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Prevalence and Outcome of COVID -19 in A Limited-Resource Setting, A cross-sectional Study, Sudan, 2021

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ABSTRACT— COVID-19 is RNA virus was identified in 2019 in Wuhan, China and it causes a various degree of respiratory affection ranging from mild respiratory illness to life threatening respiratory failure. The main diagnostic test is detection of the virus by PCR in a nasopharyngeal swab. We aimed to determine the incidence, clinical presentation, and outcome of COVID-19 patients in a limited resources setting. We included 258 COVID-19 cases from Shendi isolation center, Sudan. This study was conducted during the period between November 2020 and June 2021. The most common age group was found to be between 61—80years representing 46.5% of the patients. More than half of them were males. The clinical presentations of the patients were dominated by the following profile: Fever in 211 patients (81.8%), dyspnea in 169 patients (65.5%), cough in 160 patients (62%), sore throat in 49 patients (19%), headache in 21 patients (8.1%), fatigue in 14 patients (5.4%), chest pain in 7 patients (2.7%), anosmia in 6 patients (2.3%), loss of appetite in 5 patients (1.9%), abdominal pain in 2 patients (0.8%), diarrhea in 2 patients (0.8%), vomiting in one patient (0.4%), loss of test in 3 patients (1.2%), nausea in one patient)0.4%(, and rhinorrhea in one patient (0.4%). Most of patients were from rural areas (67.8%). The most common chronic illness seen was DM in 58 patients (22.5%) and hypertension in 43 patients (16.7%). Mortality rate was (28.7%) (affecting 74 patients), In COVID-19, the most common presenting symptoms are: fever, cough and dyspnea are. Mortality rate is found to be very high in this study; both DM and hypertension are associated with increased incidence and mortality rate of COVID-19. The mortality rate is directly proportionate to increase in age; as the age group 61-80 representing 46.5% of the patients.

KEYWORDS: COVID -19; Clinical presentation; Incidence; Outcome; Sudan

1. INTRODUCTION

Coronaviruses are a family of RNA viruses with spike like projections on its surface giving it a crown like appearance under microscope [1]. They are found in humans and other mammals, such as dogs, cats, chicken, cattle, pigs, and birds [2]. It can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) [3]. A novel Corona virus (COVID-19) was identified in 2019 in Wuhan, China. This is a new corona virus that has not been previously identified in humans [4]. Infection can be spread by asymptomatic - and symptomatic carriers [2]. Inhalation of virus, deposition of virus on exposed mucous membranes, and touching mucous membranes with soiled hands contaminated with virus [5]/. The average time from exposure to appearance of symptoms is within 5 days, [2]. The symptoms and signs of COVID-19 are varied, and they may include fever, cough, shortness of

breath, fatigue, muscle or body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea, vomiting or diarrhea [6]. The reported neurological manifestations of COVID-19 include headache, dizziness, confusion, altered sense of smell (hyposmia/anosmia), loss of taste (ageusia) [7]. Fainting and skin manifestations have been less frequently reported [8]. Emergency signs and symptoms can involve: difficulty of breathing, permanent chest pain, inability to stay awake, new confusion, pale, and gray or blue-colored skin, lips or nail beds [3]. Complications of COVID-19 involve: Sepsis, ARDS, acute respiratory failure, arrhythmia [9], myocarditis, stress-related cardiomyopathy and renal complications varying from mild proteinuria and minor serum creatinine elevations to acute kidney injury (AKI) and renal failure. in addition, liver injury or pancreatic injury has also been reported [7]. Acute cerebrovascular disease and encephalitis are observed with severe illness [2]. Other reported neurological complications are epilepsy, ataxia (lack of voluntary muscle movement), and Guillain-Barré syndrome [7].

Moreover, rhabdomyolysis, chronic fatigue [9]. Re-infection with SARS-CoV-2 is expected and has been previously reported, however, this data highlights that the overall risk, as detected through national surveillance, remains low [10]. People who had COVID-19 had an 84% lower risk of becoming reinfected and a 93% lower risk of symptomatic infection during 7 months of follow-up [11]. Diagnosis of COVID-19 is based on a reverse-transcription PCR of nasopharyngeal and oropharyngeal swab samples [12]. However, because of false-negative test result rates of SARS-CoV-2 PCR testing of nasal swabs, clinical, laboratory, and imaging findings may also be used to make a presumptive diagnosis [2]. Chest radiographs of patients with COVID-19 typically demonstrate bilateral air-space consolidation [6]. CT scan may show ground glass appearance. A ‘reversed halo sign’ is also seen in many patients, which is observed as a focal area of patchy opacities surrounded by a peripheral ring with consolidation. Other findings include pleural effusion, cavitation, calcification, and lymphadenopathy [12]. But chest CT imaging findings in approximately 15% of individuals and chest radiograph findings in approximately 40% of individuals can be normal [2]. Older patients and patients with chronic diseases (such as chronic lung diseases or cancer) can be more likely to get severely ill from COVID-19. Severe illness means that a person with COVID-19 may need hospitalization, intensive care or mechanical ventilation, or they may even die [13].

In this study, we aimed to determine the incidence, clinical presentation, and outcome of COVID-19 patients in a limited resources setting.

2. METHODS

This is study was a retrospective, descriptive, hospital-based study. It was conducted in Shendi isolation center which receives patients from in and out Shendi town and provides health care for patients of COVID-19. Shendi town is 170km north to Khartoum the capital of Sudan. Shendi isolation center's wards consist of 4 rooms with 3 beds in each one making a total of 12 beds, with 3 oxygen concentrators and 30 oxygen cylinders. The working staff in the center consists of 1 medical officer, 2 nurses, a health officer, disinfection and cleaning staff. The center is considered a class (A) primary health facility. The data was collected using carefully designed questionnaire from doctors' records. Formal ethical approval was taken from local ethical committee and administration of the study area. The information gathered will be kept confidential. The study population included COVID-19 PCR positive patients who were been admitted to Shendi isolation center in the period from November 2020 to June 2021. The study enrolled 258 patients.

Data analysis: The data was entered to the computer from an excel sheet recording using software program, the data were analyzed and the results were expressed as figures, tables, graphs using Statistical Package for Social Science (SPSS).

3. RESULTS

We involved 339 patients with suspected COVID-19 conducted at Shendi isolation center during the period from November 2020 to June 2021.

The total number of patients with suspected COVID-19 was admitted to Shendi isolation center during the study period from November 2020 to June 2021 were 339 patients, 258 positive and 81 negative, 138 females and 201 males, 74 patients 28.7% died Table [1].

Three patients 1.2% between (6-20) years, 23 patients 8.9% between (21-40) years, 98 patients 38% between (41-60) years, 120 patients 46.5% between (61-80) years, 14 patients 5.4% between (81-90) years. Regarding gender distribution 152 are male patients 59.3% and 106 are female patients 40.7%. Regarding incidence in males according to age 2 patients 1.3% between (6-20) years, 13 patients 8.6% between (21-40) years, 58 patients 38.2% between (41-60) years, 71 patients 46.7% between (61-80) years, 8 patients 5.3% between (81-90) years. Regarding incidence in female according to age 1 patients 0.9% between (6-20) years, 10 patients 9.4% between (21-40) years, 40 patients 37.7% between (41-60) years, 49 patients 46.2% between (61-80) years, 6 patients 5.7% between (81-90) years.

Regarding residence of patients: Eighty-three are patients from urban areas 32.2%, and 175 are patients from rural areas 67.8%.

Regarding chronic diseases in included patients: Fifty-eight patients with DM 22.5%, 43 patients with hypertension 16.7%, 4 patients with thyroid disease 1.6%, 3 patients with atherosclerosis 1.2%, 1 patient with asthma 0.4%, 1 patient with CVA 0.4%.

Regarding symptoms and signs: Two hundred and eleven patients with fever 81.8%, 169 patients with dyspnea 65.5%, 160 patients with cough 62%, 49 patients with sore throat 19%, 21 patients with headache 8.1%, 14 patients with fatigue 5.4%, 7 patients with chest pain 2.7%, 6 patients with anosmia 2.3%, 5 patients with loss of appetite 1.9%, 2 patients with abdominal pain 0.8%, 2 patients with diarrhea 0.8%, 1 patients with vomiting 0.4%, 3 patients with ageusia 1.2%, 1 patient with nausea 0.4%, and 1 patient with rhinorrhea 0.4%.

3.1 Regarding outcome in included patients

One hundred and forty-eight patients are alive 71.3%, and 74 patients are dead 28.7%.
Regarding outcome according to age, 2 patients between (6-20 years) 66.7% are alive, 1 patient 33.3% are dead. 20 patients between (21-40 years) 87% are alive, 3 patients 13% are dead. 82 patients between (41-60 years) 83.7% are alive, 16 patients 16.3% are dead, 75 patients between (61-80 years) 62.5% are alive, 45 patients 37.5% are dead. 5 patients between (81-90 years) 35.7% are alive, 9 patients 64.3% are dead. There is a significant association between age and outcome ($p = 0.000$) (Table 2).

Regarding outcome according to gender 109 male patients 71.7% are alive, and 43 patients died 28.3%, 75 female 70.8% are alive, and 31 patients 29.2% are alive. There is no significant association between gender and outcome ($p = 0.867$) Table (2).

Regarding outcome according to residence 53 patients from urban areas 63.9% are alive, and 30 patients from urban areas 36.1% are dead, 131 patients from rural areas 74.9% are alive and 44 patients from rural areas 25.1% are alive. There is no significant association between residence and outcome ($p = .068$) (Table 2).

Regarding outcome according to symptoms: 152 patients with fever72.04% are alive, and 59 patients are dead 27.96%, there is no significant association between fever and outcome (p = 0.588). 120 patients with cough75% are alive, and 40 patients are dead 25%, there is no significant association between cough and outcome (p = .095). 106 patients with dyspnea disease 62.72% are alive, and 63 patients are dead 37.28%, there is a significant association between dyspnea and outcome (p = .000). Thirty-eight patients with sore throat77.55% are alive, and 11 patients are dead 22.45%, there is no significant association between sore throat and outcome (p = 0.284). 15 patients with headache71.43% are alive, and 6 patients are dead 28.57%, there is no significant association between headache and outcome (p = .991). 4 patients with anosmia66.66% are alive, and 2 patients are dead 33.33%. There is no significant association between anosmia and outcome (p = 0.799). Eleven patients with fatigue 78.57% are alive, and 3 patients are dead 21.43%, there is no significant association between fatigue and outcome (p = .537). 5 patients with chest pain71.43% are alive, and 2 patients are dead 28.57%, there is no significant association between chest pain and outcome (p = 0.995). The 5 patients with loss of appetite are alive 100%, there is no significant association between loss of appetite and outcome (p = 0.152). 1 patient with diarrhea 50% is alive, and 1 patient is dead 50%, there is no significant association between diarrhea and outcome (p = 0.503). The 2 patients with abdominal pain are alive 100%, there is no significant association between abdominal pain and outcome (p = .368). The only 1 patient with nausea is alive 100%, there is no significant association between nausea and outcome (p = .525). Additionally, the only 1 patient with vomiting is alive 100%, there is no significant association between vomiting and outcome (p = .525). One patient with ageusia 33.33% is alive, and 2 patients are dead 66.66%, there is no significant association between ageusia and outcome (p = .143). The only one patient with rhinorrhea is alive 100%, there is no significant association between rhinorrhea and outcome (p = 0.114) (Table (3).

Regarding outcome according to chronic diseases: 38 patients with DM 65.5% are alive, and 20 patients are dead 34.5%, there is no significant association between age and outcome (p = 0.267). 28 patients with HTN 72.6% are alive, and 15 patients are dead 34.9%, there is no significant association between age and outcome (p = 0.325). 2 patients with thyroid disease 50% are alive, and 2 patients are dead 50%, there is no significant association between age and outcome (p = 0.342). 1 patient with atherosclerosis 33.3% are alive, and 2 patients are dead 66.7%, there is no significant association between age and outcome (p = 0.143). The one patient with CVA died 100%, the one patient with asthma died 100% (Table 3).

Regarding outcome according to temperature in the study area: in November 2020, the temperature was between 20.5 – 35.3 (median = 27.9) and the new cases were 7 (2.1% of total cases), 1 of them died (1.2% of total deaths). In December 2020, the temperature was between 18.5 – 33.5 (median = 26) and the new cases were 52 (15% of total cases) 9 of them died (10.8% of total deaths), In Jan 2021 the temperature was between 17.4 – 32.3 (median = 24.85) and the new cases were 34 (10% of total cases) 4 of them died (4.8% of total deaths). In February 2021, the temperature was between 16.6 – 31.7 (median = 24.15) and the new cases were 20 (5.9% of total cases) 5 of them died (6% of total deaths).In March 2021, the temperature was between 21.3 – 38.0 (median = 29.65) and the new cases were 61 (18% of total cases) 14 of them died (16.9% of total deaths).In April 2021 the temperature was between (24.1 – 40.7) (median = 32.4) and the new cases were 53 (15.6% of total cases) 22 of them died (26.5% of total deaths).In May 2021, the temperature was between (26.5 – 42.8) (median = 34.65) and the new cases were 76 (22.4% of total cases) 24 of them died (28.9% of total deaths), In June 2021 the temperature was between (29.6 – 43.6) (median = 36.6) and the new cases were 23 (6.8% of total cases) 4 of them died (4.8% of total deaths), there is no significant association between temperature and outcome (p = .059) (Table 4).

Table [1]: Distribution of positive and negative according to test results.

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Test	Frequency	Percent
Negative	81	23.9
Positive	258	76.1
Total	339	100.0

Table [2]: Sociodemographic factors' distribution among study population.

Factor	Outcome				Total	P. value
	Alive		Death			
	%	N	%	N		
						Age group
20 years<	6	85.7	1	14.3	7	
21 – 40 years	35	92.1	3	7.9	38	
41 – 60 years	107	84.3	20	15.7	127	0.000
61 – 80 years	99	67.3	48	32.7	147	
80 years >	8	40.0	12	60.0	20	
						Gender
Male	151	75.1	50	24.9	201	.867
Female	104	75.4	34	24.6	138	
						Residence
Urban	53	63.9	30	36.1	83	.068
Rural	131	74.9	44	25.1	175	

Table [3]: Patients' characteristics, and their cross tabulation to death and their significance.

Symptoms	Patients	Deaths	Percent of deaths to cases	P value
Fever	211	59	27.96%	.588
Cough	160	40	25%	.095
Dyspnea	169	63	37.28%	.000
Sore throat	49	11	22.45%	.284
Headache	21	6	28.57%	.991
Anosmia	6	2	33.33%	.799
Fatigue	14	3	21.43%	.537
Chest pain	7	2	28.57%	.995
Diarrhea	2	1	50%	.503
Nausea	1	1	100%	.525
Abdominal pain	2	0	0%	.368
Vomiting	1	0	0%	.525
Loss of appetite	5	0	0%	.152
Ageusia	3	2	66.66%	.143
Rhinorrhea	1	1	100%	.114
DM	58	20	34.5%	.267
HTN	43	15	34.9%	.325
Thyroid disease	4	2	50%	.342
Atherosclerosis	3	2	66.7%	.143
Asthma	1	1	100%	.114

CVA	1	1	100%	.114

Table [4]: Month Incidence of new cases and deaths according to temperature.

Period	Temperature	New cases	Percent to total cases	Deaths	Percent to total deaths
Nov 2020	20.5 – 35.3 0C	7	2.1%	1	1.2%
Dec 2020	18.8 – 33.5 0C	52	15%	9	10.8%
Jan 2021	17.4 – 32.3 0C	34	10%	4	4.8%
Feb 2021	16.6 – 31.7 0C	20	5.9%	5	6%
March 2021	21.3 – 38.8 0C	61	18%	14	16.9%
April 2021	24.1 – 40.7 0C	53	15.6%	22	26.5%
May 2021	26.5 – 42.8 0C	76	22.4%	24	28.9%
June 2021	29.6 – 43.6 0C	23	6.8%	4	4.8%

4. DISCUSSION

In this descriptive prospective hospital-based study, we described the incidence, clinical features and outcome according to age, gender, residence and chronic diseases in 258 patients with COVID-19 during the period from November 2020 to June 2021 at Shendi isolation center, Sudan. Out of those 258 patients, the mortality rate was 28.7%(74 patients), which is considered very high in comparison with an international study conducted in Madrid was done in April 2020 by Teodoro del Sera et al, investigated the incidence, severity, mortality rate, clinical features, and risk factors of symptoms of COVID-19 in home-dwelling older people id [14] which reported6.7% death rate, the increased death rate in our study is attributed to the limited facilities in isolation center and human resources along with the late presentation of most of our patients. The most common age group was found to be between (61-80 years) representing 46.5% of the patients which is very close to an international study conducted by Hongdou lietal in China in Hubei province and other parts of China, in January 2020(15) this is most properly due to the associated co-morbidities in these age group. Regarding gender distribution males are found to be more affected than females with a male to female ratio of 1.52:1.06 in our study which is very consistent with an international study conducted in China this due the fact that in Sudan males in contrast to females do engage to a variety of activities requiring social contact, thus more risk of acquiring the virus. Regarding residence urban areas are found to be less affected with 67.8% of patients from rural areas, this is most likely due to the better educational level and better health awareness level in urban areas and less social gatherings. In our study, Diabetes Mellitus is found to be the most common chronic disease associated with COVID-19 infection (22.5%) which is very close to an international study conducted in Tarragona [60]. To estimate the possible relationships between pre-existing medical conditions, including common co morbidities and chronic medications and risk for suffering COVID-19 disease in middle-aged and older adult and all individuals aged more than 50 years, followed by Hypertension (16.7%) which is far less in comparison to Tarragona study in Spain in first day of March 2020 to 23rd of May 2020 [16]. There was79 083persons participated (77 676 community-dwelling and 1407 nursing-home residents), who were all individuals aged >50 years.

Fever is the most common seen in 81.8% of patients. A comparison between our study and an international study in the Bronx on July 2020 by retrospective study included the first 200 patients admitted to a tertiary medical center, the presenting symptoms in our study compared with the international symptoms (17) listed in table [6].

Regarding outcome according to the gender the mortality rate is found to be almost equal in both males and

females and directly proportionate with age above twenty years of old, with adolescent and pediatrics showing better outcomes which is mostly attributed to less prevalent chronic co-morbidities in those age groups. In our study we found that mortality rate in urban areas is more than rural areas. In our study the outcome regarding chronic diseases both Diabetes Mellitus and Hypertension are associated with increased mortality rate, no enough evidence to prove the asthma relation with increased mortality rate. In our study the peak of both incidence and mortality rate was on May 2021 (22.4% of total cases 28.9% of total deaths) and no enough data to compare with other countries. In our study we couldn't identify an obvious relation between number of new cases and mortality rate with temperature in the specific month.

Table [6] Comparison of incidence of symptoms between our study and Teodoro Del Ser Et al.

Symptom	Percent in our study	Percent in Teodoro del Ser Et al study
Fever	81.8%	72.6%
Cough	62%	56.5%
Dyspnea	65%	40.3%
Sore throat	19%	37.1%
Headache	8%	35.5%
Anosmia	2.3%	37.1%
Fatigue	5.4%	58%
Chest pain	2.7%	--
Diarrhea	0.8%	33.9%
Nausea	0.4%	24.2%
Abdominal pain	0.8%	--
Vomiting	0.4%	--
Loss of appetite	1.9%	41.9%
Aguesia	1.2%	--
Rhinorrhea	0.4%	--
Myalgia	--	35.5%

5. CONCLUSION

COVID-19 is common in Shendi Sudan. Fever, cough, and dyspnea are the most common presenting symptoms. The mortality rate is found to be very high in this study with limited facilities and human resources along with the late presentation of most of the patients. Both Diabetes Mellitus and Hypertension are associated with an increase in both the incidence and mortality rate of COVID- 19. Males are at a slightly increased risk of getting an infection with COVID-19, but the mortality rate is almost equal between males and females. The mortality rate is directly proportionate to an increase in age, the peak is between (61-80 years) representing 46.5% of the patients. In this study, rural areas had increased incidence have decreased mortality rates, on the other hand, urban areas had decreased incidence and had increased mortality rates.

5. REFERENCES

[1] Singhal T. A review of coronavirus disease-2019 (COVID-19). The indian journal of pediatrics. 2020 Apr; 87(4):281-6.

[2] Wiersinga WJ, Rhodes A, Cheng AC, Peacock SJ, Prescott HC. Pathophysiology, transmission,

diagnosis, and treatment of coronavirus disease 2019 (COVID-19): a review. Jama. 2020 Aug 25; 324(8):782-93.

[3] Poongothai S, Anjana RM, Aarthy R, Kasthuri S, Begum MA, Karkuzhali K, Viswanathan K, Sundari BB, Pavitha R, Hemalatha B, Nisha AA. Strategies adopted in conduct of clinical trials amidst coronavirus disease-2019 (COVID-19). Journal of Diabetology. 2020 May 1; 11(2):81.

[4] Chiodini J. Online learning in the time of COVID-19. Travel medicine and infectious disease. 2020 Mar; 34:101669.

[5] Atherstone C, Siegel M, Schmitt-Matzen E, Sjoblom S, Jackson J, Blackmore C, Neatherlin J. SARS-CoV-2 transmission associated with high school wrestling tournaments—Florida, December 2020–January 2021. Morbidity and Mortality Weekly Report. 2021 Jan 29; 70(4):141.

[6] Centers for Disease Control and Prevention. Interim clinical guidance for management of patients with confirmed coronavirus disease (COVID-19).

[7] Bohn MK, Hall A, Sepiashvili L, Jung B, Steele S, Adeli K. Pathophysiology of COVID-19: mechanisms underlying disease severity and progression. Physiology. 2020 Sep 1; 35(5):288-301.

[8] Baclic DC, Murthy S, Emeriaud G, Money D, Yeung T, Poliquin G, Brooks J, Decou ML, Ofner M, Waechter J, Evans G. Clinical Management of Patients with COVID-19–2nd Interim Guidance.

[9] WebMD. Complications Coronavirus Can Cause. 2020. https://www.webmd.com/lung/coronavirus-complications [accessed 25/6/2021]

[10] Shastri J, Parikh S, Aggarwal V, Agrawal S, Chatterjee N, Shah R, Devi P, Mehta P, Pandey R. Severe SARS-CoV-2 breakthrough reinfection with delta variant after recovery from breakthrough infection by alpha variant in a fully vaccinated health worker. Frontiers in Medicine. 2021:1379.

[11] CIDRAP. Previous COVID-19 may cut risk of reinfection 84%. 2021. https://www.cidrap.umn.edu/news-perspective/2021/04/previous-covid-19-may-cut-risk-reinfection-84. [accessed 25/6/2021]

[12] Parasher A. COVID-19: Current understanding of its pathophysiology, clinical presentation and treatment. Postgraduate Medical Journal. 2021 May 1; 97(1147):312-20.

[13] Centers for Disease Control and Prevention. People with certain medical conditions. URL https://www. cdc. gov/coronavirus/2019-ncov/need-extra-precautions/groups-at-higher-risk. Html. 2020 Nov.

[14] Del Ser T, Fernández-Blázquez MA, Valentí M, Zea-Sevilla MA, Frades B, Alfayate E, Saiz L, Calero O, García-López FJ, Rábano A, Medina M. Residence, clinical features, and genetic risk factors associated with symptoms of COVID-19 in a cohort of older people in Madrid. Gerontology. 2021; 67(3):281-9.

[15] Li H, Wang S, Zhong F, Bao W, Li Y, Liu L, Wang H, He Y. Age-dependent risks of incidence and

mortality of COVID-19 in Hubei Province and other parts of China. Frontiers in medicine. 2020 Apr 30; 7:190.

[16] Vila-Córcoles A, Ochoa-Gondar O, Satué-Gracia EM, Torrente-Fraga C, Gomez-Bertomeu F, Vila-Rovira A, de Diego-Cabanes C, Bejarano-Romero F, Basora-Gallisà J. Influence of prior comorbidities and chronic medications use on the risk of COVID-19 in adults: a population-based cohort study in Tarragona, Spain. BMJ open. 2020 Dec 1; 10(12):e041577.

[17] Palaiodimos L, Kokkinidis DG, Li W, Karamanis D, Ognibene J, Arora S, Southern WN, Mantzoros CS. Severe obesity, increasing age and male sex are independently associated with worse in-hospital outcomes, and higher in-hospital mortality, in a cohort of patients with COVID-19 in the Bronx, New York. Metabolism. 2020 Jul 1; 108:154262.