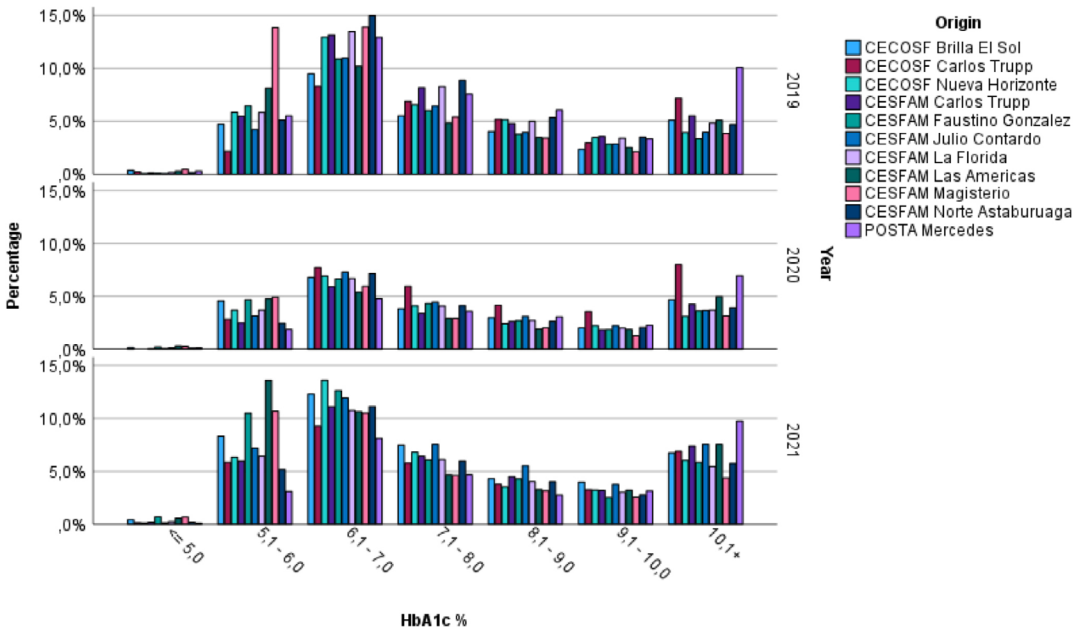
Year (n°)	Mean HbA1c% ± SD	P25	P50	P75	Sex (n°)	Mean HbA1c% by Sex ± SD
2019 (24842)	7,67 ± 1,92	6,3	7,1	8,6	Man (9763)	7,73 ± 1,91
					Woman (15079)	7,63 ± 1,92
2020 (14465)	8,01 ± 2,21	6,3	7,3	9,3	Man (5831)	8,09 ± 2,20
					Woman (8634)	7,95 ± 2,21
2021 (24961)	7,82 ± 2,18	6,2	7,1	9	Man (9826)	7,96 ± 2,19
					Woman (15135)	7,73 ± 2,17

of samples measured from women is higher than that from men in the years analyzed. When analyzing the sample by year, patients with HbA1c values less than or equal to 7% in 2019, 2020, and 2021 correspond to 49.42%, 44.56%, and 49.16% respectively. Patients assessed as prediabetic (HbA1c between 5.7% and 6.4%) in 2019, 2020, and 2021 corresponded to 25.87%, 22.22% and 25.94% respectively. In all years, for the HbA1c range of 7.1% to 10%, the rate for men is always higher than that for women. As described previously, the most critical range of HbA1c corresponds to the range ≥ 10.1%, which for 2019 and 2020 remained around 5% but exceeded this value for 2021 with statistically significant differences ($p < 0.001$). Furthermore, for this range, the percentage of men is higher than that of women during 2020 and 2021. When comparing the HbA1c values between the three years, it is verified that there are significant differences between the years 2019 and 2020 ($p < 0.001$) and between the years 2020 and 2021 ($p < 0.001$). When comparing the years 2019 and 2021, it is verified that there are no significant differences ($p = 0.144$).

Graph 2 shows the percentage of samples in which the HbA1c parameter was analyzed, separated by the HbA1c range, PHC in which the sample was taken, and year. For 2019, the highest rate of samples from all PHC was in the HbA1c range between 6.1% and 7%. However, this distribution varies for 2020 and 2021, observing a shift towards values greater than 7% of HbA1c, specifically for the Carlos Trupp Community Family Health Center (CECOSF) population in 2020 and for people coming from Posta Mercedes in 2021. This latest PHC service is in a rural sector of the commune of Talca.



Graph 1. Percentage of patients analyzed at the Talca Community Clinical Laboratory who had their HbA1c measured, classified by year, by sex and by HbA1c range, during the period from 2019 to 2021 (n = 64,268).



Graph 2. Percentage of patients analyzed at the Talca Community Clinical Laboratory who had their HbA1c measured, classified by year, by HbA1c range, and by origin, during the period from 2019 to 2021 (n = 64,268).

DISCUSSION

The number of samples in which the HbA1c parameter was measured during the pandemic decreased in the critical months of confinement and the average HbA1c value increased in this period. These results coincide with those described by Biamonte et al., who analyzed anthropometric and HbA1c measurements during confinement and found a significant increase in both parameters[14]. However, other studies showed that controlled diabetic patients improved their HbA1c levels during confinement. Tannus et al. found an improvement in HbA1c results in diabetic patients associated with the control of insulin therapy during the COVID-19 confinement period[15]. This result is likely due to the increased time available for frequent self-monitoring of blood glucose at home and adjustments in insulin therapy. Probably, the patients had better access to control via telematics than patients in our study, who were only contacted by telephone and on specific occasions due to the health contingency. This would partly explain the difference in HbA1c levels in both studies, since in our PHC services direct care was modified with the intention that health personnel would dedicate themselves to the care of serious cases of infected patients by the Sars Cov 2 virus and to prevent chronic patients from contracting the disease. During this period, PHC services were implemented to care for diabetic patients through telephone calls, and only some diabetic patients were called, generally, those most compromised in their health[16]. Regarding the number of samples in which HbA1c was measured, this study revealed that the samples decreased by 42% in 2020 compared to 2019 (considering 2019 as a period of attention within normality for the number of samples analyzed), which coincides with the confinement measures applied by the State, and which agrees with other studies that showed a decrease in the number of visits for the same reason. Bancks et al. reported an 8% increase in non-attendance of diabetic patients during the pandemic period[17], which coincides with the trend found in the present study, although to a lesser extent. On the other hand, Cuevas et al. reported that 32% of diabetic patients stopped controlling their HbA1c in the year 2020[18], which is similar to the results reported here. However, Tullo et al. reported an increase in the number of cares for diabetic patients during the year 2020[19], which they assume may be due to the

increase in mortality in diabetic patients infected with COVID-19, and which stimulated this population to carry out an exhaustive control of their underlying disease. With the background obtained in this study, a certain explanation cannot be found as to why the number of samples analyzed in our population decreased; however, it can be assumed that factors that influenced this trend could be the fear of contracting the disease. COVID-19 disease, the lack of personnel to care for chronic diseases, and an inadequate strategy to maintain control of these patients in the context of the pandemic by health personnel, among other causes. Regarding the number of samples analyzed per year and classified by sex, it was found in this study that most people who control their HbA1c are women. This behavior was maintained in the three years analyzed, probably due to the good self-care practices that women usually develop. In a comparative study between men and women on foot care and other risk factors for the diabetic population, Rossaneis et al. showed that the low frequency of drying of the interdigital spaces, the lack of periodic evaluation of the feet, unsatisfactory hygiene, among other factors, was significantly higher among men than among women[20]. Regarding the HbA1c ranges classified by sex and year, we found no significant differences in the values between 2019 and 2021. However, a significant difference is observed when comparing both periods with the year 2020. This phenomenon may be because the health checks were carried out mainly in symptomatic people at high risk of complications from diabetes. A bibliographic review by Jácome dos Santos et al. concluded that diabetic patients prioritized individual care measures over direct care offered by the health system during the pandemic[21], which could justify that most low-risk diabetic patients prefer self-care. Only those complicated diabetic patients were controlled in the HbA1c parameter. It should be noted that for the range of HbA1c ≥ 10.1%, there was an increase in the percentage of samples analyzed in 2021, which was not present in previous years. This increase is probably explained by an increase in patients whose disease worsened. This result coincides with what was described by Foppa et al., who point out that the quality-of-care indicators of a group of diabetic patients showed a significant worsening during 2020 compared to 2019[22]. They state that one of the reasons for the worsening of these indicators (among which is HbA1c) is the cancellation of controls by PHC services. Regarding the PHC, it is observed that those with the smallest population of patients controlled by the HbA1c parameter have the highest mean HbA1c value. This result may indicate that non-standardized strategies for the population that controls this parameter should be used at the community level. Regarding the percentage of samples in which the HbA1c parameter was measured, classified by origin and year, the present study shows that the percentage of samples decreased in all CESFAM analyzed in 2020. Even so, it is observed that CESFAM Las Americas and CESFAM Faustino González present a significant increase in the percentage of patients who are classified as "controlled" for the HbA1c parameter in 2020, this percentage being higher than that shown in 2019, which allows us to infer that the intervention strategies for chronic patient care may be more effective for care. These results coincide with those reported by Walker et al., who described improved HbA1c levels in diabetic patients who received telematic medical care during the pandemic[23]. The coincidence between both results lies in the good monitoring strategies of the diabetic population. In the case of PHC Las Americas, it is known that the personnel assigned to care for diabetic patients carried out the most exhaustive follow-up possible in the telematic modality and with the tools available at the time, mainly by telephone call. Regarding the HbA1c values analyzed by month and year, the months with the highest HbA1c values occurred in April, May, and June of 2020, which coincide with the period of strict confinement. This upward trend in values is maintained until August 2021, which coincides with the lifting of strict containment measures. This result coincides with that reported by Jin et al., who points out that the rise in HbA1c values in diabetic patients coincided with the period of confinement in China and that this social distancing led to a decrease in physical activity and a change in the eating habits of diabetic patients[24].

In addition, lifestyle changes caused deterioration in metabolic status and glycemic control.

The results of this study provide valuable insights into the impact of the COVID-19 pandemic on HbA1c levels in patients attending the PHC network in the municipality of Talca. However, generalizing these findings to other populations should be cautiously approached. The demographic, socioeconomic, and healthcare access characteristics of Talca during the pandemic may not be representative of different regions, both nationally and internationally. Nevertheless, the findings could apply to similar contexts, particularly in rural or semi-urban areas where limitations in in-person care and reliance on telemedicine were prevalent during the pandemic. Future studies should replicate this research in other regions with different population characteristics and healthcare structures to improve external validity.

This study has several limitations that should be considered when interpreting the results. First, it was impossible to differentiate between patients with and without a diagnosis of DM2 due to the lack of specific data. This limits the ability to accurately analyze the behavior of HbA1c levels in defined patient subgroups. Second, data collection relied on records provided by the Community Clinical Laboratory of Talca. This could introduce selection bias by excluding patients not undergoing testing during the study period. The inability to obtain further information on patients' risk factors, such as lifestyle or socioeconomic status, also limits the analysis of potential confounding factors. Finally, while the use of the HPLC technique ensures high precision in HbA1c measurements, variability between different health centers and the conditions of telemedicine during the pandemic could have influenced the consistency of the results. These limitations suggest additional studies addressing these constraints to confirm and expand upon the findings presented.

During the COVID-19 pandemic, nursing staff was key in monitoring and controlling chronic diseases like diabetes. Despite the challenges posed by health restrictions, nurses adapted to new modes of care, including telemedicine and remote monitoring. This work was crucial in mitigating the negative impact of lockdown measures on HbA1c levels, as their intervention allowed for some level of glycemic control in many patients, despite the reduction in the frequency of in-person check-ups[25–27].

CONCLUSION

The COVID-19 pandemic significantly impacted HbA1c levels in patients attending the PHC network in the commune of Talca. There was an increase in HbA1c levels in most patients, suggesting that lockdown measures, the possible reduction in the frequency of medical check-ups, and changes in lifestyle habits, may have negatively affected diabetes control during this period. The number of patients with HbA1c parameters checked decreased significantly in the pandemic year 2020, compared to 2019, recovering in 2021 when mobility restrictions were lifted. The number of women who control the HbA1c parameter is higher than that of men, regardless of the year analyzed. By 2021, more men with critical HbA1c values will be observed than women. The highest mean HbA1c values are recorded in PHC in rural areas. The months with the highest HbA1c records were April, May, and June 2020. These findings provide additional justification for optimizing intervention strategies for patients with diabetes in new episodes of social confinement due to new pandemics. Nursing staff was essential in caring for diabetic patients during the COVID-19 pandemic. Their ability to adapt to new circumstances, using resources such as telemedicine and remote monitoring, was crucial in reducing the adverse impacts on diabetes management in the Primary Health Care network. These efforts highlight the importance of strengthening and supporting the work of nursing staff, especially during times of health crises.

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Responsibility of the author

Roberto Antonio Fuentealba-Leyton: Conceptualization, data curation, formal analysis, investigation, design and development of the methodology, project administration, provision of study materials, software programming, and design, supervision and leadership in planning, validation of results, data visualization, drafting of the original manuscript, and subsequent review and editing.

Jessica Pamela Noack-Segovia: Conceptualization, data curation, formal analysis, investigation, design and development of the methodology, provision of study materials, validation of results, data visualization, drafting of the original manuscript, and subsequent review and editing.

María Cristina Levet-Hernández: Formal analysis, investigation, design, and development of the methodology, provision of study materials, validation of results, data visualization, drafting of the original manuscript, and subsequent review and editing.

Rafael Antonio Izquierdo-Valenzuela: Participated in the formal analysis, investigation, design, and development of the methodology, provision of study materials, validation of results, data visualization, drafting of the original manuscript, and subsequent review and editing.

María José Rodríguez-Becerra: Collaborated in the formal analysis, investigation, design, and development of the methodology, provision of study materials, validation of results, data visualization, drafting of the original manuscript, and subsequent review and editing.

Sebastián Alfonso Miranda-Piña: Contributed to the formal analysis, investigation, design, and development of the methodology, provision of study materials, validation of results, data visualization, drafting of the original manuscript, and subsequent review and editing.

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