

Overweight: A risk factor for COVID-19 --- A medical conundrum or a reality?

Rajiva Rajiva¹, Dharamjeet S. Faujdar², Saurabh Bobdey², Maninder P. S. Pardal²

¹Chief Medical Officer and Consultant (Full Time), THDC India Ltd, ²Department of Community Medicine, Armed Forces Medical College, Pune, Maharashtra, India

ABSTRACT

Introduction: Obesity may contribute to the initiation, progression, transmission, and deterioration of COVID-19. However, there was lack of such studies carried out by Indian workers. **Materials and Methods:** Data of cumulative cases of COVID-19 of various countries as on the day the peak incidence were reported in each country during the first and second waves of the pandemic was obtained from the internet. Data on prevalence of overweight were obtained by doing a thorough search of existing literature. The data so collected were tabulated and analyzed using SPSS version 20 to establish a correlation coefficient between overweight and COVID-19. Data pertaining to overweight status and age profile and COVID-19 status as on 28 Feb 2021 was collated as part of routine surveillance from the Health Department in an urban area. The total population for which the above data was obtained was 1107. The data so collected were subject to statistical analysis using SPSS version 20, to find out the odds ratio of overweight as a risk factor for COVID-19 after adjusting for age. **Results:** Correlation coefficient between overweight and COVID-19 for data pertaining to the first wave and the second wave 0.95 and 0.94, respectively. Odds ratio of overweight as a risk factor for COVID-19 after adjusting for age works out to 2.95 (95% confidence interval 2.30- 3.78). Mean age of the study subjects was 32.61 years (median 32 years, minimum 19 years, maximum 54 years, standard deviation 6.62). **Limitations:** The limitation of the present study is that the workers could only obtain retrospective data, carry out a case-control study and calculate odd ratio for overweight as a risk factor for COVID-19.

Keywords: COVID-19, odds ratio, overweight

Introduction

An outbreak of pneumonia which emerged in Wuhan City of Hubei Province in China alerted the medical and scientific communities in December 2019. A novel betacoronavirus, which we now know as SARS-CoV-2, was identified to be the causal agent.^[1]

The COVID-19 pandemic has posed a critical threat to public health across the globe.^[2]

Several workers have carried out studies which have established a relationship, correlation, or links between obesity and severity of COVID-19, greater risk of needing hospitalization, intensive care unit admission, and mechanical ventilation.^[3-9]

Obesity may also contribute to the initiation, progression, transmission, and deterioration of COVID-19.^[10-14] However, there was lack of such studies carried out by Indian workers. It was keeping in view the importance of overweight/obesity as a risk factor for COVID-19 and severity of COVID-19, coupled with the lack of similar studies in this part of the globe that the present study was carried out.

Materials and Methods

Data of cumulative cases of COVID-19 of various countries across the globe, as on the day the peak incidence of COVID-19

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Rajiva R, Faujdar DS, Bobdey S, Pardal MP. Overweight: A risk factor for COVID-19 --- A medical conundrum or a reality? J Family Med Prim Care 2021;10:4096-101.

Address for correspondence: Dr. Maninder P. S. Pardal, MD (PSM), Professor, Department of Community Medicine, Armed Forces Medical College, Pune - 411 040, Maharashtra, India. E-mail: ltcolpmpsingh@yahoo.com

Received: 17-05-2021

Revised: 06-07-2021

Accepted: 09-07-2021

Published: 29-11-2021

Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_889_21

were reported in each country during the first wave of COVID-19 pandemic was obtained from the internet. Similar data for the same countries were obtained during the second wave of the pandemic. Since different countries were in different stages of the pandemic during the first wave and the second wave, dates to which the data for each country pertains during both the waves are different.

Data on population, land mass, and population density of India and various other countries were also obtained from the internet.^[15-17] Data on prevalence of overweight of the same countries were obtained by doing a thorough search of existing literature and the internet; and from the official website of WHO.^[18-20]

The prevalence of overweight was converted into actual numbers of overweight in each country based on the population of that particular country. The data so collected were tabulated and analyzed using SPSS version 20 to establish a correlation coefficient between overweight and COVID-19 after controlling for confounding variables, such as population, land mass, and population density. The above analysis was carried out for both sets of data i.e. data of the first wave and the second wave.

Data pertaining to overweight status and age profile and COVID-19 status as on 28 Feb 2021 were collated as part of routine surveillance from the Health Department of a few wards of municipal corporation in an urban area. The total population for which the above data were obtained was around 1107. The data so collected were subject to statistical analysis using SPSS version 20, to find out the odds ratio of overweight as a risk factor for COVID-19 after adjusting for age.

Inclusion criteria

Subjects in respect of whom overweight status and COVID-19 status were known were included in the study.

Exclusion criteria

Subjects in respect of whom COVID-19 status was not known were excluded from the study.

Results

The data depicting population of each country, prevalence of overweight, actual numbers of overweight and number of cases

Table 1: Population of each country, prevalence of overweight, actual numbers of overweight, prevalence of COVID-19 and number of cases of COVID-19 as on the date shown against each country during the first wave of the COVID-19 pandemic

Country	Population	Prevalence of overweight	Overweight actual numbers	Number of COVID-19 cases	Prevalence of COVID-19	Date to which the data pertains
India	1380004385	19.3	266340846.3	5115893	0.370715706	16-Sep-20
Pakistan	220892340	26.2	57873793.08	139230	0.063030705	14-Jun-20
Afghanistan	38928346	19.7	7668884.162	18969	0.048727989	05-Jun-20
Sri Lanka	21413249	24.2	5182006.258	2454	0.011460195	10-Jul-20
Nepal	29136808	19.6	5710814.368	144872	0.49721301	21-Oct-20
Vietnam	97338579	18.3	17812959.96	509	0.000522917	30-Jul-20
Thailand	69799978	34.7	24220592.37	599	0.000858166	22-Mar-20
Indonesia	273523615	28.3	77407183.05	266845	0.097558304	25-Sep-20
Bangladesh	164689383	19	31290982.77	153277	0.093070359	02-Jul-20
Malaysia	32365999	41.7	13496621.58	3333	0.010297844	03-Apr-20
Nigeria	206139589	26	53596293.14	26484	0.012847605	01-Jul-20
Ethiopia	114963588	18.1	20808409.43	37665	0.032762547	21-Aug-20
Egypt	102334404	61.9	63344996.08	52211	0.051019987	19-Jun-20
Congo	89561403	28.1	25166754.24	4628	0.005167405	02-Sep-20
South Africa	59308690	51.9	30781210.11	421966	0.711474153	24-Jul-20
Tanzania	59734218	24.5	14634883.41	480	0.00080356	29-Apr-20
Kenya	53771296	22.6	12152312.9	17603	0.032736797	26-Jul-20
Uganda	45741007	19	8690791.33	413	0.00090291	30-May-20
Sudan	44033463	26.8	11800968.08	3138	0.007126398	21-May-20
South Sudan	11193725	10.8	1208922.3	1317	0.01176552	07-Jun-20
USA	331002651	70.2	232363861	4331003	1.308449641	24-Jul-20
Brazil	212559417	56.9	120946308.3	2555518	1.202260543	29-Jul-20
Spain	46754758	67.2	31419197.38	98581	0.21084699	20-Mar-20
Italy	60461826	64.1	38756030.47	53598	0.08864767	21-Mar-20
France	65273511	62.9	41057038.42	52128	0.07986088	31-Mar-20
United Kingdom	67886011	67.2	45619399.39	66705	0.098260303	10-Apr-20
Germany	83783942	62.8	52616315.58	50871	0.060716885	27-Mar-20
Switzerland	8654622	57.9	5011026.138	5615	0.064878628	20-Mar-20
Sweden	10099265	59.9	6049459.735	62680	0.620639225	24-Jun-20
Australia	25499884	67.2	17135922.05	1609	0.006309833	22-Mar-20
New Zealand	4822233	68	3279118.44	514	0.010658962	28-Mar-20

Table 2: Population of each country, prevalence of overweight, actual numbers of overweight, prevalence of COVID-19 and number of cases of COVID-19 as on the date shown against each country during the second wave of the COVID-19 pandemic

Country	Population	Prevalence of overweight	Overweight actual numbers	Number of COVID-19 cases	Prevalence of COVID-19	Date to which the data pertains
India	1393409038	19.7	274501580.5	2,14,85,383	1.541929356	06-May-21
Pakistan	225199937	28.4	63956782.11	7,56,285	0.335828247	18-Apr-21
Afghanistan	39835428	23	9162148.44	44,228	0.111026798	19-Nov-20
Sri Lanka	2149731	23.3	500887.323	1,17,529	5.467149146	05-May-21
Nepal	2967492	21	623173.32	3,59,610	12.11831405	05-May-21
Vietnam	97338579	18.3	17812959.96	1,642	0.001686895	28-Jan-21
Thailand	69950850	32.6	22803977.1	53,022	0.075798936	24-Apr-21
Indonesia	276361783	28.2	77934022.81	10,66,313	0.385839528	30-Jan-21
Bangladesh	166303498	20	33260699.6	6,59,278	0.396430627	07-Apr-21
Malaysia	32776194	42.5	13929882.45	2,09,661	0.639674637	30-Jan-21
Nigeria	211400708	28.9	61094804.61	1,18,969	0.056276538	22-Jan-21
Ethiopia	117876227	20.9	24636131.44	2,11,314	0.179267699	02-Apr-21
Egypt	104258327	63.5	66204037.65	1,38,062	0.132422996	31-Dec-20
Congo	92377993	25.3	23371632.23	10678	0.01155903	24-Apr-21
South Africa	60041994	53.8	32302592.77	11,49,591	1.91464494	06-Jan-21
Tanzania	61498437	27.7	17035067.05	509	0.000827663	08-May-20
Kenya	54985698	25.5	14021352.99	1,28,178	0.233111527	26-Mar-21
Uganda	47123531	19	8953470.89	25,059	0.053177254	09-Dec-20
Sudan	44909353	28.9	12978803.02	26,083	0.058079216	20-Jan-21
South Sudan	11381378	10.8	1229188.824	6,931	0.060897723	22-Feb-21
USA	332915073	67.9	226049334.6	2,25,35,465	6.76913328	08-Jan-21
Brazil	213993437	56.5	120906291.9	1,23,24,765	5.759412612	25-Mar-21
Spain	46745216	61.6	28795053.06	23,40,143	5.006165765	15-Jan-21
Italy	60367477	58.5	35314974.05	11,12,045	1.842126018	13-Nov-20
France	65426179	59.5	38928576.51	17,62,270	2.693524254	07-Nov-20
United Kingdom	68207116	63.7	43447932.89	29,52,054	4.328073335	08-Jan-21
Germany	83900473	56.8	47655468.66	30,64,382	3.65240134	14-Apr-21
Switzerland	8715494	54.3	4732513.242	1,76,177	2.021422997	02-Nov-20
Sweden	10160169	56.4	5730335.316	4,07,334	4.009126226	23-Dec-20
Australia	25788215	64.5	16633398.68	16,303	0.0632188	30-Jul-20
New Zealand	4860643	65.6	3188581.808	2,219	0.045652396	10-Jan-21

Table 3: Odds ratio of overweight as a risk factor for COVID-19 after adjusting for age

Overweight	COVID-19 positive	COVID-19 negative	Total
Yes	0362	0234	0596
No	0176	0335	0511
Total	0538	0569	1107

Table 4: Age group-wise distribution of the study subjects

Age group	Number (%)
<20 years	001 (0.09)
20-29 years	386 (34.86)
30-39 years	549 (49.59)
40-49 years	166 (14.99)
>50 years	005 (0.45)
Total	1107 (100)

The data depicting odds ratio of overweight as a risk factor for COVID-19 after adjusting for other confounding variables, such as coronary artery disease, primary hypertension and type II diabetes mellitus is presented in Table 3.

Correlation coefficient between overweight and COVID-19 for data pertaining to the first wave and the second wave was 0.95 and 0.94, respectively. Correlation coefficient between population density of various countries and COVID- during the first wave and the second wave was a poor 0.019 and 0.004, respectively. Geographical area of various countries and COVID-19 during the first wave and the second wave showed a strong correlation coefficient of 0.65 and 0.67, respectively. Odds ratio of overweight as a risk factor for COVID-19 after adjusting for age works out to 2.95 (95% confidence interval 2.30–3.78). Thus, the strong positive correlation coefficient is further strengthened by the statistically significant odds ratio.

of COVID-19 for the first wave are presented in Table 1. Similar data for the second wave are tabulated in Table 2.

Mean age of the study subjects was 32.61 years (median 32 years, minimum 19 years, maximum 54 years, standard

Table 5: Age group-wise overweight status of the study subjects

Age group	Number (%)
<20 years	0 (0.00)
20-39 years	251 (42.11)
30-39 years	257 (43.12)
40-49 years	86 (14.42)
>50 years	4 (0.67)
Total	596 (100)

Table 6: Age group-wise COVID-19 status of the study subjects

Age group	Number (%)
<20 years	001 (0.18)
20-9 years	180 (33.45)
30-39 years	279 (51.85)
40-49 years	077 (14.31)
>50 years	001 (0.18)
Total	538 (100)

deviation 6.62). Age group-wise distribution of the study subjects is tabulated in Table 4. Age group-wise overweight status of the study subjects is tabulated in Table 5. Age group wise COVID-19 status of the study subjects is tabulated in Table 6.

Discussion

The association of higher prevalence of COVID-19 in countries with higher prevalence of overweight was first hypothesized by Banerjee.^[21]

A strong correlation of obesity with influenza and other respiratory viral infections has already been established. The association of obesity with various comorbidities strengthens its role as an exponentially important factor in determining the morbidity and mortality risk in SARS CoV2 patients.^[22]

Kevin reported a weak positive correlation of 0.289 between prevalence of BMI >40 and COVID-19 cases.^[23]

Several workers have listed obesity as major risk factor for the initiation, progression, and outcomes of COVID-19.^[6,10-12,14,24,25]

Ahmed also observed a correlation between obesity and the current COVID-19 pandemic. Obesity as defined by BMI is more prevalent in Italy, as compared to China. This might be contributory factor to the difference in fatality rates between the two countries. Another observation by the same worker is that the United States has a higher prevalence of obesity as compared to China; and also the highest mortality rates from COVID-19.^[13]

Obesity has also been shown to have deleterious effects on host immunity, thereby increasing the risk for susceptibility to

infection, severity, and adverse endpoints after infection including higher rates of hospitalization, admission to intensive care unit, and death. Obesity has thus been an underappreciated and one of the strongest risk factor for COVID-19. There is increasing evidence to demonstrate a strong correlation between obesity and COVID-19.^[26,27]

Gabriel reported a direct correlation between increase in BMI and the proportion of patients with severe COVID-19.^[28]

Grazia reported biological and physiological plausibility between overweight/obesity and COVID-19 outcomes.^[8]

Yue observed an odds ratio of 1.72 (95% CI 1.04–2.85) between obesity and severe or fatal COVID-19.^[29]

Popkin *et al.*^[30] observed that overweight increased the risk of COVID-19 by 44.0% [relative risk (RR) =1.44; 95% CI, 1.08–1.92; $P = 0.0100$] and individuals with obesity almost doubled the risk (RR = 1.97; 95% CI, 1.46–2.65; $P < 0.0001$).

The primary care physician when he comes across an overweight patient can advise the patient regarding overweight being a risk factor COVID-19. The physician can advise the patient to get himself/herself vaccinated against COVID-19. The overweight patient can also be advised by the primary care physician to reduce his/her weight to within desirable limits by adopting suitable lifestyle modification measures. Although overweight is a major risk factor for various diseases, primary care physicians find managing overweight and obesity a difficult business. Anderson reported favorable outcomes for the effectiveness of individually directed advice in reducing overweight.^[31]

Limitations

The limitation of the present study is that the workers could control only for three confounding variables viz, population, land mass, and population density while calculating the correlation coefficient between overweight and COVID-19, as data of only these three variables was available to accessible by the workers. Data in respect of other confounding variables, such as age distribution of various populations, sex distribution of various populations, were not available to the workers. Another limitation of the study is that the workers could only obtain retrospective data, carry out a case-control study and calculate odd ratio for overweight as a risk factor for COVID-19. Prospective or cohort study could not be carried out due to resource constraints. We therefore recommend that further studies in this field be carried out to validate the results obtained by us. Our study validates the association of overweight and COVID-19 which has been observed by several workers. Our study is one of the pioneering works in establishing a strong positive correlation coefficient between prevalence of overweight and COVID-19.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

- Ruiz-Roso MB, de Carvalho Padilha P, Mantilla-Escalante DC, Ulloa N, Brun P, Acevedo-Correa D, *et al.* Covid-19 confinement and changes of adolescent's dietary trends in Italy, Spain, Chile, Colombia and Brazil. *Nutrients* 2020;12:1807. doi: 10.3390/nu12061807.
- Buscemi S, Buscemi C, Batsis JA. There is a relationship between obesity and COVID-19 but more information is needed. *Obesity* (Silver Spring, Md.) 2020. doi: 10.1002/oby. 22883.
- Scheen AJ. Obesity and risk of severe COVID-19. *Rev Med Suisse* 2020;16:1115-9.
- Luzi L, Radaelli MG. Influenza and obesity: Its odd relationship and the lessons for COVID-19 pandemic. *Acta Diabetol* 2020;57:759-64.
- Chiappetta S, Sharma AM, Bottino V, Stier C. COVID-19 and the role of chronic inflammation in patients with obesity. *Int J Obes (Lond)* 2020;44:1790-92.
- Lavie CJ, Sanchis-Gomar F, Henry BM & Lippi G (2020) COVID-19 and obesity: links and risks, *Expert Review of Endocrinology & Metabolism*, 15:4, 215-216, DOI: 10.1080/17446651.2020.1767589.
- Bello-Chavolla OY, Bahena-López JP, Antonio-Villa NE, Vargas-Vázquez A, González-Díaz A, Márquez-Salinas A, *et al.* Predicting mortality due to SARS-CoV-2: A mechanistic score relating obesity and diabetes to COVID-19 outcomes in Mexico. *J Clin Endocrinol Metab* 2020;105:dga346.
- Caci G, Albini A, Malerba M, Noonan DM, Pochetti P, Polosa R. COVID-19 and obesity: Dangerous liaisons. *J Clin Med* 2020;9:2511.
- Palaiodimos L, Kokkinidis DG, Li W, Karamanis D, Ognibene J, Arora S, *et al.* 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;108:154262. doi: 10.1016/j.metabol.2020.154262.
- Hu X, Pan X, Zhou W, Gu X, Shen F, Yang B, Hu Z. Clinical epidemiological analyses of overweight/obesity and abnormal liver function contributing to prolonged hospitalization in patients infected with COVID-19. *International Journal of Obesity*. <https://doi.org/10.1038/s41366-020-0634-3>.
- Goossens GH, Dicker D, Farpour-Lambert NJ, Frühbeck G, Mullerova D, Woodward E, Jens-Christian H. Obesity and COVID-19: A Perspective from the European Association for the Study of Obesity on Immunological Perturbations, Therapeutic Challenges, and Opportunities in Obesity. *Obes Facts*. Published online: August 13, 2020. DOI: 10.1159/000510719.
- Tartof SY, Qian L, Hong V, Wei R, Nadjafi RF, Fischer H, *et al.* Obesity and Mortality Among Patients Diagnosed With COVID-19: Results From an Integrated Health Care Organization. *Ann Intern Med*. doi:10.7326/M20-3742.
- Albashir AAD. The potential impacts of obesity on COVID-19. *Clinical Medicine* 2020 Vol 20, No 4 July 2020. *Clinical Medicine Publish Ahead of Print*, published on June 22, 2020 as doi:10.7861/clinmed.2020-0239.
- Finer N, Garnett SP, Bruun JM. COVID-19 and obesity. *Clin Obes*. 2020;10:e12365. <https://doi.org/10.1111/cob.12365>.
- https://www.google.com/search?source=hp&ei=QipPX-e6D8OYmgft46GwDw&q=population+of+india&oeq=popu&gs_lcp=CgZwc3ktYWIQAxgAMgUIABCxAzICCAAYBQgAELEDMgUIABCxAzIFCAAQsQMyAggAMgIIADIFCAAQsQMyAggAMgUIABCxAzoOCAAQ6gIQtAIQmQE5QI6CwguELEDEI MBEJMCoggIABCxAxCDAToCCC46BQguELEDOgcIABCxAxAKUMYXWJYdYKApAFwAHgAgAHIAogBuAiSAQUyLTmuMZgBAKABAaoBB2d3cy13aXqwAQY&client=psy-ab
- https://www.google.com/search?source=hp&ei=QipPX-e6D8OYmgft46GwDw&q=land+mass+of+india&oeq=land+mass+&gs_lcp=CgZwc3ktYWIQAxgAMgcIABBGEpsBMgIIADICCAAYAggAMgIIADICCAAYBAGAEAOyAggAMgIIADICCAAY6DggAEOoCELQCEJoBEOUCoggIABCxAxCDAToFCC4QsQM6BQgAELEDOgsLLhCxAxDHARCjAjoICC4QsQM0QgwE6CwguELEDEIMBEJMCog4ILhCxAxDHARCjAhCTAjoHCAAQsQMOCIC8-AFYvosCYIusAmgCcAB4AIABlWsiAYAXkgEJMi04LjAuMS4xmAEAoAEBqgEHZ3dzLXdpereABBg&client=psy-ab
- <https://www.worldometers.info/world-population>.
- Coronavirus Update: Available from: <https://www.worldometers.info/coronavirus/>. [Last accessed on 2021 May 01].
- World Population Review; 2018. Available from: <https://worldpopulationreview.com/countries/median-age/>. [Last accessed on 2021 May 01].
- WHO. Global Health Observatory Data Repository. Prevalence of Overweight among Adults, BMI>25 (Age Standardized). Available from: <https://apps.who.int/gho/data/node.main.A897A?lang=en>. [Last accessed on 2020 Sep 19].
- Banerjee A. COVID-19: The curious case of the dog that did not bark. *Med J Dr DY Patil Vidyapeeth* 2020;13:189.
- Banerjee M, Gupta S, Sharma P, Shekhawat J, Gauba K. Obesity and COVID-19: A Fatal Alliance. *Indian J Clin Biochem* 2020;35:1-8. doi: 10.1007/s12291-020-00909-2.
- Curtin KM, Pawloski LR, Mitchell P, Dunbar J. COVID-19 and morbid obesity: Associations and consequences for policy and practice. *World Med Health Policy* 2020. doi: 10.1002/wmh3.361.
- Korakas E, Ikonomidis I, Kousathana F, Balampanis K, Kountouri A, Raptis A, *et al.* Obesity and COVID-19: Immune and metabolic derangement as a possible link to adverse clinical outcomes. *Am J Physiol Endocrinol Metab* 2020;319:E105-9.
- Rychter AM, Zawada A, Ratajczak AE, Dobrowolska A, Krela-Kaźmierczak I. Should patients with obesity be more afraid of COVID-19? *Obes Rev* 2020;21:e13083.
- Zhou Y, Chi J, Lv W, Wang Y. Obesity and diabetes as high-risk factors for severe coronavirus disease 2019 (Covid-19). *Diabetes Metab Res Rev* 2021;37:e3377.
- Ritter A, Kreis NN, Louwen F, Yuan J. Obesity and COVID-19: Molecular mechanisms linking both pandemics. *Int J Mol Sci* 2020;21:5793.
- Pasquarelli-do-Nascimento G, Braz-de-Melo HA, Faria SS, Santos IO, Kobinger GP, Magalhães KG. Hypercoagulopathy and Adipose Tissue Exacerbated Inflammation May Explain

- Higher Mortality in COVID-19 Patients With Obesity. *Front Endocrinol (Lausanne)* 2020;11:530. doi: 10.3389/fendo.2020.00530.
29. Zhou Y, Yang Q, Chi J, Dong B, Lv W, Shen L, *et al.* Comorbidities and the risk of severe or fatal outcomes associated with coronavirus disease 2019: A systematic review and meta-analysis. *Int J Infect Dis* 2020;99:47-56.
30. Popkin BM, Du S, Green WD, Beck MA, Algaith T, Herbst CH, *et al.* Individuals with obesity and COVID-19: A global perspective on the epidemiology and biological relationships. *Obes Rev* 2020;21:e13128.
31. Anderson P. Reducing overweight and obesity: closing the gap between primary care and public health. *Fam Pract* 2008;25(Suppl 1):i10-6.