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Impact of COVID-19 Pandemic on Cost of Chronic Diseases Treatment and Care at Public Hospitals in Wallaga Zones, Oromia Regional State, Ethiopia: Hospital Based Cross-Sectional Study

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Abstract

Objective: Aimed to determine the impact of COVID-19 pandemic on cost of chronic diseases treatment and care at public hospitals in Wallaga Zones, Oromia Regional State, Ethiopia, from August 01 to 31, 2020.

Methods: An institutional based cross-sectional study design was used and the sample size for the study (n = 642) was determined using a single population mean formula. Data was collected using interviews and analyzed using SPSS version 25. Descriptive statistics were performed and the cost of follow-up care before and after the pandemic was compared using a Related-samples Wilcoxon signed-rank test, declaring the level of significance of the median cost difference at P<0.05.

Results: A total of 642 patients were included in the study, among whom 605 (94.2%) of them responded to the interviews. There was a significant median cost difference (n = 593, Z = 5.05, p = 0.001) between the cost of chronic diseases among follow-up patients during the pandemic compared to the costs incurred by these patients before the pandemic.

Conclusion: The cost of follow-up care among chronic disease patients during the COVID-19 pandemic was significantly higher compared to before the pandemic era. Therefore, healthcare providers should arrange special fee waiver mechanisms for chronic disease healthcare costs during such types of pandemics and provide the services at proximal health facilities.

Keywords: COVID-19 Pandemic, Chronic Disease, Cost of Illness, Follow up Care, Ethiopia

Background

Globally, chronic diseases (CDs) are major public health problems that account for 60% of all deaths and are the cause of 35% of deaths in low and 40% of deaths occurring in middle income countries.[1-3] Many low- and middle-income countries (LMICs) are undergoing a gradual epidemiologic transition as the disease burden shifts from infectious to non-communicable diseases .[4-6]

Healthcare systems in LMICs are mostly unprepared to handle the increasing burden of non-communicable diseases (NCDs), resulting in no or limited access to affordable prevention and diagnosis of NCDs.[7] These add up to higher NCD treatment costs, the financing of which mostly comes from households' out-of-pocket (OOP) spending .[8]

COVID-19 originated first in China, in Wuhan, Hubei province, in late December 2019, as a health crisis that struck the global community, causing dismal repercussions. SARS-CoV-2 has spread fast all over the world to involve over 200 countries, making it a pandemic. The World Health Organization (WHO) notified COVID-19 as a pandemic on March 12, 2020. [9, 10]

The COVID-19 pandemic disrupts entire societies, including the routine health care systems. The comprehensive effort to contain the pandemic and minimize the subsequent morbidity and mortality has affected both the continuity and quality of care for patients with CDs.[11]

During the pandemic, most global healthcare resources are focused on COVID-19 control and prevention. This resource reallocation could disrupt the continuum of care for patients with CDs. Diabetes, chronic obstructive pulmonary disease, hypertension, heart disease, asthma, cancer, and depression were the conditions reported to be most impacted by the reduction in healthcare resources due to the pandemic.[12]

Resources at all levels have shifted away from CDs management and prevention during the outbreak, and the lock-down of many services has translated into reduced access, a decrease in referrals, and reduced hospitalizations of patients with non-COVID-19 pathology.[13]

As the pandemic continues to rapidly spread, our attention often focuses on the numbers of confirmed and probable cases, hospitalizations, and deaths, which can be called the "direct" effects of the pandemic. However, these numbers do not capture the full extent of the pandemic because it has also generated important spillover (indirect) effects by decreasing the supply of and altering patient demand for non-COVID-19-related medical care. [14]

A lock-down, self-isolation, and social distancing are some of the measures taken by governments of different countries aimed at decelerating the pandemic spread. The pandemic influenced everyone around the globe, but it can cause more concerns for people living with chronic illnesses .[15]

Ethiopia had the first COVID-19 positive case confirmed on March 13th, 2020.[16] At this time, the government declared a state of emergency, labeling the pandemic as a national threat and launching overall preventive measures, including advising the community to stay at home, practicing strict and frequent hand washing, and wearing a face mask. The government also restricted the movement of its people from place to place and laid temporary restrictions on market places, restaurants, shops, cinema houses, religious, and cities.[17] During this time, the number of hospital visits dropped sharply to utilize health services, including CD follow-up. [18]

Many studies have revealed the direct impact of COVID-19 on health care provision and utilization. But none of them reported the impact of the pandemic on illness costs of chronic disease follow-up care from a patient perspective. So, the study aimed to

determine the impact of the COVID-19 pandemic on the cost of follow-up care among chronic disease patients at public hospitals.

Methods and Materials

Study Setting

This study was conducted from August 01 to 31, 2020 in East Wallaga, West Wallaga, and Horro Guduru Wallaga zones of Oromia National Regional State, Ethiopia.

Study Design and Costing Method

A cross-sectional institutional-based study design was used. The bottom-up costing approach was used. To analyze the cost of the treatment during the follow-up visit with respect to patient perspective and the indirect costs(income lost due to productive time lost) that were estimated using earnings lost.[19]

The time foregone and productive time lost were converted into indirect costs based on the daily wage rate and then multiplied by the number of working days lost. The daily wage rate for patients was estimated by dividing their monthly income by 30 days for both patients and caregivers.[19]

All costs included in the analysis were measured in terms of Ethiopian Birr (ETB) and were converted to US$(US dollar) during the analysis, and the average currency exchange rate was (August 2020; *1* US$ = *35.99 ETB*).

Study Participants

All chronic disease patients who visited public hospitals in the Wallaga Zones were the source population, and all patients who visited the three Wallaga Zones' selected study hospitals during the study period were the study population.

Inclusion and Exclusion Criteria

All patients of the selected CDs in the study area who visited the study hospitals were included in the study. Patients whose age was less than 15 years old and without accompanying patients who were seriously ill and unable to respond to the interviews were excluded from the study.

Sample Size and Sampling Procedures

The sample size was determined by using the single population mean formula, applying the following assumptions: two-sided alpha error (ϵ) set at 0.05, 95% confidence level, and mean cost of DM (μ) = 48.99 ETB, and standard deviation (SD)= 30.89 ETB [20], adding 5% non-response rate.

Using the formula, $\mathbf{n} = \frac{(z - \alpha/2)^2 * \sigma 2}{\epsilon 2 \mu 2}$ ..... [21], n= 642.

Among thirteen public hospitals in the study area, data was collected from the selected CDs of follow-up care patients from Nekemte specialized hospitals, Sire hospital, Gida hospital, Arjo hospital, Shambu hospital, Guduru hospital, Gimbi hospital, and Nedjo hospital.

The determined sample size was allocated to each study hospital proportionally based on the proportion of each CDS patient who attended follow-up care.Wollega University referral hospital was purposely excluded from the study, which was an isolation and treatment center for COVID-19 during the study period, and four other hospitals were excluded due to their low CDS patient flow.

A total of 642 participants were selected by using a systematic sampling method at each study hospital. A simple random sampling technique was employed to select the first participant from the registration book.

Data Collection Procedures

The structured questionnaire was developed in English after reviewing relevant literature, and it was translated into Afan Oromo. Data collection and supervision were carried out by eight data collectors, with four supervisors assigned. These data collectors and supervisors were trained before the pre-test and actual data collection started. The questionnaires were pre-tested in Bedele Hospital using 32(5%) of the determined sample size. It was collected by face-to-face interview. Patients who completed their chronic outpatient services and returned to leave the study hospitals were interviewed.

Study Variables

Socio-demographic and economic characteristics, health service costs (non-medical costs; transportation, food, accommodation, and income lost, and medical costs; registration, consultation, laboratory, radiology, and drugs) were assessed and determined.

Operational Definitions

Before COVID-19: The period before March 13, 2020, when Ethiopia had the first confirmed COVID-19 positive case.

Chronic disease follow up patients: A patient visited the study hospital for the follow-up care of one of; hypertension (HTN), diabetic's mellitus (DM), heart failure (HF), mental illness, HIV (Human immune virus), stroke, epilepsy, and asthma.

Chronic disease: Any of the following illnesses that persist over time, can gradually progress, do not resolve spontaneously, and may not be cured, like HTN, DM. HF, mental illness, HIV, stroke, epilepsy, and asthma.

Direct costs: The expenditures in ETB spent by chronic disease patients and their families on the diagnosis and treatment of chronic illness per prescription of physicians in the study hospitals.

During COVID-19: The period after March 13, 2020, when Ethiopia had the first confirmed COVID-19 positive case**.**

Indirect costs: the number of productive days lost by patients and their families as a result of chronic illness care and treatment.

Medical cost: The cost component of chronic disease patients' follow-up visits at study hospitals that includes registration, laboratory, radiology, and drug costs.

Non-medical cost: The cost component that includes transportation, food, accommodation, and income lost among chronic disease patients during follow-up visits at study hospitals.

Data Management and Analysis

Data was entered in to Epi-data version 3.1 and exported to SPSS version 25 software for analysis. Descriptive statistics and median were performed for all study variables based on their characteristics. Finally, the normality distribution of treatment cost data was checked, and it was not normally distributed. As a result, non-parametric tests were used to analyze the median cost for each cost category, as well as a 2-paired sample Wilcoxon sign rank test to compare the costs incurred before and during the pandemic lock-down, with the level of significance of the median cost difference set at $p<0.05$.

Patient and Public Involvement

None

Results

Socio-demographic Characteristics

A total of 642 patients were included in the study, among whom 605 responded to the interview, making a 94.2% response rate. An almost equal number of male and female participants participated in the study. More than half of the participants, 352 (58.2%), were from urban areas, and the majority of them, 421 (69.6%), were married.

Regarding the educational status of the participants, 137 (22.6%) were illiterates who were unable to read and write (Table 1). The average participant age was 43.29 (16.5%) years, the average monthly income was 84.32 (±70.65) US dollars, and the average household size was 4.46 (±3.43).

Table 1: Socio-demographic and economic characteristics of chronic diseases patients visited public hospitals in the three Wallaga zones, Oromia National Regional State, Ethiopia 2020 (N= 605)

Socio-demographic Characteristics (N= 605)		Frequency (n)	Percentage (%)
Sex	Male	302	49.9
	Female	303	50.1
Residence place	Urban	352	58.2
	Rural	253	41.8
Marital status	Single	130	21.5
	Married	421	69.6
	Separated	7	1.2
	Divorced	2	0.3
	Widowed	45	7.4

Religion	Orthodox	165	27.3
	Muslim	59	9.8
	Protestant	373	61.7
	Others	8	1.3
Ethnic group	Oromo	552	91.2
	Amhara	48	7.9
	Gurage	4	0.7
	Tigre	1	0.2
Educational status	Illiterate	137	22.6
	Read &Write	102	16.9
	Grade 1-8	99	16.4
	Grade 9-8	151	25.0
	Diploma and above	116	19.2
Employment status	Government employee	93	15.4
	NGO* employee	89	14.7
	Merchant	100	16.5
	Housewife	114	18.8
	Farmer	107	17.7
	Others**	102	16.9

*NGO= non-governmental organization, ** Daily laborer, students

Costs of Follow up Care

The total cost for the treatment of CDs before the COVID-19 pandemic among patients who incurred any one or more types of cost was on average 10.70(±10.50) US dollars, with the median cost of 8.04 US dollars among 600 patients before the pandemic. The total cost of the treatment of the diseases per follow-up visit during

the pandemic among 597 patients was 13.40(±11.54) US dollars and the median cost was 10.41 US dollars.

The median income lost due to productivity time lost for the treatment of CDs before the pandemic was 1.48 US dollars among 501 participants who had income, which was almost similar to the income lost when visiting the study hospitals during the pandemic, which was 1.40 US dollars.

The total median non-medical cost incurred for the follow-up care was 2.57 US dollars before the pandemic among 463 patients and 5.49 US dollars among the same number of patients during the pandemic.

The total median transportation cost to travel to hospitals and travel back to their homes, the participants incurred 1.14 US dollars before the pandemic and 2.29 US dollars during the pandemic among 430 patients who paid for transportation.

The total median cost incurred for the accommodation and food during the follow-up visit was 3.43 US dollars before the pandemic and 4.29 US dollars during the pandemic among 199 participants.

The total median medical cost was 3.71 US dollars before the pandemic, whereas it was 4.29 US dollars during the pandemic hospital visit among 425 participants who paid for the prescribed drugs (Table 2).

Table 2: Chronic diseases follow-up treatment and care cost categories among chronic diseases patients at public hospitals in the three Wallaga zones, Oromia National Regional state, Ethiopia 2020(N= 605)

Cost Categories	Era of COVID-19 Pandemic	Observation (N)	Median (US$)	Significance level of median cost difference (During- Before covid-19)
Income lost (*a*)	Before	501	1.48	Z = 1.780, p = 0.075
	During	501	1.40	
Transportation (*b*)	Before	430	1.14	Z = 8.028, p = 0.001
	During	430	2.29	
Food and accommodation c	Before	199	3.43	Z = 1.189, p = 0.169
	During	199	4.29	
Total nonmedical cost (*a*+*b*+*c*) = (*d*)	Before	463	2.57	Z = 4.903, p = 0.001
	During	463	5.49	
Total medical cost (*e*)	Before	425	3.71	Z = 2.382, p = 0.017
	During	425	4.29	
Total cost per patient per visit (*d*+*e*)	Before	600	8.04	Z = 5.05, p=0.001
	During	593	10.41	

Note: 1US$ = 35.99 ETB, August, 2020

Cost Difference Based on COVID-19 Pandemic

Patients were categorized according to the type of chronic disease for which they visited study hospitals (Table 3). There was a significant median cost difference (n = 593, Z = 5.05, p = 0.001) between the cost of follow-up care during the COVID-19 pandemic lock-down compared to the costs incurred before the pandemic (Table 4).

This showed that 348 out of 593 (58.7%) patients incurred significantly higher costs during the pandemic compared to before the pandemic. The median cost of follow-up care during the pandemic was 10.41 US dollars compared to 8.04 US dollars before the COVID-19 pandemic.

The study showed that there was no significant median difference in income lost among patients who had income during and before the pandemic (n = 501, Z = 1.780, p = 0.075). The median income lost during the pandemic was 1.48 US dollars compared to the income lost before the pandemic, which was 1.40 US dollars.

There was a significant median cost difference in non-medical costs per patient during and before the pandemic (n = 463, Z = 4.903, p = 0.001). This showed significantly higher costs have been incurred by more than half of the patients, 276 (59.61%), during the pandemic compared to before the pandemic. The median non-medical cost observed among the patients was 5.49 and 2.57 US dollars per follow-up visit during and before the pandemic, respectively.

The study revealed that there was no statistical significance in the median cost difference of food and accommodation incurred during and before the pandemic (n = 199, Z = 1.189, p = 0.169), and the median of this cost category was 4.29 and 3.13 US dollars during and before the pandemic lock-down, respectively.

The majority of the patients, 289 (67.2%), paid higher transportation fees when they visited hospitals during the pandemic compared to before the pandemic. There was a significant median cost difference in transportation costs during and before the pandemic (n = 430, Z = 8.028, p = 0.00), which was explained by the fact that the median transportation cost was 1.14 US dollars and 2.29 US dollars during and before the pandemic, respectively.

More than half of the patients, 236 (55.5%), incurred higher costs for medical services during the pandemic compared to before the pandemic. There was a significant median cost difference during and before the pandemic (n = 425, Z = 2.382, p = 0.017) in which the median cost was 4.29 and 3.71 US dollars during and before the pandemic lock-down.

The study showed that the majority of the HTN patients, 128 (60.7%), paid a high amount of money during the pandemic compared to before the pandemic among 211 patients who paid for the services. There was a significant median cost difference per visit during and before the pandemic (n = 211, Z = 3.632, p = 0.00). The median cost observed among these patients was 7.58 and 10.14 US per follow-up visit before and during the pandemic, respectively.

More than half of DM patients (59.17%) paid higher costs for the services during the pandemic compared to before the pandemic. The total cost incurred by these patients was significantly higher during the pandemic compared to before the pandemic (n = 169, Z = 3.095, p = 0.002). The median cost was 11.39 and 8.11 US dollars during and before the pandemic lock-down, respectively.

The study revealed that there was no statistical significance in the median difference in total cost incurred by HF patients during and before the pandemic era (n = 61, Z = -0.055, p = 0.956). Among 61 HF patients, only 31(50.82%) paid a higher amount of money during the pandemic compared to before the pandemic.

Similarly, there was no statistical significance in the median difference of total cost incurred by patients who visited the hospitals for mental health follow up for the treatment of diseases during and before the pandemic era (n = 41, Z =-1.497, p = 0.134). Among 41 patients, only 20(40.82%) paid a higher amount of money during the pandemic.

The study also showed that there was a statistically significant median difference in total cost incurred by HIV patients during and before the pandemic lock-down (n = 49, Z = 3.356, p = 0.00). Among 49 patients, the majority of them 34(69.39%) incurred a higher cost per visit during the pandemic compared to before the pandemic lock-down.

There was no statistical significance in the median difference of total cost incurred by asthma patients during and before the pandemic era (n = 28, Z = 1.731, p = 0.184). Similarly, there was no statistically significant median difference in total cost incurred by epilepsy patients during and before the pandemic lock-down (n = 18, Z = 1.328, p = 0.184)(Table 4).

Table 3: Types of chronic diseases among chronic diseases patients at public hospitals in the three Wallaga zones, Oromia National Regional state, Ethiopia 2020(N= 605)

Types of Chronic diseases	Frequency(n)	Percentage (%)
Hypertension	214	35.4
Diabetic mellitus	173	28.6
Heart failure	62	10.2
Mental disease	51	8.4
HIV/AIDS	50	8.3
Asthma	29	4.8
Epilepsy	18	3.0
Stroke	3	0.5

Table 4: Chronic diseases follow up visit for the treatment and care cost among chronic disease patients at public hospitals in the three Wallaga zones, Oromia National Regional state, Ethiopia 2020(N= 605)

Types of CD	Era of COVID-19 Pandemic	Observation (N)	Median (US$)	Significance level of median cost difference (During- Before covid-19)
HTN	Before	211	7.58	*Z = 3.632, p = 0.001*
	During	211	10.14	
DM	Before	169	8.12	*Z = 3.095, p = 0.002*
	During	169	11.39	
HF	Before	61	9.06	*Z = -0.055, p = 0.956*
	During	61	8.2	
Mental disease	Before	49	11.63	*Z = -1.497, p = 0.134*
	During	49	8.86	
HIV	Before	49	6.12	*Z = 3.356, p = 0.000*
	During	49	12.24	
Asthma	Before	28	7.33	*Z = 1.731, p =0.184*
	During	28	10.34	
Epilepsy	Before	18	5.70	*Z = 1.328, p =0.184*
	During	18	10.00	

Note: 1US$ = 35.99 ETB, August, 2020

Discussion

The study evaluated the illness cost of chronic diseases before and during the COVID-19 pandemic lock-down. Accordingly, more than half of the chronic patients (58.7%) incurred a significantly higher total cost during the pandemic lock-down compared to before the pandemic. This is explained by the median cost that was increased by 29.39% (Table 4).

This finding supports the study's findings that chronic illness costs account for more than 75% of total healthcare costs in high-income countries.[22, 23] During the pandemic, most global healthcare resources are focused on COVID-19, and this resource reallocation could disrupt the continuum of care for patients with CDs.[11, 12, 24] This could be explained by the fact that the global pandemic's disruption of the health-care system may impose additional costs on CD patients.

The study revealed that the non-medical cost during the follow-up visit per patient during the era of COVID-19 was significantly higher than the cost incurred before the pandemic era by the same patients, which was doubled during the pandemic. This significant difference probably might be due to a strict lock-down that could affect these patients adversely as they require regular follow-up visits that lead to further health consequences and additional costs. [25, 26]

Transportation costs were one of the cost categories that doubled during the pandemic compared to before the pandemic. The median cost per patient per visit of this cost category during the pandemic era was significantly increased by two folds. This could be due to the fact that the government restricted the movement of its people from place to place and laid a temporary restriction on public transport across-regions and cities.[17, 25]

The study discovered a significant median cost difference in medical costs, with the median of this cost category increasing by 15.6% during the pandemic. This finding

is in line with the study report that revealed that before the pandemic, one in three Americans did not take their medications as prescribed because of high costs, but during a global pandemic, forgoing medications involves even more risks for chronic care patients and incurs even higher costs in the long run. [27]

The study also evaluated the illness cost of each selected chronic disease. Accordingly, for the follow-up care of HTN patients, the patients incurred significantly higher costs during the pandemic compared to before the pandemic, which was raised by 33.76% during the pandemic. The cost incurred before the COVID-pandemic was almost comparable with other study reports, but the cost incurred during the pandemic was higher than the study report on the cost of hypertension before the COVID-19 lockdown in Ethiopia. [28]

Again, the study showed that the cost of DM follow-up visit per patient during the pandemic lock-down was significantly higher than the cost incurred before the pandemic, which was increased by 40.53%. However, before and during the COVID-19 lock-down, the cost of DM in this study was lower than the study reports in Ethiopia. [20, 29] This variation could be attributed to differences in DM complications and treatment among study participants.

Despite HIV care and treatment being an exempted service in Ethiopia, patients incurred nonmedical costs. The study revealed that the cost incurred by HIV patients for follow-up treatment and care per visit per patient during the pandemic lock-down was significantly higher than the cost incurred before the pandemic, which was increased by two folds. The cost of HIV treatment and care reported in the study was higher than in other Ethiopian studies .[30, 31]

However, there was no significant statistical median cost difference for the follow-up care of HF, mental illness, asthma, and epilepsy during and before the pandemic; a slight median cost difference was observed during and before the pandemic.

Limitation of the Study

The cost findings in the study could be underestimated for the reason that the income loss of unemployed patients and unemployed caregivers due to productivity time lost were not included in the cost estimation. However, the cost of illness analysis was limited to the patients' perspective and did not incorporate other intangible costs (stigma and discrimination, pain) associated with chronic illness, which were not also estimated in the current study.

Conclusion

This study revealed that the total cost of follow-up care among chronic disease patients during the COVID-19 pandemic lock-down was significantly higher compared to before the pandemic era among the same patients. A comprehensive package of chronic disease treatment and care is demanded at different levels of health facilities in the health system of the country. Therefore, healthcare providers should arrange special fee waiver mechanisms for chronic disease healthcare costs during such types of pandemics and provide the services at proximal health facilities.

Declarations

Ethical Approval and Consent to Participate

An appropriate research ethical approval was obtained from the ethical review board of Wallaga University, Institute of health sciences (Reference number: IRB/233/2020). The study was conducted in accordance with the Declaration of Helsinki. The questionnaire was designed to be anonymous, and the result did not identify the personalities of the respondents; rather, it was presented in the

aggregated statistics. The data was kept in protected and safe locations. Paper-based data was kept in a locked cabinet, and computer-based data was password secured. Data sharing was enacted based on the consent and permission of research participants and the ethical and legal rules of data sharing, and it was not accessed by a third person, except the research teams.

Authors Contribution and Conflict of interests

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agreed to be accountable for all aspects of the work.

All authors declared that they have no conflicts of interest related to this work.

Consent for Publication

NA

Availability of Data and Materials

All the data supporting the study's findings are within the manuscript. Additional detailed information and raw data will be shared upon request addressed to the corresponding author.

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Acronyms

ETB: Ethiopian Birr, HF: Heart Failure, HIV: Human Immune Virus, HTN: Hypertension, LMICs: Low-and-middle-income countries, NCDs: Non-communicable diseases, OOP: Out-of-pocket, TB: Tuberculosis, WHO: World Health Organization

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	-
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	-
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	-
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	-
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	-
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	12-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	-
Generalisability	21	Discuss the generalisability (external validity) of the study results	-
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Impact of COVID-19 Pandemic on Cost of Chronic Diseases Treatment and Care at Public Hospitals in Wallaga Zones, Oromia Regional State, Ethiopia: Hospital Based Cross-Sectional Study

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Impact of COVID-19 Pandemic on Cost of Chronic Diseases Treatment and Care at Public Hospitals in Wallaga Zones, Oromia Regional State, Ethiopia: Hospital Based Cross-Sectional Study

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Abstract

Introduction: Globally, around one third of the population has at least one long-term health condition that could be affected by the COVID-19 pandemic. Despite, studies have revealed the direct impact of COVID-19 on health care provision and utilization, the impact of the pandemic on cost of chronic disease treatment and care from a patient perspective was scanty. So, the study aimed to determine the impact of COVID-19 pandemic on cost of chronic diseases treatment and care at public hospitals in Wallaga Zones, Oromia Regional State, Ethiopia, from August 01 to 31, 2020.

Methods: An institutional based cross-sectional study design was used and the sample size for the study (n = 642) was determined using a single population mean formula. Data was collected using interviews and analyzed using SPSS version 25. Descriptive statistics were performed and the cost of follow-up care before and after the pandemic was compared using a Related-samples Wilcoxon signed-rank test, declaring the level of significance of the median cost difference at $P<0.05$.

Results: A total of 642 patients were included in the study, among whom 605 (94.2%) of them responded to the interviews. There was a significant median cost difference (n = 593, Z = 5.05, p = 0.001) between the cost of chronic diseases among follow-up patients during the pandemic compared to the costs incurred by these patients before the pandemic.

Conclusion: The cost of follow-up care among chronic disease patients during the COVID-19 pandemic was significantly higher compared to before the pandemic era. Therefore, healthcare providers should arrange special fee waiver mechanisms for chronic disease healthcare costs during such types of pandemics and provide the services at proximal health facilities.

Keywords: COVID-19 Pandemic, Chronic Disease, Cost of Illness, Follow up Care, Ethiopia

Strengths and Limitations of the Study

- The cost findings in the study could be underestimated due to; the income loss of unemployed patients and their companions due to productivity time lost were not included in the cost estimation,
- The cost of illness analysis was limited to the patients' perspective and did not incorporate the intangible costs,
- Also, children (<15 years) and elderly (greater than 65 years) were not included in the valuation of lost work days.
- Finally, there might be a recall bias.

Background

Globally, chronic diseases (CDs) are the major public health problems that account for 60% of all deaths(35% in low and 40% in middle income countries).[1-3] Including Ethiopia many low and middle-income countries (LMICs) are undergoing a gradual epidemiologic transition as the disease burden shifts from infectious to non-communicable diseases(NCDs).[4-6]Healthcare systems in these countries are mostly unprepared to handle the increasing burden of these diseases, resulting in no or limited access to affordable prevention and diagnosis of NCDs.[7] These challenges

add up to higher NCDs treatment costs and even the financing of which mostly comes from households' out-of-pocket (OOP) spending.[8]

COVID-19 pandemic was also another challenge which disrupts entire societies, including the routine health care systems in Ethiopia. The comprehensive effort to contain the pandemic and minimize the subsequent morbidity and mortality has affected both the continuity and quality of care.[9]During the pandemic, most global healthcare resources are focused on COVID-19 prevention and control. This resource reallocation could disrupt the continuum of care for patients with CDs in this era. Diabetes, chronic obstructive pulmonary disease, hypertension, heart disease, asthma, cancer, and depression were some of the conditions reported to be most impacted by the reduction in healthcare resources due to the pandemic.[10] Resources at all levels have shifted away from CDs management and prevention during the outbreak, and the lock-down of many services has translated into reduced access, a decrease in referrals, and reduced hospitalizations of patients with non-COVID-19 pathology.[11] As the pandemic continues to rapidly spread, attentions often focuses on the numbers of confirmed and probable cases, hospitalizations, and deaths, which can be called the "direct" effects of the pandemic. However, these numbers do not capture the full extent of the pandemic because it has also generated important spillover (indirect) effects by decreasing the supply of and altering patient demand for non-COVID-19-related medical care.[12]

In Ethiopia, the government declared a state of emergency, labeling the pandemic as a national threat and launching overall preventive measures, including advising the community to stay at home, practicing strict and frequent hand washing, and wearing a face mask. Also, restricted the movement of its people from place to place and laid temporary restrictions on market places, restaurants, shops, cinema houses,

religious, and cities.[13] During this time, the number of hospital visits dropped sharply to utilize health services, including CDs follow-up.[14] Many studies have revealed the direct impact of COVID-19 on health care provision and utilization. But, there has been little emphasis on the impact of the pandemic on illness costs of chronic disease follow-up care from a patient perspective. So, the study aimed to determine the impact of the COVID-19 pandemic on the cost of follow-up care among chronic disease patients at public hospitals.

Methods and Materials

Study Design and Setting

An institutional-based cross-sectional study design was used to conduct this study. It was conducted from August 01 to 31, 2020 in the three wallaga zones namely; East Wallaga, West Wallaga, and Horro Guduru Wallaga zones of Oromia Regional State, Ethiopia. These three Wallaga zones are among the twenty one zones of Oromia region and were found in the western direction of the region, Oromia. The capital town of east Wallaga zone, Nekemte town; west Wallaga zone, Gimbi town and Horro Guduru Wallaga zone, shambu town were located 333km, 441km, and 314km west direction of Addis Ababa, capital city of Ethiopia, respectively.

Study Participants

All chronic disease patients who visited public hospitals in the Wallaga Zones were the source population, and all patients who visited the three Wallaga Zones' selected study hospitals during the study period were the study population.

Inclusion and Exclusion Criteria

All patients of the selected CDs in the study area who visited the study hospitals were included in the study. Patients whose age was less than 15 years old and without

accompanying parents who were seriously ill and unable to respond to the interviews were excluded from the study.

Sample Size and Sampling Methods

The sample size was determined by using the single population mean formula, applying the following assumptions: two-sided alpha error (ϵ) set at 0.05, 95% confidence level, and mean cost of DM (μ) = 48.99 ETB, and standard deviation (SD)= 30.89 ETB[15], adding 5% non-response rate.

Using the formula, n = $\frac{(z-\alpha/2)2*\sigma 2}{\epsilon 2\mu 2}$ ..... [16], n= 642.

Among thirteen public hospitals in the study area, data was collected from the selected CDs of follow-up care patients from Nekemte specialized hospitals, Sire hospital, Gida hospital, Arjo hospital, Shambu hospital, Guduru hospital, Gimbi hospital, and Nedjo hospital which were selected using simple random sampling technique.

The determined sample size was allocated to each study hospital proportionally based on the proportion of each CD patients who attended follow-up care. Wallaga University referral hospital was purposely excluded from the study, which was an isolation and treatment center for COVID-19 during the study period, and four other hospitals were excluded due to their low CD patients flow.

Finally, to sample patients at each study hospital, systematic random sampling technique was used to select 642 participants. A simple random sampling technique was employed to select the first participant from the registration book.

Data Collection

The structured questionnaire was developed in English after reviewing relevant literatures, and it was translated into Afan Oromo. Data collection and supervision were carried out by eight data collectors, with four supervisors assigned. These data

collectors and supervisors were trained before the pre-test and actual data collection started. The questionnaires were pre-tested in Bedele hospital using 32(5%) of the determined sample size. It was collected by face-to-face interview. Patients who completed their chronic outpatient services and returned to leave the study hospitals were interviewed.

Study Variables

Socio-demographic and economic characteristics, health service costs (non-medical costs; transportation, food, accommodation, and income lost, and medical costs; registration, consultation, laboratory, radiology, and drugs) were assessed and determined.

Operational Definitions

Before COVID-19: The period before March 13, 2020, when Ethiopia had the first confirmed COVID-19 positive case.

Chronic disease follow up patients: A patient visited the study hospital for the follow-up care of one of; hypertension (HTN), diabetic's mellitus (DM), heart failure (HF), mental illness, HIV (Human immune virus), stroke, epilepsy, and asthma.

Chronic disease: Any of the following illnesses that persist over time, can gradually progress, do not resolve spontaneously, and may not be cured, like HTN, DM. HF, mental illness, HIV, stroke, epilepsy, and asthma.

Direct costs: The expenditures in ETB spent by chronic disease patients and their families on the diagnosis and treatment of chronic illness per prescription of physicians in the study hospitals.

During COVID-19: The period after March 13, 2020, when Ethiopia had the first confirmed COVID-19 positive case.

Indirect costs: the number of productive days lost by patients and their families as

a result of chronic illness treatment and care.

Medical cost: The cost component of chronic disease patients' follow-up visits at study hospitals that includes registration, laboratory, radiology, and drug costs.

Non-medical cost: The cost component that includes transportation, food, accommodation, and income lost among chronic disease patients during follow-up visits at study hospitals.

Data Analysis

Data was entered in to Epi-data version 3.1 and exported to SPSS version 25 software for analysis. Descriptive statistics were performed for all study variables based on their characteristics. The bottom-up costing approach was used to estimate the direct cost for the follow-up visit with respect to patient perspective and the indirect costs (income lost due to productive time lost) were estimated using earnings lost both before and during COVID-19 pandemic.[17] The time foregone and productive time lost were converted into indirect costs based on the daily wage rate and then multiplied by the number of working days lost. The daily wage rate for patients was estimated by dividing their monthly income by 30 days for both patients and caregivers.[17] All costs included in the analysis were measured in terms of Ethiopian Birr (ETB) and were converted to US$(US dollar) during the analysis, and the average currency exchange rate was (August 2020; *1* US$ = *35.99 ETB*).

Finally, the normality distribution of treatment cost data was checked, and it was not normally distributed. AS a result, non-parametric tests were used to analyze the median cost for each cost category, as well as a 2-paired sample Wilcoxon sign rank test to compare the costs incurred before and during the pandemic lock-down, with the level of significance of the median cost difference set at $p<0.05$.

Ethical consideration

An appropriate research ethical approval was obtained from the ethical review board of Wallaga University, Institute of health sciences (Reference number: IRB/233/2020). The study was conducted in accordance with the Declaration of Helsinki. The questionnaire was designed to be anonymous, and the result did not identify the personalities of the respondents; rather, it was presented in the aggregated statistics. Written consent was obtained from the study participants. The data was kept in protected and safe locations. Paper-based data was kept in a locked cabinet, and computer-based data was password secured. Data sharing was enacted based the ethical and legal rules of data sharing, and it was not accessed by a third person, except the research teams.

Patient and Public Involvement

None

Results

Socio-demographic Characteristics

A total of 642 patients were included in the study, among whom 605 responded to the interview, yielding 94.2% response rate. An almost equal number of male and female participated in the study. More than half of the participants, 352 (58.2%), were from urban areas, and the majority of them, 421 (69.6%), were married.

Regarding the educational status of the participants, 137 (22.6%) were illiterates (Table 1).The average participant's age was 43.29 (SD=16.5) years, the average monthly income was 84.32 (SD=70.65) US dollars, and the average household size was 4.46 (SD=3.43).

Table 1: Socio-demographic characteristics and classification of study participants by chronic diseases conditions in the public hospitals of the three Wallaga zones, Oromia National Regional State, Ethiopia 2020 (N= 605)

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Characteristics (N= 605)		Frequency (n)	Percentage (%)
Sex	Male	302	49.9
	Female	303	50.1
Residence place	Urban	352	58.2
	Rural	253	41.8
Marital status	Single	130	21.5
	Married	421	69.6
	Separated	7	1.2
	Divorced	2	0.3
	Widowed	45	7.4
Religion	Orthodox	165	27.3
	Muslim	59	9.8
	Protestant	373	61.7
	Others	8	1.3
Ethnic group	Oromo	552	91.2
	Amhara	48	7.9
	Gurage	4	0.7
	Tigre	1	0.2
Educational status	Illiterate	137	22.6
	Read &Write	102	16.9
	Grade 1-8	99	16.4
	Grade 9-8	151	25.0
	Diploma and above	116	19.2

Employment status	Government employee	93	15.4
	NGO* employee	89	14.7
	Merchant	100	16.5
	Housewife	114	18.8
	Farmer	107	17.7
	Others**	102	16.9
Types of Chronic diseases	Hypertension	214	35.4
	Diabetic mellitus	173	28.6
	Heart failure	62	10.2
	Mental disease	51	8.4
	HIV/AIDS	50	8.3
	Asthma	29	4.8
	Epilepsy	18	3.0
	Stroke	3	0.5

**NGO*= non-governmental organization, ** Daily laborer, students

The Overall Cost of CD Follow-up Care before and during the Pandemic

The total cost for the treatment of CDs before the COVID-19 pandemic among patients who incurred any one or more types of cost was on average 10.41(SD=10.19) US dollars, with the median cost of 9.76(IQR=8.64) US dollars among 600 patients before the pandemic. The total cost of the treatment of the diseases per follow-up visit during the pandemic among 593 patients was 13.02(SD=11.22) US dollars and the median cost was 12.27(IQR=10.40) US dollars. The median income lost due to productivity time lost for the treatment of CDs before the pandemic was 1.48(IQR=2.71) US dollars among 501 participants who had

income, which was almost similar to the income lost when visiting the study hospitals during the pandemic, which was 1.40 (IQR=2.85)US dollars.

The total median non-medical cost incurred for the follow-up care was 6.05(IQR=5.55) US dollars before the pandemic among 463 patients and 7.98(IQR=7.50) US dollars among the same number of patients during the pandemic.

The total median transportation cost to travel to hospitals and travel back to their homes, the participants incurred 1.141 (IQR=1.94) US dollars before the pandemic and 2.29(IQR=3.05) US dollars during the pandemic among 430 patients who paid for transportation.

The total median cost incurred for the accommodation and food during the follow-up visit was 3.43(IQR=4.91) US dollars before the pandemic and 4.29(IQR=633) US dollars during the pandemic among 199 participants.

The total median medical cost was 3.71(IQR=5.22) US dollars before the pandemic, whereas it was 4.29 (IQR=5.91) US dollars during the pandemic hospital visit among 425 participants who paid for the prescribed drugs (Table 2).

Table 2: The overall cost of chronic diseases follow-up treatment and care before and during the pandemic among chronic diseases patients at public hospitals in the three Wallaga zones, Oromia National Regional state, Ethiopia 2020(N= 605)

Cost Categories	Era of COVID-19 Pandemic	Observation-on (N)	Mean(SD)	Median (IQR)	Significance level of median cost difference (During-Before covid-19)
Income lost (*a*)	Before	501	2.27(2.75)	1.48(2.71)	Z = 1.780, p = 0.075
	During	501	2.25(2.72)	1.40(2.85)	
Transportation	Before	430	1.91(2.13)	1.14(1.94)	Z = 8.028,

(*b*)	During	430	3.43(4.42)	2.29(3.05)	p = 0.001
Food and accommodation (c)	Before	199	4.67(5.05)	3.43(4.91)	Z = 1.189, p = 0.169
	During	199	5.6(5.94)	4.29(6.33)	
Total nonmedical cost (*a*+*b*+*c*) = (*d*)	Before	463	4.58(5.35)	6.05(5.55)	Z = 4.903, p = 0.001
	During	463	6.81(7.58)	7.98(7.50)	
Total medical cost (*e*)	Before	425	5.51(8.43)	3.71(5.22)	Z = 2.382, p = 0.017
	During	425	5.93(7.81)	4.29(5.91)	
Total cost per patient per visit (*d*+*e*)	Before	600	10.41(10.19)	9.76(8.64)	Z = 5.05, p=0.001
	During	593	13.02(11.22)	12.27(10.40)	

Note: 1US$ = 35.99 ETB, August, 2020; SD: Standard Deviation; IQR: Interquartile Range

Cost Difference Based on COVID-19 Pandemic

There was a significant median cost difference (n = 593, Z = 5.05, p = 0.001) between the cost of follow-up care during the COVID-19 pandemic lock-down compared to the costs incurred before the pandemic (Table 3). This showed that 348 out of 593 (58.7%) patients incurred significantly higher costs during the pandemic compared to before the pandemic. The median cost of follow-up care during the pandemic was 12.27(IQR=10.40) US dollars compared to 9.76(IQR=8.64) US dollars before the COVID-19 pandemic.

The study showed that there was no significant median difference in income lost among patients who had income during and before the pandemic (n = 501, Z = 1.780, p = 0.075). The median income lost during the pandemic was 1.48(IQR=2.71) US dollars compared to the income lost before the pandemic, which was 1.40(IQR=2.85) US dollars.

There was a significant median cost difference in non-medical costs per patient during and before the pandemic (n = 463, Z = 4.903, p = 0.001). This showed significantly higher costs have been incurred by more than half of the patients, 276 (59.61%), during the pandemic compared to before the pandemic. The median non-medical cost observed among the patients was 7.98(IQR=7.50) and 6.05(IQR=5.55) US dollars per follow-up visit during and before the pandemic, respectively.

The study revealed that there was no statistical significance in the median cost difference of food and accommodation incurred during and before the pandemic (n = 199, Z = 1.189, p = 0.169), and the median of this cost category was 4.29(IQR=6.33) and 3.13(IQR=4.91) US dollars during and before the pandemic lock-down, respectively.

The majority of the patients, 289 (67.2%), paid higher transportation fees when they visited hospitals during the pandemic compared to before the pandemic. There was a significant median cost difference in transportation costs during and before the pandemic (n = 430, Z = 8.028, p = 0.00), which was explained by the fact that the median transportation cost was 1.14 (IQR=1.94) US dollars and 2.29 (IQR=3.05) US dollars during and before the pandemic, respectively.

More than half of the patients, 236 (55.5%), incurred higher costs for medical services during the pandemic compared to before the pandemic. There was a significant median cost difference during and before the pandemic (n = 425, Z = 2.382, p = 0.017) in which the median cost was 4.29 (IQR=5.91) and 3.71(IQR=5.22) US dollars during and before the pandemic lock-down.

The study showed that the majority of the hypertensive (HTN) patients, 128 (60.7%), paid a high amount of money during the pandemic compared to before the pandemic among 211 patients who paid for the services. There was a significant median cost

difference per visit during and before the pandemic (n = 211, Z = 3.632, p = 0.00). The median cost observed among these patients was 7.58 (IQR=7.53) and 10.14 (IQR=8.74) US per follow-up visit before and during the pandemic, respectively.

More than half of diabetes mellitus (DM) patients (59.17%) paid higher costs for the services during the pandemic compared to before the pandemic. The total cost incurred by these patients was significantly higher during the pandemic compared to before the pandemic (n = 169, Z = 3.095, p = 0.002). The median cost was 11.39 (IQR=10.87) and 8.11(IQR=9.26) US dollars during and before the pandemic lock-down, respectively.

The study revealed that there was no statistical significance in the median difference in total cost incurred by heart failure (HF) patients during and before the pandemic era (n = 61, Z = -0.055, p = 0.956). Among 61 HF patients, only 31(50.82%) paid a higher amount of money during the pandemic compared to before the pandemic.

Similarly, there was no statistical significance in the median difference of total cost incurred by patients who visited the hospitals for mental health follow up for the treatment of diseases during and before the pandemic era (n = 41, Z =-1.497, p = 0.134). Among 41 patients, only 20(40.82%) paid a higher amount of money during the pandemic.

The study also showed that there was a statistically significant median difference in total cost incurred by HIV patients during and before the pandemic lock-down (n = 49, Z = 3.356, p = 0.00). Among 49 patients, the majority of them 34(69.39%) incurred a higher cost per visit during the pandemic compared to before the pandemic lock-down.

There was no statistical significance in the median difference of total cost incurred by asthma patients during and before the pandemic era (n = 28, Z = 1.731, p = 0.184).

Similarly, there was no statistically significant median difference in total cost incurred by epilepsy patients during and before the pandemic lock-down (n = 18, Z = 1.328, p = 0.184) (Table 3).

Table 3: Cost of chronic diseases follow-up treatment and care by disease types among chronic disease patients at public hospitals in the three Wallaga zones, Oromia National Regional state, Ethiopia 2020(N= 605)

Types of CDs	Era of COVID-19 Pandemic	Observation (N)	Mean(SD)	Median (IQR)	Significance level of median cost difference(During-Before covid-19)
HTN	Before	211	10.03(11.86)	7.58(7.53)	*Z = 3.632, p = 0.001*
	During	211	12.65(10.42)	10.14(8.74)	
DM	Before	169	10.64(8.42)	8.12(9.26)	*Z = 3.095, p = 0.002*
	During	169	13.56(10.49)	11.39(10.87)	
HF	Before	61	12.64(12.85)	9.06(8.53)	*Z = -0.055, p = 0.956*
	During	61	12.51(11.34)	8.2(12.52)	
Mental disease	Before	49	13.08(8.97)	11.63(10.10)	*Z = -1.497, p = 0.134*
	During	49	10.91(8.45)	8.86(10.24)	
HIV	Before	49	7.37(6.65)	6.12(6.76)	*Z = 3.356, p = 0.000*
	During	49	16.58(18.32)	12.24(14.25)	
Asthma	Before	28	8.95(6.40)	7.33(10.68)	*Z = 1.731, p =0.184*
	During	28	12.92(12.34)	10.34(8.18)	

Epilepsy	Before	18	7.70(7.01)	5.70(11.18)	*Z = 1.328,* *p =0.184*
	During	18	10.44(5.74)	10.00(9.84)	

Note: 1US$ = 35.99 ETB, August, 2020; SD: Standard Deviation; IQR: Interquartile Range

Discussion

This study was aimed to determine the impact of COVID-19 pandemic on cost of chronic diseases treatment and care at public hospitals in Wallaga Zones, Oromia Regional State, Ethiopia. The study found that, the cost of follow-up treatment and care among chronic disease patients during COVID-19 pandemic was significantly higher compared to before the pandemic era.

This indicated that, more than half of the chronic patients, 58.7%, incurred a significantly higher total cost during the pandemic lock-down compared to before the pandemic. This finding supports the study's findings that chronic illness costs account for more than 75% of total healthcare costs in high-income countries.[18, 19] During the pandemic, most global healthcare resources are focused on COVID-19, and this resource reallocation could disrupt the continuum of care for patients with CDs.[9, 10, 20] This could be explained by the fact that the global pandemic's disruption of the health-care system may impose additional costs on CD patients.

The study revealed that the non-medical cost during the follow-up visit per patient during the era of COVID-19 was significantly higher than the cost incurred before the pandemic era by the same patients, which was doubled during the pandemic. This significant difference probably might be due to a strict lock-down that could affect these patients adversely as they require regular follow-up visits that lead to further health consequences and additional costs.[21,22]

Transportation costs were one of the cost categories that doubled during the pandemic compared to before the pandemic. The median cost per patient per visit of this cost category during the pandemic era was significantly increased by two folds. This could be due to the fact that the government restricted the movement of its people from place to place and laid a temporary restriction on public transport across-regions and cities.[13, 21]

The study discovered a significant median cost difference in medical costs, with the median of this cost category increasing by 15.6% during the pandemic. This finding is in line with the study report that revealed that before the pandemic, one in three Americans did not take their medications as prescribed because of high costs, but during a global pandemic, forgoing medications involves even more risks for chronic care patients and incurs even higher costs in the long run.[23]

The study also evaluated the illness cost of each selected chronic disease. Accordingly, for the follow-up care of HTN patients, the patients incurred significantly higher costs during the pandemic compared to before the pandemic, which was raised by 33.76% during the pandemic. The cost incurred before the COVID-pandemic was almost comparable with other study reports, but the cost incurred during the pandemic was higher than the study report on the cost of hypertension before the COVID-19 lockdown in Ethiopia.[24]

Again, the study showed that the cost of DM follow-up visit per patient during the pandemic lock-down was significantly higher than the cost incurred before the pandemic, which was increased by 40.53%. However, before and during the COVID-19 lock-down, the cost of DM in this study was lower than the study reports in Ethiopia.[15, 25] This variation could be attributed to differences in DM complications and treatment among study participants.

Despite HIV care and treatment being an exempted service in Ethiopia, patients incurred nonmedical costs. The study revealed that the cost incurred by HIV patients for follow-up treatment and care per visit per patient during the pandemic lock-down was significantly higher than the cost incurred before the pandemic, which was increased by two folds. The cost of HIV treatment and care reported in the study was higher than in other Ethiopian studies.[26, 27]

However, there was no significant statistical median cost difference for the follow-up care of heart failure, mental illness, asthma, and epilepsy during and before the pandemic; a slight median cost difference was observed during and before the pandemic.

Conclusion

This study revealed that the total cost of follow-up care among chronic disease patients during the COVID-19 pandemic lock-down was significantly higher compared to before the pandemic era among the same patients. A comprehensive package of chronic disease treatment and care is demanded at different levels of health facilities in the health system of the country. Therefore, healthcare providers, hospital administrators and the local government should arrange special fee waiver mechanisms for chronic disease healthcare costs during such types of pandemics and provide the services at proximal health facilities.

Declarations

Authors Contribution and Conflict of interests

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agreed to be accountable for all aspects of the work.

All authors declared that they have no conflicts of interest related to this work.

Consent for Publication

NA

Availability of Data and Materials

All the data supporting the study's findings are within the manuscript. Additional detailed information and raw data will be shared upon request addressed to the corresponding author.

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Acronyms

ETB: Ethiopian Birr, HF: Heart Failure, HIV: Human Immune Virus, HTN: Hypertension, LMICs: Low-and-middle-income countries, NCDs: Non-communicable diseases, OOP: Out-of-pocket, WHO: World Health Organization

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	-
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	-
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	-
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	-
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	-
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	12-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	-
Generalisability	21	Discuss the generalisability (external validity) of the study results	-
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Impact of the COVID-19 pandemic on the cost of chronic diseases treatment and care at public hospitals in Wallaga zones, Oromia Regional State, Ethiopia: A hospital-based, cross-sectional study

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Impact of the COVID-19 pandemic on the cost of chronic diseases treatment and care at public hospitals in Wallaga zones, Oromia Regional State, Ethiopia: A hospital-based, cross-sectional study

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Abstract

Introduction: Globally, around one third of the population has at least one long-term health condition that could be affected by the COVID-19 pandemic. Despite, studies have revealed the direct impact of COVID-19 on health care provision and utilization, the impact of the pandemic on cost of chronic disease treatment and care from a patient perspective was scanty. So, the study aimed to determine the impact of the COVID-19 pandemic on cost of chronic diseases treatment and care at public hospitals in Wallaga Zones, Oromia Regional State, Ethiopia, from August 1 to 31, 2020.

Globally, around one-third of the population has at least one long-term health condition that could be affected by the COVID-19 pandemic. Despite studies revealing the direct impact of COVID-19 on health care provision and utilization, the impact of the pandemic on the cost of chronic disease treatment and care from a patient perspective was scanty. So, the study aimed to determine the impact of the COVID-19 pandemic on the cost of chronic disease treatment and care at public hospitals in Wallaga Zones, Oromia Regional State, Ethiopia, from August 1 to 31, 2020.

Methods: An institutional-based cross-sectional study design was used, and the sample size for the study (n = 642) was determined using a single population mean formula. Data was collected using interviews and analyzed using SPSS version 25.

Descriptive statistics were performed, and the cost of follow-up care before and after the pandemic was compared using a related-samples Wilcoxon signed-rank test, declaring the level of significance of the median cost difference at P<0.05.

Results: A total of 642 patients were included in the study, of whom 605 (94.2%) responded to the interviews. There was a significant median cost difference (n = 593, Z = 5.05, p = 0.001) between the cost of chronic diseases among follow-up patients during the pandemic and the costs incurred by these patients before the pandemic.

Conclusion: The cost of follow-up care among chronic disease patients during the COVID-19 pandemic was significantly higher compared to before the pandemic era. Therefore, healthcare providers should arrange special fee waiver mechanisms for chronic disease healthcare costs during such types of pandemics and provide the services at proximal health facilities.

Keywords: COVID-19 Pandemic, Chronic Disease, Cost of Illness, Follow up care, Ethiopia

Strengths and Limitations of the Study

- A less costly and time-consuming retrospective costing approach was used.
- The cost of illness analysis in this study was limited to the patients' perspective.
- The study did not include the costs experienced by patients who were employed before the pandemic but then lost their jobs.
- Children less than 15 years of age and the elderly greater than 65 years of age were not included in the valuation of lost work days in the cost estimation.
- There might also be a recall bias.

Background

Chronic diseases (CDs) are the major public health problems that account for 60% of all deaths (35% in low- and middle-income countries). [1-3] including Ethiopia, many low and middle-income countries (LMICs) are undergoing a gradual epidemiologic transition as the disease burden shifts from infectious to non-communicable diseases (NCDs). [4–6] Healthcare systems in these countries are mostly unprepared to handle the increasing burden of these diseases, resulting in no or limited access to affordable prevention and diagnosis of NCDs. [7] These challenges add up to higher NCD treatment costs, whose financing mostly comes from households' out-of-pocket (OOP) spending. [8]

The COVID-19 pandemic was also another challenge that disrupted entire societies, including the routine health care systems in Ethiopia. The comprehensive effort to contain the pandemic and minimize the subsequent morbidity and mortality has affected both the continuity and quality of care. [9] During the pandemic, most global healthcare resources were focused on COVID-19 prevention and control. This resource reallocation could disrupt the continuum of care for patients with CDs in this era. Diabetes, chronic obstructive pulmonary disease, hypertension, heart disease, asthma, cancer, and depression were some of the conditions reported to be most impacted by the reduction in healthcare resources due to the pandemic. [10] Resources at all levels have shifted away from CDs management and prevention during the outbreak, and the lockdown of many services has translated into reduced access, a decrease in referrals, and reduced hospitalizations of patients with non-COVID-19 pathology. [11] As the pandemic continues to rapidly spread, attention often focuses on the numbers of confirmed and probable cases, hospitalizations, and deaths, which can be called the "direct" effects of the pandemic. However, these

numbers do not capture the full extent of the pandemic because it has also generated important spillover (indirect) effects by decreasing the supply of and altering patient demand for non-COVID-19-related medical care. [12]

In Ethiopia, the government declared a state of emergency, labeling the pandemic a national threat and launching overall preventive measures, including advising the community to stay at home, practicing strict and frequent hand washing, and wearing a face mask. Also, it restricted the movement of its people from place to place and laid temporary restrictions on market places, restaurants, shops, cinema houses, religious institutions, and cities. [13] During this time, the number of hospital visits dropped sharply to utilize health services, including CD follow-up. [14] Many studies have revealed the direct impact of COVID-19 on health care provision and utilization. But there has been little emphasis on the impact of the pandemic on the costs of chronic disease follow-up care from a patient perspective. So, the study aimed to determine the impact of the COVID-19 pandemic on the cost of follow-up care among chronic disease patients at public hospitals.

Methods and Materials

Study Design and Setting

An institutional-based cross-sectional study design was used to conduct this study. It was conducted from August 1 to 31, 2020, in the three wallaga zones, namely, East Wallaga, West Wallaga, and Horro Guduru Wallaga zones, of Oromia Regional State, Ethiopia. These three Wallaga zones are among the twenty-one zones of the Oromia region and were found in the western direction of the region, Oromia. The capital towns of east Wallaga zone, Nekemte town; west Wallaga zone, Gimbi town; and Horro Guduru Wallaga zone, Shambu town, were located 333km, 441km, and 314km west of Addis Ababa, the capital city of Ethiopia, respectively.

Study Participants

All chronic disease patients who visited public hospitals in the Wallaga Zones were the source population, and all patients who visited the three Wallaga Zones' selected study hospitals during the study period were the study population.

Inclusion and Exclusion Criteria

All patients from the selected CDs in the study area who visited the study hospitals were included in the study. Patients whose age was less than 15 years old and without accompanying parents who were seriously ill and unable to respond to the interviews were excluded from the study.

Sample Size and Sampling Methods

The sample size was determined by using the single population mean formula, applying the following assumptions: two-sided alpha error (ϵ) set at 0.05, 95% confidence level, mean cost of DM (μ) = 48.99 ETB, and standard deviation (SD) = 30.89 ETB[15], adding a 5% non-response rate.

Using the formula, n = $\frac{(z-\alpha/2)2 * \sigma 2}{\epsilon 2 \mu 2}$ ..... [16], n= 642.

Among thirteen public hospitals in the study area, data was collected from the selected CDs of follow-up care patients from Nekemte specialized hospitals, Sire hospital, Gida hospital, Arjo hospital, Shambu hospital, Guduru hospital, Gimbi hospital, and Nedjo hospital, which were selected using a simple random sampling technique.

The determined sample size was allocated to each study hospital proportionally based on the proportion of CD patients who attended follow-up care. Wallaga University referral hospital was purposely excluded from the study, which was an isolation and treatment center for COVID-19 during the study period, and four other hospitals were excluded due to their low CD patient flow.

Finally, a simple random sampling technique was used from the registration book to sample patients at each study hospital as per their proportion to select 642 participants.

Data Collection

The structured questionnaire was developed in English after reviewing relevant literature, and it was translated into Afan Oromo. Data collection and supervision were carried out by eight data collectors, with four supervisors assigned. These data collectors and supervisors were trained before the pre-test and actual data collection started. The questionnaires were pre-tested in Bedele Hospital using 32 (5%) of the determined sample size. It was collected through a face-to-face interview. Patients who completed their chronic outpatient services and returned to leave the study hospitals were interviewed.

Study Variables

Socio-demographic and economic characteristics, health service costs (non-medical costs; transportation, food, accommodation, and income lost, and medical costs; registration, consultation, laboratory, radiology, and drugs) were assessed and determined.

Operational Definitions

Before COVID-19: The period before March 13, 2020, when Ethiopia had the first confirmed COVID-19 positive case.

Chronic disease follow-up patients: A patient visited the study hospital for the follow-up care of one of the following: hypertension (HTN), diabetes mellitus (DM), heart failure (HF), mental illness, HIV (Human Immune Virus), stroke, epilepsy, and asthma.

Chronic disease: any of the following illnesses that persist over time, can gradually

progress, do not resolve spontaneously, and may not be cured: HTN, DM, HF, mental illness, HIV, stroke, epilepsy, and asthma.[14]

Direct costs: the expenditures in ETB spent by chronic disease patients and their families on the diagnosis and treatment of chronic illness per prescription of physicians in the study hospitals.

During COVID-19: the period after March 13, 2020, when Ethiopia had the first confirmed COVID-19 positive case.

Indirect costs: the number of productive days lost by patients and their families as a result of chronic illness treatment and care.

Medical cost: the cost component of chronic disease patients' follow-up visits at study hospitals that includes registration, laboratory, radiology, and drug costs.

Non-medical cost: the cost component that includes transportation, food, accommodation, and income lost among chronic disease patients during follow-up visits at study hospitals.

Data Analysis

Data was entered into Epi-data version 3.1 and exported to SPSS version 25 software for analysis. Descriptive statistics were performed for all study variables based on their characteristics. The bottom-up costing approach was used to estimate the direct cost of the follow-up visit with respect to the patient's perspective, and the indirect costs (income lost due to productive time lost) were estimated using earnings lost both before and during the COVID-19 pandemic. [17] The time foregone and productive time lost were converted into indirect costs based on the daily wage rate and then multiplied by the number of working days lost. The daily wage rate for patients was estimated by dividing their monthly income by 30 days for both patients and caregivers. [17] All costs included in the analysis were measured in

terms of Ethiopian Birr (ETB) and were converted to US$(US dollar) during the analysis, and the average currency exchange rate was (August 2020; *1* US$ = *35.99 ETB*).

Finally, the normality distribution of treatment cost data was checked, and it was not normally distributed. As a result, non-parametric tests were used to analyze the median cost for each cost category, as well as a 2-paired sample Wilcoxon sign rank test to compare the costs incurred before and during the pandemic lockdown, with the level of significance of the median cost difference set at $p<0.05$.

Ethical consideration

An appropriate research ethical approval was obtained from the ethical review board of Wallaga University, Institute of Health Sciences (Reference number: IRB/233/2020). The study was conducted in accordance with the Declaration of Helsinki. The questionnaire was designed to be anonymous, and the result did not identify the personalities of the respondents; rather, it was presented in the aggregated statistics. Written consent was obtained from the study participants. The data was kept in protected and safe locations. Paper-based data was kept in a locked cabinet, and computer-based data was password-secured. Data sharing was enacted based on the ethical and legal rules of data sharing, and it was not accessed by a third party except the research teams.

Patient and Public Involvement

None

Results

Socio-demographic Characteristics

A total of 642 patients were included in the study, among whom 605 responded to the interview, yielding a 94.2% response rate. An almost equal number of males and females participated in the study. More than half of the participants, 352 (58.2%), were from urban areas, and the majority of them, 421 (69.6%), were married.

Regarding the educational status of the participants, 137 (22.6%) were illiterates (Table 1).The average participant's age was 43.29 (SD=16.5) years, the average monthly income was 84.32 (SD=70.65) US dollars, and the average household size was 4.46 (SD=3.43).

Table 1: Socio-demographic characteristics and classification of study participants by chronic diseases conditions in the public hospitals of the three Wallaga zones, Oromia National Regional State, Ethiopia 2020 (N= 605)

Characteristics (N= 605)		Frequency (n)	Percentage (%)
Sex	Male	302	49.9
	Female	303	50.1
Residence place	Urban	352	58.2
	Rural	253	41.8
Marital status	Single	130	21.5
	Married	421	69.6
	Separated	7	1.2
	Divorced	2	0.3
	Widowed	45	7.4
Religion	Orthodox	165	27.3

	Muslim	59	9.8
	Protestant	373	61.7
	Others	8	1.3
Ethnic group	Oromo	552	91.2
	Amhara	48	7.9
	Gurage	4	0.7
	Tigre	1	0.2
Educational status	Illiterate	137	22.6
	Read &Write	102	16.9
	Grade 1-8	99	16.4
	Grade 9-8	151	25.0
	Diploma and above	116	19.2
Employment status	Government employee	93	15.4
	NGO* employee	89	14.7
	Merchant	100	16.5
	Housewife	114	18.8
	Farmer	107	17.7
	Others**	102	16.9
Types of Chronic diseases	Hypertension	214	35.4
	Diabetic mellitus	173	28.6
	Heart failure	62	10.2
	Mental disease	51	8.4
	HIV/AIDS	50	8.3
	Asthma	29	4.8

	Epilepsy	18	3.0
	Stroke	3	0.5

*NGO= non-governmental organization, ** Daily laborer, students

The Overall Cost of CD Follow-up Care before and during the Pandemic

The total cost for the treatment of CDs before the COVID-19 pandemic among patients who incurred any one or more types of cost was on average 10.41 (SD = 10.19) US dollars, with the median cost of 9.76 (IQR = 8.64) US dollars among 600 patients before the pandemic. The total cost of the treatment of the diseases per follow-up visit during the pandemic among 593 patients was 13.02 (SD = 11.22) US dollars, and the median cost was 12.27 (IQR = 10.40) US dollars.

The median income lost due to productivity time lost for the treatment of CDs before the pandemic was 1.48 (IQR = 2.71 US dollars) among the 501 participants who had income, which was almost similar to the income lost when visiting the study hospitals during the pandemic, which was 1.40 (IQR = 2.85 US dollars).

The total median non-medical cost incurred for the follow-up care was 6.05 (IQR = 5.55) US dollars before the pandemic among 463 patients and 7.98 (IQR = 7.50) US dollars among the same number of patients during the pandemic.

The total median transportation cost to travel to hospitals and travel back to their homes was 1.141 (IQR = 1.94) US dollars before the pandemic and 2.29 (IQR = 3.05) US dollars during the pandemic among the 430 patients who paid for transportation.

The total median cost incurred for the accommodation and food during the follow-up visit was 3.43 (IQR = 4.91) US dollars before the pandemic and 4.29 (IQR = 633) US dollars during the pandemic among 199 participants.

The total median medical cost was 3.71 (IQR = 5.22) US dollars before the pandemic, whereas it was 4.29 (IQR = 5.91) US dollars during the pandemic hospital visit among the 425 participants who paid for the prescribed drugs (Table 2).

Table 2: The overall cost of chronic diseases follow-up treatment and care before and during the pandemic among chronic diseases patients at public hospitals in the three Wallaga zones, Oromia National Regional state, Ethiopia 2020(N= 605)

Cost Categories	Era of COVID-19 Pandemic	Observation-on (N)	Mean(SD)	Median (IQR)	Significance level of median cost difference (During-Before covid-19)
Income lost (*a*)	Before	501	2.27(2.75)	1.48(2.71)	Z = 1.780, p = 0.075
	During	501	2.25(2.72)	1.40(2.85)	
Transportation (*b*)	Before	430	1.91(2.13)	1.14(1.94)	Z = 8.028, p = 0.001
	During	430	3.43(4.42)	2.29(3.05)	
Food and accommodation (c)	Before	199	4.67(5.05)	3.43(4.91)	Z = 1.189, p = 0.169
	During	199	5.6(5.94)	4.29(6.33)	
Total nonmedical cost (*a*+*b*+*c*) = (*d*)	Before	463	4.58(5.35)	6.05(5.55)	Z = 4.903, p = 0.001
	During	463	6.81(7.58)	7.98(7.50)	
Total medical cost (*e*)	Before	425	5.51(8.43)	3.71(5.22)	Z = 2.382, p = 0.017
	During	425	5.93(7.81)	4.29(5.91)	
Total cost per patient per visit (*d*+*e*)	Before	600	10.41(10.19)	9.76(8.64)	Z = 5.05, p=0.001
	During	593	13.02(11.22)	12.27(10.40)	

Note: 1US$ = 35.99 ETB, August, 2020; SD: Standard Deviation; IQR: Interquartile Range

Cost Difference Based on COVID-19 Pandemic

There was a significant median cost difference (n = 593, Z = 5.05, p = 0.001) between the cost of follow-up care during the COVID-19 pandemic lockdown and the costs incurred before the pandemic (Table 3). This showed that 348 out of 593 (58.7%) patients incurred significantly higher costs during the pandemic compared to before the pandemic. The median cost of follow-up care during the pandemic was 12.27 (IQR = 10.40) US dollars, compared to 9.76 (IQR = 8.64) US dollars before the COVID-19 pandemic.

The study showed that there was no significant median difference in income lost among patients who had income during and before the pandemic (n = 501, Z = 1.780, p = 0.075). The median income lost during the pandemic was 1.48 (IQR = 2.71 US dollars) compared to the income lost before the pandemic, which was 1.40 (IQR = 2.85 US dollars).

There was a significant median cost difference in non-medical costs per patient during and before the pandemic (n = 463, Z = 4.903, p = 0.001). This showed significantly higher costs were incurred by more than half of the patients, 276 (59.61%), during the pandemic compared to before the pandemic. The median non-medical cost observed among the patients was 7.98 (IQR = 7.50) and 6.05 (IQR = 5.55) US dollars per follow-up visit during and before the pandemic, respectively.

The study revealed that there was no statistical significance in the median cost difference of food and accommodation incurred during and before the pandemic (n = 199, Z = 1.189, p = 0.169), and the median of this cost category was 4.29 (IQR = 6.33) and 3.13 (IQR = 4.91) US dollars during and before the pandemic lock-down, respectively.

The majority of the patients, 289 (67.2%), paid higher transportation fees when they visited hospitals during the pandemic compared to before the pandemic. There was a significant median cost difference in transportation costs during and before the pandemic (n = 430, Z = 8.028, p = 0.00), which was explained by the fact that the median transportation cost was 1.14 (IQR = 1.94) US dollars and 2.29 (IQR = 3.05) US dollars during and before the pandemic, respectively.

More than half of the patients, 236 (55.5%), incurred higher costs for medical services during the pandemic compared to before the pandemic. There was a significant median cost difference during and before the pandemic (n = 425, Z = 2.382, p = 0.017), in which the median cost was 4.29 (IQR = 5.91) and 3.71 (IQR = 5.22) US dollars during and before the pandemic lockdown.

The study showed that the majority of the hypertensive (HTN) patients, 128 (60.7%), paid a high amount of money during the pandemic compared to before the pandemic among the 211 patients who paid for the services. There was a significant median cost difference per visit during and before the pandemic (n = 211, Z = 3.632, p = 0.00). The median cost observed among these patients was 7.58 (IQR = 7.53) and 10.14 (IQR = 8.74) US per follow-up visit before and during the pandemic, respectively.

More than half of diabetes mellitus (DM) patients (59.17%) paid higher costs for services during the pandemic compared to before the pandemic. The total cost incurred by these patients was significantly higher during the pandemic compared to before the pandemic (n = 169, Z = 3.095, p = 0.002). The median cost was 11.39 (IQR = 10.87) and 8.11 (IQR = 9.26) US dollars during and before the pandemic lockdown, respectively.

The study revealed that there was no statistical significance in the median difference in total cost incurred by heart failure (HF) patients during and before the pandemic era (n = 61, Z = -0.055, p = 0.956). Among 61 HF patients, only 31 (50.82%) paid a higher amount of money during the pandemic compared to before the pandemic.

Similarly, there was no statistical significance in the median difference in total cost incurred by patients who visited the hospitals for mental health follow-up for the treatment of diseases during and before the pandemic era (n = 41, Z =-1.497, p = 0.134). Among 41 patients, only 20 (40.82%) paid a higher amount of money during the pandemic.

The study also showed that there was a statistically significant median difference in total cost incurred by HIV patients during and before the pandemic lockdown (n = 49, Z = 3.356, p = 0.00). Among 49 patients, the majority of them 34(69.39%) incurred a higher cost per visit during the pandemic compared to before the pandemic lockdown.

There was no statistical significance in the median difference in total cost incurred by asthma patients during and before the pandemic era (n = 28, Z = 1.731, p = 0.184). Similarly, there was no statistically significant median difference in total cost incurred by epilepsy patients during and before the pandemic lockdown (n = 18, Z = 1.328, p = 0.184) (Table 3).

Table 3: Cost of chronic diseases follow-up treatment and care by disease types among chronic disease patients at public hospitals in the three Wallaga zones, Oromia National Regional state, Ethiopia 2020(N= 605)

Types of CDs	Era of COVID-19 Pandemic	Observation (N)	Mean(SD)	Median (IQR)	Significance level of median cost difference(During-Before covid-19)
HTN	Before	211	10.03(11.86)	7.58(7.53)	*Z = 3.632, p = 0.001*
	During	211	12.65(10.42)	10.14(8.74)	
DM	Before	169	10.64(8.42)	8.12(9.26)	*Z = 3.095, p = 0.002*
	During	169	13.56(10.49)	11.39(10.87)	
HF	Before	61	12.64(12.85)	9.06(8.53)	*Z = -0.055, p = 0.956*
	During	61	12.51(11.34)	8.2(12.52)	
Mental disease	Before	49	13.08(8.97)	11.63(10.10)	*Z = -1.497, p = 0.134*
	During	49	10.91(8.45)	8.86(10.24)	
HIV	Before	49	7.37(6.65)	6.12(6.76)	*Z = 3.356, p = 0.000*
	During	49	16.58(18.32)	12.24(14.25)	
Asthma	Before	28	8.95(6.40)	7.33(10.68)	*Z = 1.731, p =0.184*
	During	28	12.92(12.34)	10.34(8.18)	
Epilepsy	Before	18	7.70(7.01)	5.70(11.18)	*Z = 1.328, p =0.184*
	During	18	10.44(5.74)	10.00(9.84)	

Note: 1US$ = 35.99 ETB, August, 2020; SD: Standard Deviation; IQR: Interquartile Range

Discussion

This study was aimed at determining the impact of the COVID-19 pandemic on the cost of chronic disease treatment and care at public hospitals in Wallaga Zones,

Oromia Regional State, Ethiopia. The study found that the cost of follow-up treatment and care among chronic disease patients during the COVID-19 pandemic was significantly higher compared to before the pandemic era.

This indicated that more than half of the chronic patients, 58.7%, incurred a significantly higher total cost during the pandemic lockdown compared to before the pandemic. This finding supports the study's findings that chronic illness costs account for more than 75% of total healthcare costs in high-income countries. [18, 19] However, this study was conducted during the COVID-19 pandemic and in a low-income country, but these studies were not conducted at the time of the pandemic and were also conducted in high-income countries. During the pandemic, most global healthcare resources are focused on COVID-19, and this resource reallocation could disrupt the continuum of care for patients with CDs. [9, 10, 20] This could be explained by the fact that the global pandemic's disruption of the health care system may impose additional costs on CD patients.

The study revealed that the non-medical cost during the follow-up visit per patient during the era of COVID-19 was significantly higher than the cost incurred before the pandemic era by the same patients, which was doubled during the pandemic. This significant difference might be due to a strict lockdown that could affect these patients adversely as they require regular follow-up visits that lead to further health consequences and additional costs. [21,22]

Transportation costs were one of the cost categories that doubled during the pandemic compared to before the pandemic. The median cost per patient per visit of this cost category during the pandemic era was significantly increased by two folds. This could be due to the fact that the government restricted the movement of its

people from place to place and laid a temporary restriction on public transport across regions and cities. [13, 21]

The study discovered a significant median cost difference in medical costs, with the median of this cost category increasing by 15.6% during the pandemic. This finding is in line with the study report that revealed that before the pandemic, one in three Americans did not take their medications as prescribed because of high costs, but during a global pandemic, forgoing medications involves even more risks for chronic care patients and incurs even higher costs in the long run. [23] However, comparing study findings in this study setting with those in a high-resource setting is taken as a weakness of this study.

The study also evaluated the cost of each selected chronic disease. Accordingly, for the follow-up care of HTN patients, the patients incurred significantly higher costs during the pandemic compared to before the pandemic, which were raised by 33.76% during the pandemic. The cost incurred before the COVID pandemic was almost comparable with other study reports, but the cost incurred during the pandemic was higher than the study report on the cost of hypertension before the COVID-19 lockdown in Ethiopia. [24]

Again, the study showed that the cost of DM follow-up visits per patient during the pandemic lockdown was significantly higher than the cost incurred before the pandemic, which was increased by 40.53%. However, before and during the COVID-19 lockdown, the cost of DM in this study was lower than the study reported in Ethiopia. [15, 25] This variation could be attributed to differences in DM complications and treatment among study participants.

Despite HIV care and treatment being an exempted service in Ethiopia, patients incurred nonmedical costs. The study revealed that the cost incurred by HIV patients

for follow-up treatment and care per visit per patient during the pandemic lock-down was significantly higher than the cost incurred before the pandemic, which was increased by two folds. The cost of HIV treatment and care reported in the study was higher than in other Ethiopian studies. [26, 27]

However, there was no significant statistical median cost difference for the follow-up care of heart failure, mental illness, asthma, and epilepsy during and before the pandemic; a slight median cost difference was observed during and before the pandemic.

Conclusion

This study revealed that the total cost of follow-up care among chronic disease patients during the COVID-19 pandemic lockdown was significantly higher compared to before the pandemic era among the same patients. In this study, hypertensive patients had the greatest impact on the cost of ongoing care as a result of the COVID-19 pandemic. A comprehensive package of chronic disease treatment and care is demanded at different levels of health facilities in the country's health system. Therefore, healthcare providers, hospital administrators, and the local government should arrange special fee waiver mechanisms for chronic disease healthcare costs during such types of pandemics and provide the services at proximal health facilities.

Declarations

Author's Contributionship Statement

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agreed to be accountable for all aspects of the work.

Conflict of Interest Statement

All authors declared that they have no conflicts of interest related to this work.

Consent for Publication

NA

Availability of Data and Materials

All the data supporting the study's findings are within the manuscript. Additional detailed information and raw data will be shared upon request addressed to the corresponding author.

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Acronyms

ETB: Ethiopian Birr, HF: Heart Failure, HIV: Human Immune Virus, HTN: Hypertension, LMICs: Low-and-middle-income countries, NCDs: Non-communicable diseases, OOP: Out-of-pocket, WHO: World Health Organization

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	-
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	-
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	-
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	-
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	-
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	12-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	-
Generalisability	21	Discuss the generalisability (external validity) of the study results	-
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Impact of the COVID-19 pandemic on the cost of chronic diseases treatment and care at public hospitals in Wallaga zones, Oromia Regional State, Ethiopia: A hospital-based, cross-sectional study

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Impact of the COVID-19 pandemic on the cost of chronic diseases treatment and care at public hospitals in Wallaga zones, Oromia Regional State, Ethiopia: A hospital-based, cross-sectional study

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Abstract

Objective: Globally, around one third of the population has at least one long-term health condition that could be affected by the COVID-19 pandemic. Despite the fact that studies have revealed the direct impact of COVID-19 on health care provision and utilization, the impact of the pandemic on the cost of chronic disease treatment and care from a patient perspective was scanty. So, the study aimed to determine the impact of the COVID-19 pandemic on cost of chronic diseases treatment and care at public hospitals in Wallaga Zones, Oromia Regional State, Ethiopia, from August 1 to 31, 2020.

Methods: An institutional-based cross-sectional study design was used, and the sample size for the study (n = 642) was determined using a single population mean formula. Data was collected using interviews and analyzed using SPSS version 25. Descriptive statistics were performed, and the cost of follow-up care before and after the pandemic was compared using a related-samples Wilcoxon signed-rank test, declaring the level of significance of the median cost difference at P<0.05.

Results: A total of 642 patients were included in the study, of whom 605 (94.2%) responded to the interviews. There was a significant median cost difference (n = 593, Z = 5.05, p = 0.001) between the cost of chronic diseases among follow-up patients during the pandemic and the costs incurred by these patients before the pandemic.

Conclusion: The cost of follow-up care among chronic disease patients during the COVID-19 pandemic was significantly higher compared to before the pandemic era. Therefore, healthcare providers should arrange special fee waiver mechanisms for chronic disease healthcare costs during such types of pandemics and provide the services at proximal health facilities.

Keywords: COVID-19 Pandemic, Chronic Disease, Cost of Illness, Follow up care, Ethiopia

Strengths and Limitations of the Study

- A less costly and time-consuming retrospective costing approach was used.
- The cost of illness analysis in this study was limited to the patients' perspective.
- The study did not include the costs experienced by patients who were employed before the pandemic but then lost their jobs.
- Children less than 15 years of age and the elderly greater than 65 years of age were not included in the valuation of lost work days in the cost estimation.
- There might also be a recall bias.

Background

Chronic diseases (CDs) are the major public health problems that account for 60% of all deaths (35% in low- and middle-income countries). [1-3] including Ethiopia, many low and middle-income countries (LMICs) are undergoing a gradual epidemiologic transition as the disease burden shifts from infectious to non-communicable diseases (NCDs). [4–6] Healthcare systems in these countries are mostly unprepared to handle the increasing burden of these diseases, resulting in no or limited access to affordable prevention and diagnosis of NCDs. [7] These challenges

add up to higher NCD treatment costs, whose financing mostly comes from households' out-of-pocket (OOP) spending. [8]

The COVID-19 pandemic was also another challenge that disrupted entire societies, including the routine health care systems in Ethiopia. The comprehensive effort to contain the pandemic and minimize the subsequent morbidity and mortality has affected both the continuity and quality of care. [9] During the pandemic, most global healthcare resources were focused on COVID-19 prevention and control. This resource reallocation could disrupt the continuum of care for patients with CDs in this era. Diabetes, chronic obstructive pulmonary disease, hypertension, heart disease, asthma, cancer, and depression were some of the conditions reported to be most impacted by the reduction in healthcare resources due to the pandemic. [10] Resources at all levels have shifted away from CDs management and prevention during the outbreak, and the lockdown of many services has translated into reduced access, a decrease in referrals, and reduced hospitalizations of patients with non-COVID-19 pathology. [11] As the pandemic continues to rapidly spread, attention often focuses on the numbers of confirmed and probable cases, hospitalizations, and deaths, which can be called the "direct" effects of the pandemic. However, these numbers do not capture the full extent of the pandemic because it has also generated important spillover (indirect) effects by decreasing the supply of and altering patient demand for non-COVID-19-related medical care. [12]

In Ethiopia, the government declared a state of emergency, labeling the pandemic a national threat and launching overall preventive measures, including advising the community to stay at home, practicing strict and frequent hand washing, and wearing a face mask. Also, it restricted the movement of its people from place to place and laid temporary restrictions on market places, restaurants, shops, cinema houses,

religious institutions, and cities. [13] During this time, the number of hospital visits dropped sharply to utilize health services, including CD follow-up. [14] Many studies have revealed the direct impact of COVID-19 on health care provision and utilization. But there has been little emphasis on the impact of the pandemic on the costs of chronic disease follow-up care from a patient perspective. So, the study aimed to determine the impact of the COVID-19 pandemic on the cost of follow-up care among chronic disease patients at public hospitals.

Methods and Materials

Study Design and Setting

An institutional-based cross-sectional study design was used to conduct this study. It was conducted from August 1 to 31, 2020, in the three wallaga zones, namely, East Wallaga, West Wallaga, and Horro Guduru Wallaga zones, of Oromia Regional State, Ethiopia. These three Wallaga zones are among the twenty-one zones of the Oromia region and were found in the western direction of the region, Oromia. The capital towns of east Wallaga zone, Nekemte town; west Wallaga zone, Gimbi town; and Horro Guduru Wallaga zone, Shambu town, were located 333km, 441km, and 314km west of Addis Ababa, the capital city of Ethiopia, respectively.

Study Participants

All chronic disease patients who visited public hospitals in the Wallaga Zones were the source population, and all patients who visited the three Wallaga Zones' selected study hospitals during the study period were the study population.

Inclusion and Exclusion Criteria

All patients from the selected CDs in the study area who visited the study hospitals were included in the study. Patients whose age was less than 15 years old and

without accompanying parents who were seriously ill and unable to respond to the interviews were excluded from the study.

Sample Size and Sampling Methods

The sample size was determined by using the single population mean formula, applying the following assumptions: two-sided alpha error (ϵ) set at 0.05, 95% confidence level, mean cost of DM (μ) = 48.99 ETB, and standard deviation (SD) = 30.89 ETB[15], adding a 5% non-response rate.

Using the formula, n = $\frac{(z - \alpha/2)2 * \sigma 2}{\epsilon 2 \mu 2}$ ..... [16], n= 642.

Among thirteen public hospitals in the study area, data was collected from the selected CDs of follow-up care patients from Nekemte specialized hospitals, Sire hospital, Gida hospital, Arjo hospital, Shambu hospital, Guduru hospital, Gimbi hospital, and Nedjo hospital, which were selected using a simple random sampling technique.

The determined sample size was allocated to each study hospital proportionally based on the proportion of CD patients who attended follow-up care. Wallaga University referral hospital was purposely excluded from the study, which was an isolation and treatment center for COVID-19 during the study period, and four other hospitals were excluded due to their low CD patient flow.

Finally, a simple random sampling technique was used from the registration book to sample patients at each study hospital as per their proportion to select 642 participants.

Data Collection

The structured questionnaire was developed in English after reviewing relevant literature, and it was translated into Afan Oromo. Data collection and supervision were carried out by eight data collectors, with four supervisors assigned. These data collectors and supervisors were trained before the pre-test and actual data collection started. The questionnaires were pre-tested in Bedele Hospital using 32 (5%) of the determined sample size. It was collected through a face-to-face interview. Patients who completed their chronic outpatient services and returned to leave the study hospitals were interviewed.

Study Variables

Socio-demographic and economic characteristics, health service costs (non-medical costs; transportation, food, accommodation, and income lost, and medical costs; registration, consultation, laboratory, radiology, and drugs) were assessed and determined.

Operational Definitions

Before COVID-19: The period before March 13, 2020, when Ethiopia had the first confirmed COVID-19 positive case.

Chronic disease follow-up patients: A patient visited the study hospital for the follow-up care of one of the following: hypertension (HTN), diabetes mellitus (DM), heart failure (HF), mental illness, HIV (Human Immune Virus), stroke, epilepsy, and asthma.

Chronic disease: any of the following illnesses that persist over time, can gradually

progress, do not resolve spontaneously, and may not be cured: HTN, DM, HF, mental illness, HIV, stroke, epilepsy, and asthma.[14]

Direct costs: the expenditures in ETB spent by chronic disease patients and their families on the diagnosis and treatment of chronic illness per prescription of physicians in the study hospitals.

During COVID-19: the period after March 13, 2020, when Ethiopia had the first confirmed COVID-19 positive case.

Indirect costs: the number of productive days lost by patients and their families as a result of chronic illness treatment and care.

Medical cost: the cost component of chronic disease patients' follow-up visits at study hospitals that includes registration, laboratory, radiology, and drug costs.

Non-medical cost: the cost component that includes transportation, food, accommodation, and income lost among chronic disease patients during follow-up visits at study hospitals.

Data Analysis

Data was entered into Epi-data version 3.1 and exported to SPSS version 25 software for analysis. Descriptive statistics were performed for all study variables based on their characteristics. The bottom-up costing approach was used to estimate the direct cost of the follow-up visit with respect to the patient's perspective, and the indirect costs (income lost due to productive time lost) were estimated using earnings lost both before and during the COVID-19 pandemic. [17] The time foregone and productive time lost were converted into indirect costs based on the daily wage rate and then multiplied by the number of working days lost. The daily wage rate for patients was estimated by dividing their monthly income by 30 days for both patients and caregivers. [17] All costs included in the analysis were measured in

terms of Ethiopian Birr (ETB) and were converted to US$(US dollar) during the analysis, and the average currency exchange rate was (August 2020; *1* US$ = *35.99 ETB*). The cost data was converted to real terms by adjusting market prices to reflect true costs using Ethiopian inflation data.

Finally, the normality distribution of treatment cost data was checked, and it was not normally distributed. As a result, non-parametric tests were used to analyze the median cost for each cost category, as well as a 2-paired sample Wilcoxon sign rank test to compare the costs incurred before and during the pandemic lockdown, with the level of significance of the median cost difference set at $p<0.05$.

Ethical consideration

An appropriate research ethical approval was obtained from the ethical review board of Wallaga University, Institute of Health Sciences (Reference number: IRB/233/2020). The study was conducted in accordance with the Declaration of Helsinki. The questionnaire was designed to be anonymous, and the result did not identify the personalities of the respondents; rather, it was presented in the aggregated statistics. Written consent was obtained from the study participants. The data was kept in protected and safe locations. Paper-based data was kept in a locked cabinet, and computer-based data was password-secured. Data sharing was enacted based on the ethical and legal rules of data sharing, and it was not accessed by a third party except the research teams.

Patient and Public Involvement

None

Results

Socio-demographic Characteristics

A total of 642 patients were included in the study, among whom 605 responded to the interview, yielding a 94.2% response rate. An almost equal number of males and females participated in the study. More than half of the participants, 352 (58.2%), were from urban areas, and the majority of them, 421 (69.6%), were married.

Regarding the educational status of the participants, 137 (22.6%) were illiterates (Table 1).The average participant's age was 43.29 (SD=16.5) years, the average monthly income was 84.32 (SD=70.65) US dollars, and the average household size was 4.46 (SD=3.43).

Table 1: Socio-demographic characteristics and classification of study participants by chronic diseases conditions in the public hospitals of the three Wallaga zones, Oromia National Regional State, Ethiopia 2020 (N= 605)

Characteristics (N= 605)		Frequency (n)	Percentage (%)
Sex	Male	302	49.9
	Female	303	50.1
Residence place	Urban	352	58.2
	Rural	253	41.8
Marital status	Single	130	21.5
	Married	421	69.6
	Separated	7	1.2
	Divorced	2	0.3
	Widowed	45	7.4
Religion	Orthodox	165	27.3

	Muslim	59	9.8
	Protestant	373	61.7
	Others	8	1.3
Ethnic group	Oromo	552	91.2
	Amhara	48	7.9
	Gurage	4	0.7
	Tigre	1	0.2
Educational status	Illiterate	137	22.6
	Read &Write	102	16.9
	Grade 1-8	99	16.4
	Grade 9-8	151	25.0
	Diploma and above	116	19.2
Employment status	Government employee	93	15.4
	NGO* employee	89	14.7
	Merchant	100	16.5
	Housewife	114	18.8
	Farmer	107	17.7
	Others**	102	16.9
Types of Chronic diseases	Hypertension	214	35.4
	Diabetic mellitus	173	28.6
	Heart failure	62	10.2
	Mental disease	51	8.4
	HIV/AIDS	50	8.3
	Asthma	29	4.8

	Epilepsy	18	3.0
	Stroke	3	0.5

*NGO= non-governmental organization, ** Daily laborer, students

The Overall Cost of CD Follow-up Care before and during the Pandemic

The total cost for the treatment of CDs before the COVID-19 pandemic among patients who incurred any one or more types of cost was on average 10.41 (SD = 10.19) US dollars, with the median cost of 9.76 (IQR = 8.64) US dollars among 600 patients before the pandemic. The total cost of the treatment of the diseases per follow-up visit during the pandemic among 593 patients was 13.02 (SD = 11.22) US dollars, and the median cost was 12.27 (IQR = 10.40) US dollars.

The median income lost due to productivity time lost for the treatment of CDs before the pandemic was 1.48 (IQR = 2.71 US dollars) among the 501 participants who had income, which was almost similar to the income lost when visiting the study hospitals during the pandemic, which was 1.40 (IQR = 2.85 US dollars).

The total median non-medical cost incurred for the follow-up care was 6.05 (IQR = 5.55) US dollars before the pandemic among 463 patients and 7.98 (IQR = 7.50) US dollars among the same number of patients during the pandemic.

The total median transportation cost to travel to hospitals and travel back to their homes was 1.141 (IQR = 1.94) US dollars before the pandemic and 2.29 (IQR = 3.05) US dollars during the pandemic among the 430 patients who paid for transportation.

The total median cost incurred for the accommodation and food during the follow-up visit was 3.43 (IQR = 4.91) US dollars before the pandemic and 4.29 (IQR = 633) US dollars during the pandemic among 199 participants.

The total median medical cost was 3.71 (IQR = 5.22) US dollars before the pandemic, whereas it was 4.29 (IQR = 5.91) US dollars during the pandemic hospital visit among the 425 participants who paid for the prescribed drugs (Table 2).

Table 2: The overall cost of chronic diseases follow-up treatment and care before and during the pandemic among chronic diseases patients at public hospitals in the three Wallaga zones, Oromia National Regional state, Ethiopia 2020(N= 605)

Cost Categories	Era of COVID-19 Pandemic	Observation-on (N)	Mean(SD)	Median (IQR)	Significance level of median cost difference (During-Before covid-19)
Income lost (*a*)	Before	501	2.27(2.75)	1.48(2.71)	Z = 1.780, p = 0.075
	During	501	2.25(2.72)	1.40(2.85)	
Transportation (*b*)	Before	430	1.91(2.13)	1.14(1.94)	Z = 8.028, p = 0.001
	During	430	3.43(4.42)	2.29(3.05)	
Food and accommodation (c)	Before	199	4.67(5.05)	3.43(4.91)	Z = 1.189, p = 0.169
	During	199	5.6(5.94)	4.29(6.33)	
Total nonmedical cost (*a*+*b*+*c*) = (*d*)	Before	463	4.58(5.35)	6.05(5.55)	Z = 4.903, p = 0.001
	During	463	6.81(7.58)	7.98(7.50)	
Total medical cost (*e*)	Before	425	5.51(8.43)	3.71(5.22)	Z = 2.382, p = 0.017
	During	425	5.93(7.81)	4.29(5.91)	
Total cost per patient per visit (*d*+*e*)	Before	600	10.41(10.19)	9.76(8.64)	Z = 5.05, p=0.001
	During	593	13.02(11.22)	12.27(10.40)	

Note: 1US$ = 35.99 ETB, August, 2020; SD: Standard Deviation; IQR: Interquartile Range

Cost Difference Based on COVID-19 Pandemic

There was a significant median cost difference (n = 593, Z = 5.05, p = 0.001) between the cost of follow-up care during the COVID-19 pandemic lockdown and the costs incurred before the pandemic (Table 3). This showed that 348 out of 593 (58.7%) patients incurred significantly higher costs during the pandemic compared to before the pandemic. The median cost of follow-up care during the pandemic was 12.27 (IQR = 10.40) US dollars, compared to 9.76 (IQR = 8.64) US dollars before the COVID-19 pandemic.

The study showed that there was no significant median difference in income lost among patients who had income during and before the pandemic (n = 501, Z = 1.780, p = 0.075). The median income lost during the pandemic was 1.48 (IQR = 2.71 US dollars) compared to the income lost before the pandemic, which was 1.40 (IQR = 2.85 US dollars).

There was a significant median cost difference in non-medical costs per patient during and before the pandemic (n = 463, Z = 4.903, p = 0.001). This showed significantly higher costs were incurred by more than half of the patients, 276 (59.61%), during the pandemic compared to before the pandemic. The median non-medical cost observed among the patients was 7.98 (IQR = 7.50) and 6.05 (IQR = 5.55) US dollars per follow-up visit during and before the pandemic, respectively.

The study revealed that there was no statistical significance in the median cost difference of food and accommodation incurred during and before the pandemic (n = 199, Z = 1.189, p = 0.169), and the median of this cost category was 4.29 (IQR = 6.33) and 3.13 (IQR = 4.91) US dollars during and before the pandemic lock-down, respectively.

The majority of the patients, 289 (67.2%), paid higher transportation fees when they visited hospitals during the pandemic compared to before the pandemic. There was a significant median cost difference in transportation costs during and before the pandemic (n = 430, Z = 8.028, p = 0.00), which was explained by the fact that the median transportation cost was 1.14 (IQR = 1.94) US dollars and 2.29 (IQR = 3.05) US dollars during and before the pandemic, respectively.

More than half of the patients, 236 (55.5%), incurred higher costs for medical services during the pandemic compared to before the pandemic. There was a significant median cost difference during and before the pandemic (n = 425, Z = 2.382, p = 0.017), in which the median cost was 4.29 (IQR = 5.91) and 3.71 (IQR = 5.22) US dollars during and before the pandemic lockdown.

The study showed that the majority of the hypertensive (HTN) patients, 128 (60.7%), paid a high amount of money during the pandemic compared to before the pandemic among the 211 patients who paid for the services. There was a significant median cost difference per visit during and before the pandemic (n = 211, Z = 3.632, p = 0.00). The median cost observed among these patients was 7.58 (IQR = 7.53) and 10.14 (IQR = 8.74) US per follow-up visit before and during the pandemic, respectively.

More than half of diabetes mellitus (DM) patients (59.17%) paid higher costs for services during the pandemic compared to before the pandemic. The total cost incurred by these patients was significantly higher during the pandemic compared to before the pandemic (n = 169, Z = 3.095, p = 0.002). The median cost was 11.39 (IQR = 10.87) and 8.11 (IQR = 9.26) US dollars during and before the pandemic lockdown, respectively.

The study revealed that there was no statistical significance in the median difference in total cost incurred by heart failure (HF) patients during and before the pandemic era (n = 61, Z = -0.055, p = 0.956). Among 61 HF patients, only 31 (50.82%) paid a higher amount of money during the pandemic compared to before the pandemic.

Similarly, there was no statistical significance in the median difference in total cost incurred by patients who visited the hospitals for mental health follow-up for the treatment of diseases during and before the pandemic era (n = 41, Z =-1.497, p = 0.134). Among 41 patients, only 20 (40.82%) paid a higher amount of money during the pandemic.

The study also showed that there was a statistically significant median difference in total cost incurred by HIV patients during and before the pandemic lockdown (n = 49, Z = 3.356, p = 0.00). Among 49 patients, the majority of them 34(69.39%) incurred a higher cost per visit during the pandemic compared to before the pandemic lockdown.

There was no statistical significance in the median difference in total cost incurred by asthma patients during and before the pandemic era (n = 28, Z = 1.731, p = 0.184). Similarly, there was no statistically significant median difference in total cost incurred by epilepsy patients during and before the pandemic lockdown (n = 18, Z = 1.328, p = 0.184) (Table 3).

Table 3: Cost of chronic diseases follow-up treatment and care by disease types among chronic disease patients at public hospitals in the three Wallaga zones, Oromia National Regional state, Ethiopia 2020(N= 605)

Types of CDs	Era of COVID-19 Pandemic	Observation (N)	Mean(SD)	Median (IQR)	Significance level of median cost difference(During-Before covid-19)
HTN	Before	211	10.03(11.86)	7.58(7.53)	*Z = 3.632, p = 0.001*
	During	211	12.65(10.42)	10.14(8.74)	
DM	Before	169	10.64(8.42)	8.12(9.26)	*Z = 3.095, p = 0.002*
	During	169	13.56(10.49)	11.39(10.87)	
HF	Before	61	12.64(12.85)	9.06(8.53)	*Z = -0.055, p = 0.956*
	During	61	12.51(11.34)	8.2(12.52)	
Mental disease	Before	49	13.08(8.97)	11.63(10.10)	*Z = -1.497, p = 0.134*
	During	49	10.91(8.45)	8.86(10.24)	
HIV	Before	49	7.37(6.65)	6.12(6.76)	*Z = 3.356, p = 0.000*
	During	49	16.58(18.32)	12.24(14.25)	
Asthma	Before	28	8.95(6.40)	7.33(10.68)	*Z = 1.731, p =0.184*
	During	28	12.92(12.34)	10.34(8.18)	
Epilepsy	Before	18	7.70(7.01)	5.70(11.18)	*Z = 1.328, p =0.184*
	During	18	10.44(5.74)	10.00(9.84)	

Note: 1US$ = 35.99 ETB, August, 2020; SD: Standard Deviation; IQR: Interquartile Range

Discussion

This study was aimed at determining the impact of the COVID-19 pandemic on the cost of chronic disease treatment and care at public hospitals in Wallaga Zones,

Oromia Regional State, Ethiopia. The study found that the cost of follow-up treatment and care among chronic disease patients during the COVID-19 pandemic was significantly higher compared to before the pandemic era.

This indicated that more than half of the chronic patients, 58.7%, incurred a significantly higher total cost during the pandemic lockdown compared to before the pandemic. This finding supports the study's findings that chronic illness costs account for more than 75% of total healthcare costs in high-income countries. [18, 19] However, this study was conducted during the COVID-19 pandemic and in a low-income country, but these studies were not conducted at the time of the pandemic and were also conducted in high-income countries. During the pandemic, most global healthcare resources are focused on COVID-19, and this resource reallocation could disrupt the continuum of care for patients with CDs. [9, 10, 20] This could be explained by the fact that the global pandemic's disruption of the health care system may impose additional costs on CD patients.

The study revealed that the non-medical cost during the follow-up visit per patient during the era of COVID-19 was significantly higher than the cost incurred before the pandemic era by the same patients, which was doubled during the pandemic. This significant difference might be due to a strict lockdown that could affect these patients adversely as they require regular follow-up visits that lead to further health consequences and additional costs. [21,22]

Transportation costs were one of the cost categories that doubled during the pandemic compared to before the pandemic. The median cost per patient per visit of this cost category during the pandemic era was significantly increased by two folds. This could be due to the fact that the government restricted the movement of its

people from place to place and laid a temporary restriction on public transport across regions and cities. [13, 21]

The study discovered a significant median cost difference in medical costs, with the median of this cost category increasing by 15.6% during the pandemic. This finding is in line with the study report that revealed that before the pandemic, one in three Americans did not take their medications as prescribed because of high costs, but during a global pandemic, forgoing medications involves even more risks for chronic care patients and incurs even higher costs in the long run. [23] However, comparing study findings in this study setting with those in a high-resource setting is taken as a weakness of this study.

The study also evaluated the cost of each selected chronic disease. Accordingly, for the follow-up care of HTN patients, the patients incurred significantly higher costs during the pandemic compared to before the pandemic, which were raised by 33.76% during the pandemic. The cost incurred before the COVID pandemic was almost comparable with other study reports, but the cost incurred during the pandemic was higher than the study report on the cost of hypertension before the COVID-19 lockdown in Ethiopia. [24]

Again, the study showed that the cost of DM follow-up visits per patient during the pandemic lockdown was significantly higher than the cost incurred before the pandemic, which was increased by 40.53%. However, before and during the COVID-19 lockdown, the cost of DM in this study was lower than the study reported in Ethiopia. [15, 25] This variation could be attributed to differences in DM complications and treatment among study participants.

Despite HIV care and treatment being an exempt service in Ethiopia, patients incurred nonmedical costs. The study revealed that the cost incurred by HIV patients

for follow-up treatment and care per visit per patient during the pandemic lockdown was significantly higher than the cost incurred before the pandemic, which was increased by twofold. The cost of HIV treatment and care reported in the study was higher than in other Ethiopian studies. [26, 27]

However, there was no significant statistical median cost difference for the follow-up care of heart failure, mental illness, asthma, and epilepsy during and before the pandemic; a slight median cost difference was observed during and before the pandemic.

Conclusion

This study revealed that the total cost of follow-up care among chronic disease patients during the COVID-19 pandemic lockdown was significantly higher compared to before the pandemic era among the same patients. In this study, hypertensive patients had the greatest impact on the cost of ongoing care as a result of the COVID-19 pandemic. A comprehensive package of chronic disease treatment and care is demanded at different levels of health facilities in the country's health system. Therefore, healthcare providers, hospital administrators, and the local government should arrange special fee waiver mechanisms for chronic disease healthcare costs during such types of pandemics and provide the services at proximal health facilities.

Declarations

Author's Contributionship Statement

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agreed to be accountable for all aspects of the work.

Conflict of Interest Statement

All authors declared that they have no conflicts of interest related to this work.

Consent for Publication

NA

Availability of Data and Materials

All the data supporting the study's findings are within the manuscript. Additional detailed information and raw data will be shared upon request addressed to the corresponding author.

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Acronyms

ETB: Ethiopian Birr, HF: Heart Failure, HIV: Human Immune Virus, HTN: Hypertension, LMICs: Low-and-middle-income countries, NCDs: Non-communicable diseases, OOP: Out-of-pocket, WHO: World Health Organization

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	-
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	-
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	-
		(*e*) Describe any sensitivity analyses	-
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	-
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	-
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	-
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	12-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	-
Generalisability	21	Discuss the generalisability (external validity) of the study results	-
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.