



The Effect of the COVID-19 Pandemic on Non-Communicable Disease Prevention and Management Services in the Primary Health Care System of Iran

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Abstract

Background: The COVID-19 pandemic has caused significant disruptions in the provision of non-communicable disease (NCDs) prevention and control services in many countries, and there is a concern that it would lead to long-term complications of the diseases. The aim of this study is to assess the changes in the provisions of selected NCD services before and after the COVID-19 epidemic in Iran's primary healthcare system.

Methods: In this descriptive-analytical retrospective study, the number of eight NCD services provided during the first 10 months of the COVID-19 pandemic from Feb 2020 to Dec 2020 were compared with the same period in the previous year using the data from the Iranian integrated electronic health record system (SIB) and also the association between the number of deaths due to COVID-19 and a sample of NCD services were assessed using cross-correlation analysis. The statistical analysis was performed in Stata Software v.14.

Results: The NCD services have decreased by an average of 18.89% compared to the same period in the previous year; this decline was much more severe at the beginning of the epidemic period (up to 75% in some services) and was greater in physician-provided services than in non-physician services. Also, examining the course of the selected services during this period, a gradual compensation was evident after the initial reduction.

Conclusion: The general trend of the selected services of prevention and control of NCDs in the PHC system of Iran within 10 months after the onset of COVID-19 showed a sharp decline and subsequent gradual compensation. Although the process of compensation in some services may be considered somewhat reassuring, in the case of some essential services, more effort and attention to the implementation of programs or compensatory policies seem necessary.

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↑What is "already known" in this topic:

The COVID-19 pandemic has caused significant disruptions in the provision of NCDs prevention and control services in many countries.

→What this article adds:

The impact of the COVID-19 pandemic on NCDs prevention and control services in the primary healthcare system has been significant and needs more attention.

Keywords: COVID-19 pandemic, Non-communicable diseases, Essential services, Primary health care, Iran

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Introduction

Non-communicable diseases (NCDs) account for more than 70% of all worldwide deaths, of which 80% occur in low- and middle-income countries. The burden of NCDs in Iran is growing in recent years and in 2019, 83.5% of deaths and 78.1% of the total disease burden were attributed to NCDs (1-3). Based on the National Action Plan for the Prevention and Control of NCDs and Related Risk Factors, Iran is committed to reducing 25% of premature deaths from NCDs by 2025 (4). More than a year and a half have passed since the emergence of COVID-19 in Iran, and this pandemic has had great effects on the management of NCDs. Evidence showed disruptions in the provision of services for NCDs since most health systems have difficulties in meeting the simultaneous needs of patients with COVID-19 and providing services for NCD patients such as prevention, early diagnosis, screening, treatment, and rehabilitation. Although this impact was global, it was most severe in low-income countries (1, 5). While COVID-19 control is a priority in nearly all countries, many people with NCDs may have difficulty accessing their routine prevention and care services (6). Changes made by many countries in the routine control of NCDs, including cancellation or postponement of non-emergent outpatient visits, would have important implications for disease control, diagnosis of new patients, drug adherence, and the progression of NCDs (7). Moreover, the available evidence suggest a close interaction between severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and a range of NCDs (8). COVID-19 is shown to be associated with cardiovascular diseases such as acute heart injury (e.g., myocarditis), stroke, and exacerbation of subclinical vascular injury (9). Also, there is now significant evidence that people living with NCDs (PLWNCDS), including cardiovascular disease, diabetes, chronic respiratory disease, chronic kidney disease, neurological disease, cancer, as well as conditions such as high blood pressure and obesity are at greater risk of severe complications and death from COVID-19 (1, 10-13). There is a concern that the COVID-19 pandemic may contribute to the increase in mortality and morbidity from NCDs (1).

Furthermore, some restrictive measures, such as closures, social distancing, and travel restrictions adopted in many countries, have been associated with reduced physical activity and limited access to healthy food and preventive and health-promoting services particularly in PLWNCDS (5). Fear of infection in healthcare facilities, along with restrictions on public transportation, may also

reduce a person's willingness to seek care, even in emergencies (6, 9). A recent systematic review showed that admission rates in acute cardiovascular situations and the number of medical procedures have decreased significantly; also, shorter hospital stays and longer delays between the onset of symptoms and hospital treatment have been the indirect complications of the COVID-19 pandemic (14). Finally, stigma and misinformation should be added to these barriers (15).

On February 19, 2020, the Ministry of Health and Medical Education (MoHME) of Iran confirmed two deaths due to COVID-19; the epidemic spread in Iran extremely fast, and soon, most provinces entered the stage of community transmission. In response, national structures for crisis management were formed and a set of national and subnational measures were followed including actions to maintain essential NCDs health services (16).

Information on the disruptions in the provisions of health services caused by the COVID-19 pandemic is critical for decision-making to improve health service delivery (1, 14). Therefore, this study was conducted with the aim of running a quantitative analysis of the effect of the COVID-19 pandemic on the provision of NCDs prevention and control services in the primary health care (PHC) system of Iran.

Methods

This descriptive-analytical retrospective study was part of a joint study conducted by the National Institute for Health Research and the Center for NCDs prevention and Management at MoHME on the impact of the COVID-19 pandemic on NCDs.

Source of data

In order to investigate the effect of the COVID-19 pandemic on outpatient NCD services in the PHC system, the routine data of NCD services available in the integrated electronic health record system (SIB) was collected. The SIB system is designed as an Electronic Health Record (EHR) system in the field of PHC and has been operating in the country since 2016. Currently, more than 73,500,000 of the country's population (more than 90% of the population) are registered in this system (17). All services provided at the level of the governmental PHC system of the country (except for the Mazandaran, Golestan, and Khorasan Razavi provinces, which have their own electronic health record systems), are registered in this

system at the point of service provision; therefore, the NCDs data recorded in this system can be considered as national data at the level of the governmental PHC system and the process of its changes can be analyzed (The SIB system is generally not active in the private sector). Hospitalization and death data were extracted from data published by the National COVID-19 Epidemiology Committee.

Study Design

According to the priorities and using the technical opinions of the managers of the Center for NCDs prevention and management, five care services related to the IraPEN program along with three direct visit codes of physicians related to NCDs, were selected for review in this study. Care services are algorithms designed in the SIB system to provide decision support for healthcare workers in the PHC system. The package of essential NCDs interventions in the PHC system of Iran (IraPEN) was compiled in 2016 as an indigenous model of the WHO's PEN (package of essential NCDs' interventions for PHC in low-resource settings), adapted to the requirements of the Iranian healthcare system, which is gradually expanding in the level of the whole country after the successful pilot run in four selected spatial regions (18-20). The frequency of five care services of this program embedded into the SIB system, which are provided as non-physician services, were evaluated in this study; These services include: "Cardiovascular risk assessment service", "Pre-Diabetes Care", "Hypertension Care", "Early diagnosis and screening of breast cancer", and "Early diagnosis and screening of colorectal cancer". Under the program, 10-year cardiovascular risk calculation, diagnosis of hypertension, diabetes, pre-diabetes, and hyperlipidemia are integrated into "Cardiovascular risk assessment service"; "Pre-Diabetes Care" and "Hypertension Care" are care services for chronic care of patients with hypertension and pre-diabetes by non-physicians and the two remaining services are for early diagnosis and screening of breast and colorectal cancer services using breast exam and Fecal Immunochemical Test (FIT) respectively. Also, the frequency of three physician visit codes in the SIB system (Physician visit records in the SIB system) including Hypertension, Diabetes, and Obesity Visits, were the other selected measures in this study. The mentioned services were selected due to the greater probability of showing changes.

In order to enable comparison, service information was collected in the same period of last year in addition to the period under review. Data was received for 10 months after the outbreak of COVID-19 and a similar period from last year, based on a data collection form containing the relevant codes, in three periods and with a formal request from the service provider company of the SIB system. In the first turn, the information was received from February 20, 2020, to June 09, 2020, and then it was updated in two intervals, first until August 18, 2020, and in the third turn, until December 19, 2020.

Statistical analysis

To investigate the effect of the COVID-19 pandemic on

services provided in the field of NCDs prevention and control, we assessed trends in NCD services and the percentage of reduction (percentage of change) of services during the COVID-19 epidemic compared to the same period last year by the type of services were used.

To assess trends in NCD services during and before the pandemic, daily data from the SIB was analyzed. In order to reduce fluctuations and noises in the data (which occur because of events such as holidays), the frequency of services was smoothed using moving averages. This method decreases the distortion of the data by averaging consecutive observations at each time. So, the 7-day moving average charts of the frequency of services were presented. In addition, to investigate the effect of the COVID-19 pandemic on NCD services, the percentages of changes in services during the pandemic relative to the same period before the pandemic were calculated ($(\#N \text{ of services}_{2020} - \#N \text{ of services}_{2019}) * 100 / \#N \text{ of services}_{2019}$).

Also, this study examines the association between the number of deaths due to COVID-19 and the cardiovascular risk assessment (as a sample of NCD services) using cross-correlation analysis which characterized the association of two variables at different time points. The statistical analysis was performed in Stata v.14 and the graphs were drawn using Excel 2016 and Stata v.14.

Results

In this study, the data of 8 service codes (5 non-physician care services and 3 physician visit codes) among the services of prevention and control of NCDs in the PHC system of Iran, available in the SIB, for 10 months (304 days in total) after the onset of the COVID-19 epidemic in Iran was examined.

In general, in the course of all the studied services, a phase of initial severe reduction and subsequent compensatory phase were observed during the period of 10 months after the COVID-19 epidemic. **Figure 1** shows trends in the services under study (as a 7-day moving average) during the epidemic period and the similar period of the previous year (**Fig. 1**). The total number of the selected NCD services during the COVID-19 pandemic (Feb.2020 to Dec.2020) and the same period prior to the pandemic (Feb.2019 to Dec.2019) are presented in **Table 1**.

Compared to the same period last year, there is a decrease in services, especially in the early period of the epidemic; the average decrease for all services under review and until the end of December 2020 was 18.89%. On the same ground, the decrease in physician services (26.37%) was more than in non-physician services (16.93%). **Figure 2** and **Table 2** show percentage changes in NCDs prevention and control services by service and time and its standard error.

The maximum percentage changes in services in the first period (February 20, 2020, to June 9, 2020) in the case of physician visits were for obesity complaints (74.91% reduction) and cancer screening services (62.84% reduction for colorectal cancer screening service and 62.41% for breast cancer screening service), and the least percentage changes in all study periods were found

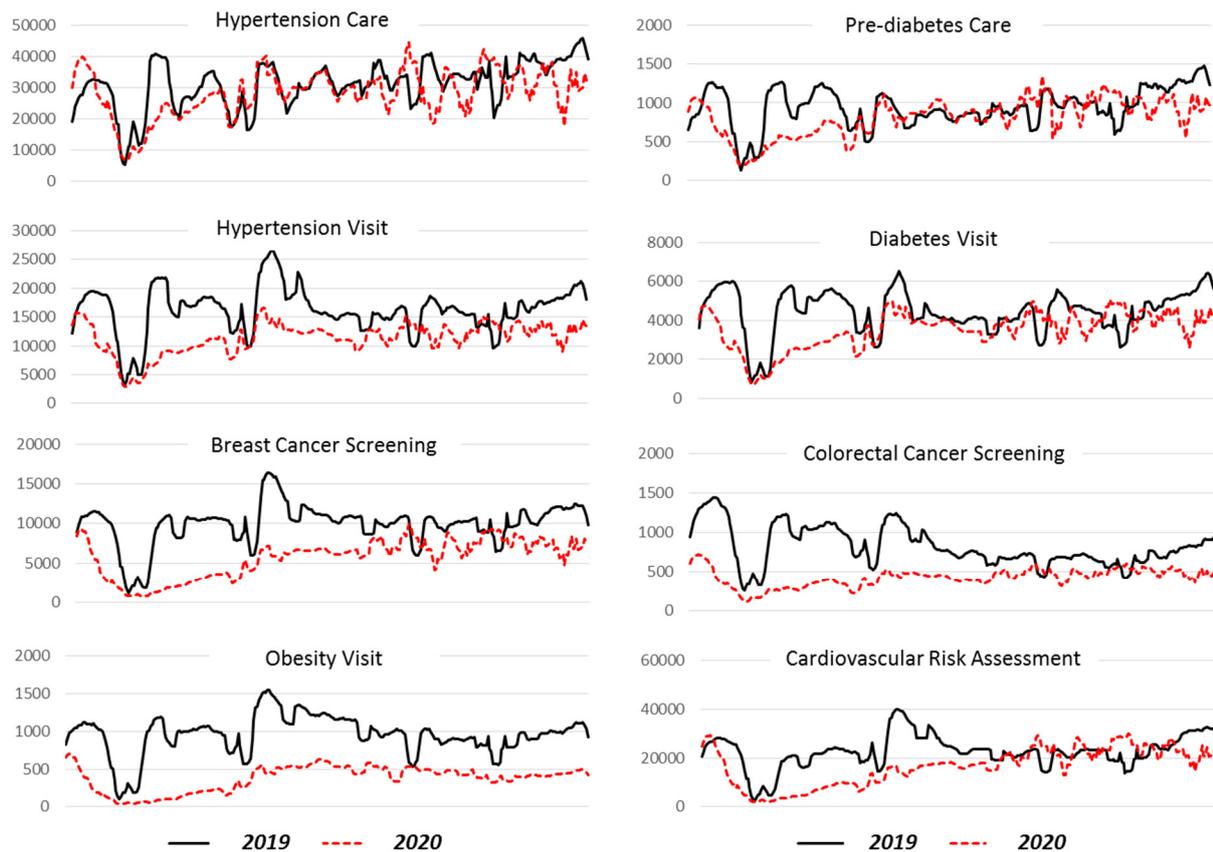


Fig. 1. Frequency of non-communicable diseases services (7-day moving average) during the COVID-19 pandemic (Feb. 2020 to Dec. 2020) compared to the same period prior to the pandemic (Feb. 2019 to Dec. 2019)

Table 1. Total number of non-communicable disease services during the COVID-19 pandemic (Feb.2020 to Dec.2020) and the same period prior to the pandemic (Feb.2019 to Dec.2019) in each period

PHC services	February 20,2019 to June 09,2019	February 20,2020 to June 09,2020	February 20,2019 to August 19,2019	February 20,2020 to August 19,2020	February 20,2019 to December 19,2019	February 20,2020 to December 19,2020
Obesity Visit	93439	23214	178830	60373	289054	113287
Colorectal Cancer Screening	104843	37654	164475	68129	248532	128038
Breast Cancer Screening	957946	356234	1769435	816326	3009663	1729757
Cardiovascular Risk Assessment	2151690	1030465	4055399	2207950	6892071	5033194
Diabetes Visit	482326	301076	789979	569168	1349156	1066883
Hypertension Visit	1700656	1046200	2961589	1916208	4922271	3459792
Pre-diabetes Care	98011	66491	158507	128267	285970	247633
Hypertension Care	2899955	2580395	5116596	4740289	9400847	8572451

for blood pressure care component by non-physicians.

Among the services provided by physicians (diabetes visits, high blood pressure visits, and obesity visits) the largest decrease is observed in the obesity visit. Also, this service code has experienced the least compensation overtime (60.66% reduction at the end of the study period). The diabetes visits by physicians in the first period of the study experienced a 34.31% reduction compared to the same period last year. At the end of the study period, this reduction reached 17.91 percent. Regarding the blood pressure visit service in the first period of the study, the percentage of reduction was 36.18%, which reached 25.57% at the end of the period.

Among the services provided by non-physicians, colorectal cancer and breast cancer screening services had the

highest reduction (more than 60%) and the least compensation overtime at the end of the study period (44.3% and 41.92%, respectively). Cardiovascular risk assessment service, in the first period of the study, has experienced a 53.74% reduction compared to the same period last year. During the second period of the study, this reduction has been partially compensated and has reached 46.3% and at the end of the study period, this reduction has reached 27.52%. Blood pressure and pre-diabetes care components by non-physicians had the lowest decrease at the end of the study period (6.49% and 10.08%, respectively). In the case of hypertension care, there seems to be more compensation in the second period, even compared to the end of the period (Fig. 2 and Table 2).

Similar to other services reviewed in the present re-

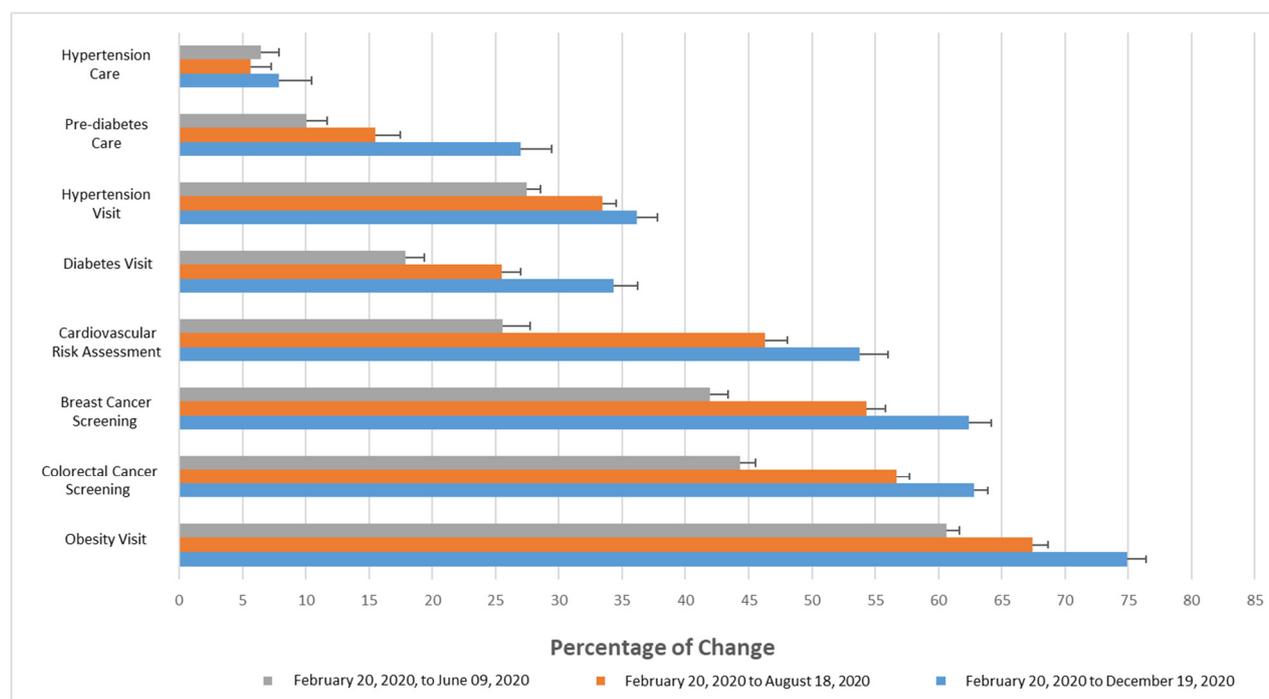


Fig. 2 . Reduction in frequency of non-communicable disease prevention and control services by service and period of review

Table 2. Percentage changes for NCD prevention and control services by service and time

Date	Percentage of Change (SE*)		
	February 20,2020 to June 09,2020	February 20,2020 to August 18,2020	February 20,2020 to December 19,2020
Obesity Visit	74.91 (1.51)	67.46 (1.21)	60.66 (0.96)
Colorectal Cancer Screening	62.84 (1.05)	56.7 (0.99)	44.3 (1.27)
Breast Cancer Screening	62.41 (1.78)	54.34 (1.44)	41.92 (1.46)
Cardiovascular Risk Assessment	53.74 (2.25)	46.3 (1.74)	25.57 (2.15)
Diabetes Visit	34.31 (1.9)	25.47 (1.5)	17.91 (1.47)
Hypertension Visit	36.18 (1.61)	33.42 (1.13)	27.44 (1.09)
Pre-diabetes Care	27.01 (2.45)	15.53 (1.91)	10.08 (1.62)
Hypertension Care	7.88 (2.56)	5.62 (1.63)	6.49 (1.41)

*SE: Standard Error

search, a gradual compensation trend is observed in the trend of cardiovascular risk assessment service after a sharp decline in March 2020.

Cross-correlation analysis of cardiovascular risk assessment service and the number of death due to COVID-19 demonstrated a moderate to strong positive correlation between the two time series with a lag of -2 weeks (the time scale is week and the correlation between these two indicators in the same time (lag=0) is 0.553. The value of the lag with the highest correlation (correlation at lag -2 is 0.677) shows the best fit between the two indicators of the number of deaths with positive test results and the number of risk assessment services. The maximum value of the correlation in time is observed in the time (-2), so the difference between the two time series is 2 weeks, and because the correlations are positive, both time series are in the same phase. This means that an increase in deaths is associated with an increase in cardiovascular risk assessment services with a two-week delay (Fig. 3 and Table 3).

Discussion

The aim of this study was to assess the effect of the COVID-19 pandemic on the provision of NCDs preven-

tion and control services in the primary healthcare system of Iran. Our results showed that after the COVID-19 epidemic in Iran, NCD services have decreased by an average of 18.89% compared to the same period in the previous year. In the course of all the services under review, a sharp decline in service delivery was observed at the beginning of the epidemic (crisis stage) and then a process of gradual compensation (return/compensation and adaptation stage) is evident; in a way that at the end of the 10-month period, on average, there was only less than 20% reduction in the total number of services studied compared to the same period last year.

During the first months of the pandemic, governments in many countries took containment measures with approaches ranging from restricting population movement and increasing social distance to carrying out voluntary or forced quarantine measures. In times of pandemic crisis, many countries postponed or reduced some aspects of routine NCD services, outpatient visits, and non-urgent surgeries to avoid unnecessary visits to hospitals, reduce hospital burdens, and reduce the risk of infection (7). In Iran, similar measures were adopted during the early stages of the epidemic. In the field of NCDs prevention and

In Iran, the Ministry of Health and Medical Education, in addition to setting up the 4030 call center to respond to people's queries (early March 2020) and advising people to use a portal of integrated electronic health record system (SIB) for screening and case finding (simultaneously with the announcement of the Iran National Mobilization against COVID-19, in mid-March 2020), which reduced the reactions caused by fear and anxiety in the community (intensified by false news and misinformation) and reduced the number of unnecessary hospital visits (16, 25), succeeded to using the capacity of the Health Care Networks of the Islamic Republic of Iran to conduct two stages of telephone screening performed by the primary health care system staff to educate, identify and follow up COVID-19 patients and high-risk groups, including NCDs patients. In this screening, the search for symptoms in high-risk populations (patients with chronic diseases and high-risk conditions such as diabetes, hypertension, and obesity, patients with malignancy, or those undergoing chemotherapy, the elderly, and pregnant women) and their family members were prioritized (26). Also, having a comprehensive primary healthcare network enabled the county to use comprehensive health service centers in rural and urban areas as the first line in the COVID-19 referral system (16).

With changes in the prevalence of COVID-19 and adopting a policy of reopening and social distancing (mitigation strategy), different departments and offices of the Ministry of Health and Medical Education were required to develop appropriate guidelines for implementing programs in different epidemic circumstances. A flexible performance in responding to different epidemic conditions and adopting dynamic and regulated strategies in line with WHO recommendations are necessary for maintaining essential health services (15). In the second phase of COVID-19 screening (the second step in combating COVID-19 and social distancing at the end of April 2020), more emphasis was placed on identifying and following up with high-risk individuals with underlying diseases. Health workers at primary health care centers were asked to make regular telephone calls to patients with NCDs to educate them on the prevention and control of COVID-19 and to encourage them to adhere to treatment and self-care (27).

The severity of the reduction in service delivery and the subsequent compensation grade in different services have been different; on the one hand, in all stages, a smaller decrease in the frequency of services provided by non-physicians was observed compared to services provided by physicians. The main justification for this phenomenon may be the effect of the relative shortage of physician manpower before the outbreak and the further involvement of physicians in providing services to COVID-19 patients, for example, in special centers (16 or 24-hour centers). However, it should be borne in mind that the shortage and problems of manpower distribution in the health sector have not been limited to physicians. Meanwhile, the evidence has shown that in general, the attitudes, strategies, and knowledge of front-line employees in practice affect the implementation of policies (16).

Among the services reviewed in this study, the obesity visits and cancer screening service in the early epidemic stages (crisis phase) had the largest decrease and showed a decrease of more than 40% at the end of the research period compared to last year. A study by the World Health Organization also reported the closure of population screening programs in more than 40 percent of countries. This was in line with the World Health Organization's initial recommendations for minimizing non-emergency care services during a pandemic (1). Suspension or reduction of cancer screening programs and diagnostic services has occurred in many countries; this, along with patients' reluctance to seek services, may delay diagnosis and cause subsequent complications (28).

Most of the known clinical risk factors that increase the severity and mortality of COVID-19 have higher rates in socioeconomically disadvantaged areas or populations; at the same time, these people are more exposed to the virus (due to the type of occupation or, for example, use of public transportation) and also, have less access to health services (29). Such an approach argues that limiting the harms of COVID-19 requires greater attention to the management of NCDs and related socioeconomic inequality areas (8). NCDs and COVID-19 are common in a set of underlying risk factors such as deprivation, obesity, old age, and ethnicity, and it is clear that these conditions are completely dependent on upstream factors such as urban design, housing, poverty, and availability of tobacco and processed foods, as well as physical inactivity. Most prevention strategies and research focus on downstream interventions that rely on influencing individual behaviors which promote health inequalities. Interventions, on the other hand, should target entire systems such as health, education, government, and communities to address the economic and environmental causes of the disease (30).

In this study, to create comparability, we used the same period of the previous year, i.e., from February 20, 2019, to December 21, 2019. It seems that there has been an increase in some services, such as blood pressure visits, obesity visits, and cardiovascular risk assessments in the first half of 2019. In 2019, the Ministry of Health and Medical Education implemented the "National Mobilization on Control of Blood Pressure" project in the form of a combination of education and advocacy from May 17 to July 8, 2019. The observed increase is consistent with this period in terms of time and therefore the possibility of a relative decrease due to the increase in services in the same period of the previous year should also be considered (31). Regarding the blood pressure care service, for which a greater decrease was observed in the second period, compared to the whole period, a slight decreasing slope of this service and some other services is observed at the end of the study period. In terms of time, this reduction may be coincident with the third wave of the COVID-19 epidemic in Iran. Evidence suggests that there is an association between COVID-19 transmission levels and restrictions on access to NCD services (1). Although the data of this study showed a positive correlation with a delay of 2 weeks, it seems that these changes in the frequency of services, in addition to the effect of the level of

transmission of COVID-19, also depend on the policies and the level of preparedness and adaptation to the conditions at each stage; so that in the third period of the study (from the beginning of September to the end of the period), despite the occurrence of the most severe wave of the disease up to that time, in practice, there is no significant reduction in the frequency of services. Temporary suspension of services, on the other hand, often leads to an accumulation of people in need of service. As new conditions become more prevalent, service restoration is likely to occur, with the constant risk of cluster recurrence or community transmission. In the case of preventive services such as screening, compensatory action is likely to be required (15).

Strength and limitations

Using the routine data of the health system collected in the SIB electronic health record system is considered an advantage in terms of ease of access, timeliness, and the use of country-level data. However, it also has limitations. Since the data were not collected for research purposes, including that the aggregated data could not be disaggregated by age, sex, or other items. Also, the use of nationwide aggregated data does not take into account epidemic changes in different provinces over time, and the overlap may have distorted existing relationships; Therefore, the study of services in different regions of the country in future research can reveal more details.

Also, the data of this research was requested on a daily basis, and therefore, duplicates have not been addressed, so it is possible that they are numerically different from the quarterly reports of the SIB system. However, this is unlikely to make a problem in comparison to the same period last year. The quality of the data is also questionable; the possibility of registering services that have not been done cannot be ruled out, the amount and effect of which are unknown, and this concern may be greater during a period of a health crisis or work overload. The SIB system is used only in the public sector, so the data of this study ignores a large part of outpatient services delivered in the private sector; however, it is likely that the decline in services in times of crisis in the private sector has been greater than in the public sector.

Conclusion

This study described the changes in the selected services of prevention and control of non-communicable diseases in the PHC system of Iran and documents the trend of these services within 10 months after the onset of COVID-19. This study showed that the COVID-19 pandemic has not only had unprecedented effects on health systems around the world but also has affected the NCDs prevention and control services in Iran's primary health care system. Although the process of compensation in some services may indicate the effectiveness of policies and be considered somewhat reassuring, in the case of some essential services, more effort and attention to the implementation of programs or compensatory policies seem necessary. Based on the data gathered in this study, in order to improve service provision and increase utilization,

a response plan for managing NCD services in the context of the COVID-19 pandemic in I.R Iran was devised.

Acknowledgments

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Authors contributions

AO conceived the study, supervised all phases of evaluation, and critically revised the manuscript; he is the guarantor. MA, PRA, AMH, and EY have cooperated in collecting primary data. AO, MA, AMH, and PRA analyzed the data. MA, PRA, FA, and SRI drafted the manuscript. NP, MP, AM, MR, MSN, CH, SS, JST, BL, and AR provided experiences and critical feedback and helped shape the research, analysis, and manuscript. The authors read and approved the final manuscript.

Ethical considerations

Ethically, the permission of the Deputy of Public Health of MOHME was obtained for using the aggregated data analyzed in this study.

Of course, general ethical considerations related to the research are considered by the authors and are also mentioned in the article.

Ownership of the data used in the above research and consent to the report of trends and indicators is in the direction of health, public benefit, and social justice and is not an example of harming or disrespecting the autonomy of individuals, groups, or communities.

Conflict of Interests

Prof. Alireza Raeisi is the Deputy Minister of Public Health at the Ministry of Health and Medical Education. Prof. Bagher Larijani is the Deputy Chairman of the Iranian Non-communicable Diseases Committee (INCCDC). Dr. Niloofar Peykari is the manager of the INCCDC Secretariat. Dr. Moloud Payab is a member of the INCCDC Secretariat. Prof. Jafar Sadegh Tabrizi is the Director of the Network Management Center and Prof. Afshin Ostovar is the Director of the Center for NCDs prevention and management of the Ministry of Health and Medical Education.

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Dr. Alireza Mahdavi Hazaveh and Dr. Alireza Moghisi are the deputies of the Center for NCDs prevention and management of the Ministry of Health and Medical Education. Dr. Parisa Rnejad Asl is an expert in the Network Management Center, and Dr. Forouzan Akrami, Dr. Mehdi Afkar, and Elham Yousefi are experts in the Center for NCDs prevention and management of the Ministry of

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