The Effect of Living Conditions When Experiencing the COVID-19 Lockdown on the Physical Activity of the Dutch Students

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I. Introduction

Since march 2020 the government of the Netherlands has implemented the state lockdown to limit the spread of the SARS-CoV-2 virus. The virus was first indicated in Wuhan, China in December 2019 [1] and has spread rapidly across the world, including the Netherlands. As the last lockdown in the Netherlands was 75 years ago in 1945, right after the Second World War, the prognosis of the impact of the modern-day lockdown on the behavior of the Dutch citizens was unpredictable due to lacking experience.

From the year 2020 up to the moment this paper is being written, lots of researches on the impact of the lockdown on the physical activity of the diverse target groups in different countries were performed, such as China [2], Italy [3], Canada [4] and UK [5]. The researches were performed by using specialized polls with data from the physical activity meters, such as specialized smartwatches(such as Fitbit, Omron) or the smartphone step-count applications. Many of these publications indicated for different demographic groups a significant decrease in overall physical activity. Some of the research papers have also indicated that with progressing adaptation to the lockdown conditions the physical activity was gradually getting closer to the pre-lockdown levels [4]. Also, it was indicated that the rate of physical activity decrease and recovery is different for different demographic groups [2] [5] [6]. Yet, the size of impact by particular external factors on the physical activity during lockdown still remains unknown. One of the factors , which needs to be considered when talking about physical activity, is a social factor. Especially, as the large part of the population has switched their habitual working lifestyle to working remotely from home, the housing conditions get much more important, as people have to spend much more time with each other inside the same household during the lockdown.

One of the demographic groups with high risk of decreasing physical activity during the lockdown are the university students [7]. As their studying programs often require long periods of reading and writing, what frequently leads to sedentary behavior, the lockdown conditions can further enhance the physical inactivity. In this particular paper, the physical activity has been estimated based on the computed amount of daily steps and the estimated daily energy expenditure based on the IPAQ (International Physical Activity Questionnaire) [8]. Also, the BMI of the students is taken into account as a physical activity parameter, as previous researches, for example in Italy [3], have indicated an increase in BMI and decrease in physical activity during the lockdown.

The influence of the social conditions, such as a fact of presence of housemates of different kind, might have an impact on the students physical activity and perception of its importance in his daily lifetime.

Based on the data from the step-counting devices and the IPAQ-scores, the research focuses on whether the dutch students living alone or with peers would experience a sharper decrease in physical activity during the COVID-19 lockdown conditions, compared to the students who live alone or with their peers.

The hypothesis is that the physical activity of the student would be experiencing a sharper decline when the student is living alone or with peers, compared to living with parents. In the moment of writing this paper, there is a lack of information about the influence of the housemates in the household on the physical activity and its perception. The hypothesis is partly based on the results from the article by C. Boot [9], which made a similar test in 2009 about the living conditions of students in the Netherlands, which shows that students living alone or with peers have scored lower on their physical activity, compared to their peers, who live with parents. The hypothesis is also based on the assumption that the influence of parents in the same household would motivate students to be leading a more healthy lifestyle, which is associated with sufficient physical activity.

The results of this data research analysis can potentially contribute to the future research on the importance of social interactions for the students physical well being. The research results can also potentially be used in the future researches about the adaptation to the lockdown conditions in the future, while maintaining a healthy physical activity pattern.

II. Method

To analyse the influence of the living conditions on the students physical activity the data collection from the Erasmus University Rotterdam is used. This data was collected during the pre-lockdown period in 2019 and during the 2020 lockdown period in the Netherlands. For both years, the students have provided their physical activity data from the seven days of measurements.

The measured physical activity data contained information

from the step-counting devices such as a specialized pedometer and a students smartphone application. Also, in both years, the students have filled in the IPAQ-questionnaire, frequently used in national monitoring of physical activity, which has shown to be an instrument of acceptable reliability and validity [8].

From the whole provided database the variables relevant to the research question have been selected. The variables of interest were the year the data was submitted (pre-lockdown period in 2019 or lockdown period in 2020), the living situation of the student (living with parents or alone/with peers), the BMI of the student, the estimated physical activity based on the IPAQ questionnaire and the counted steps data from both the specialized pedometer (Omron) and from the step-counting application on the students personal smartphone.

To compare the difference in the physical activity before and during the pandemic lockdown multiple hypothesis tests were performed. For each hypothesis testing the provided data of the students of the Erasmus University Rotterdam has been statistically analyzed.The equivalent hypothesis tests are performed for both years 2019 and 2020. The idea of the method is to indicate, if possible, that the living conditions during 2020 have the effect of intensified significance on the physical activity of an average Dutch student. In case if the null hypothesis has been proved instead of the first hypothesis, living with parents compared to living alone or with peers could be considered to have an insignificant effect on the students physical activity.

As a first step, the assumption of the overall decrease in physical activity of the students needs to be checked for the used data. To test this assumption, the selected physical activity variables are being checked for pre-lockdown (2019) and the lockdown year (2020). In this test the hypothesis is set, that for each of the selected variables (counted steps from smartphones and OMRON, IPAQ-score, BMI) there is a significant decrease to be indicated.

Afterwards, when the fact of overall physical activity decrease has been tested, the relation in the physical activity change is tested between the case of students living alone or with peers and the case of students living with parents. During the testing, first the impact of living conditions is tested for 2019 pre-lockdown period. In a first hypothesis test,the counted steps from the Omron pedometer are compared for the students living with parents and alone/with peers. For the data from the smartphone application the same type of hypothesis was made. Afterwards, the hypothesis analysis of living conditions influence on the overlap of the scores from the IPAQ questionnaire is made. Then, the hypothesis test has been performed on the change of the body mass index. Afterwards, the analogous hypothesis tests have been performed for 2020 lockdown period.

To determine the correct statistical testing method for each of the hypotheses, first the boxplots have been plotted for each of the hypothesis datasets. In case if the boxplot resembles the normal distribution, the unpaired t-test is used for hypothesis testing. Otherwise, if the data distribution deviates from normal, the Mann-Whitney statistical test is performed. Both types of tests decide whether to reject the null hypothesis at 5% significance level. As the statistical testing instrument the MATLAB programming language has been used as it has a user-friendly toolkit for performing statistical data tests.

III. Results

The contrast in physical activity has been indicated by five variables. The difference in distribution for each of the variables is visualised by the boxplots in Figure 1. For the boxplots a up to d the significant difference is visible. This impression is also supported by applying the hypothesis tests to each of the cases. As the result, the hypotheses on counted steps distribution by Omron, steps distribution by the smartphone apps and the distribution in IPAQ-scores both before and after the measurements indicate a significant decrease in physical activity. Only the test of BMI have shown no significant contrast between both years. In addition, the means and standard deviations of the used parameters were calculated (see Table I)

	2019		2020		
	μ	σ	μ	σ	p-value
Steps APP	7188	2752	4238	1726	8.339e-17
Steps Omron	6773	2177	4019	1817	1.554e-13
IPAQ1	3988	2393	2877	2237	0.00243
IPAQ2	4142	4177	2922	1780	2.343e-05
BMI	21.11	2.33	21.13	2.36	0.953

TABLE I

MEAN μ AND STANDARD DEVIATION σ, FROM BOTH 2019 AND 2020 FOR USED VARIABLES: STEPS COUNTED BY SMARTPHONE APP, STEPS COUNTED BY OMRON DEVICE, THE IPAQ SCORES PRIOR TO AND AFTER THE MEASUREMENTS AND THE ESTIMATED BMI VALUE. ALSO THE P-VALUE OF HYPOTHESIS TEST BETWEEN BOTH YEARS IS PROVIDED.

Afterwards the data distributions were compared for both years, testing the impact of the housing situation (living with parents or alone/with peers), based on selected variables. During the programming phase it was estimated by which statistical testing method can different data groups be approached. To get the idea of the data distribution before testing each hypothesis, the corresponding boxplots have been plotted in Figure 2 to visualise the distribution.

From the plots in becomes evident that most of the ten hypotheses have to deal with distributions being skewed from the normal distribution. Only the hypothesis a (Steps Distribution OMRON 2019) shows the behavior that resembles normal distribution, so only for this case the unpaired t-test is applied. For the rest of the hypotheses the Mann-Whitney statistical test is used. After running all of the hypotheses testing codes, according to p-values (see Table **??**) all of the tests resulted in failure to reject the null hypothesis at the 5% significance level (95% confidence interval), meaning that for all of the tests no significant deviation is indicated between the data of the students living with parents and the students living alone or with peers.

IV. Discussion

From the analysis results, all of the tested variables, except for the BMI index, have indicated a significant drop. For both ways of step counting (by smartphone applications and

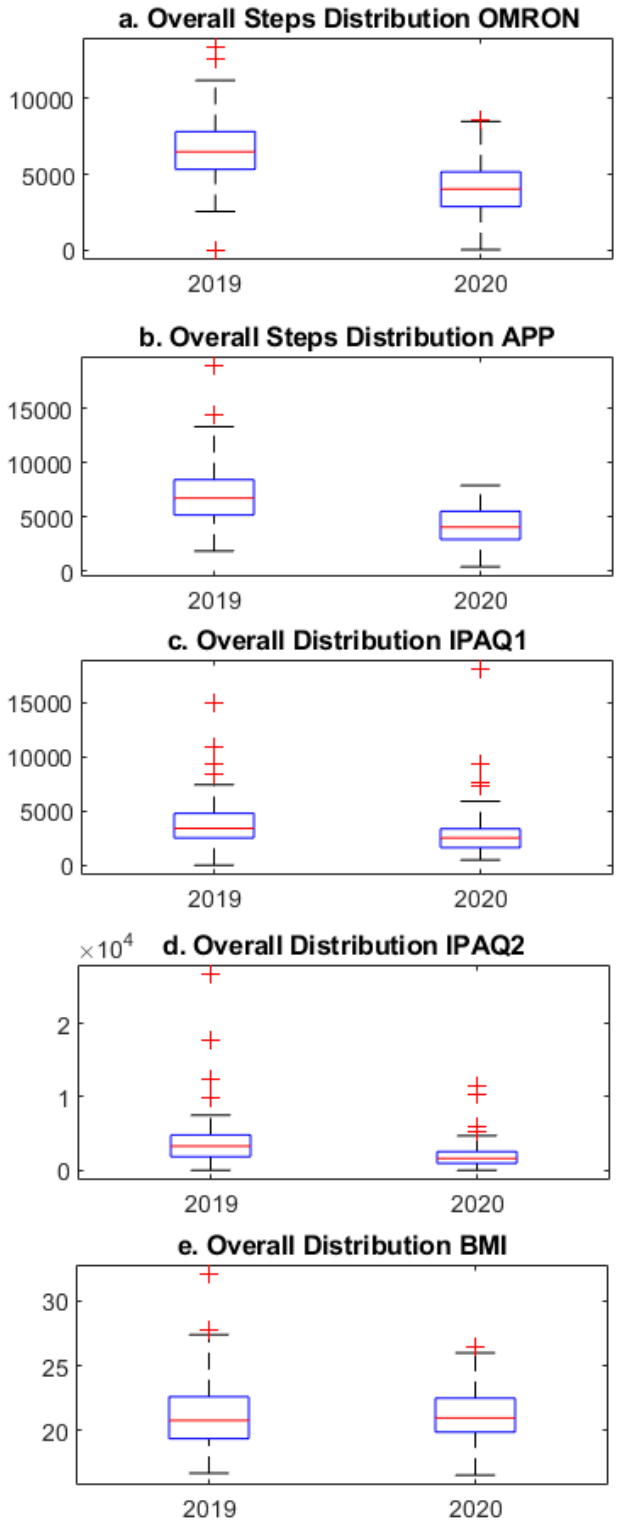

Fig. 1. The Boxplots for: (a) Overall Steps Distribution OMRON, (b) Overall Steps Distribution App, (c) Overall Distribution IPAQ1, (d) Overall Distribution IPAQ2, (e) Overall Distribution BMI

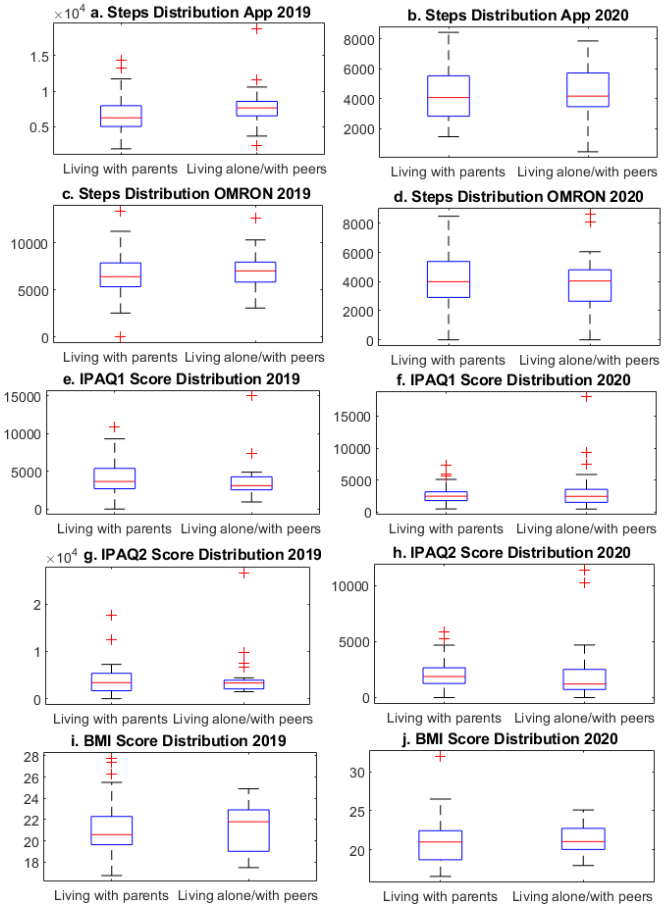

Fig. 2. The Boxplots for: (a) Steps Distribution Omron 2019, (b) Steps Distribution App 2019, (c) IPAQ Score Distribution 2019, (d) Steps Distribution Omron 2020, (e) Steps Distribution App 2020, (f) IPAQ Score Distribution 2020.

Omron) the decrease in the mean value have been estimated to be around 40% (see Table I), which means that walking activity has strongly decreased. The significance of the drop has also been indicated by the hypothesis test, with a 95% confidence interval for both cases. These results hypotheses are also supported by the boxplots in the Figure 1, where the contrast is visible on the picture.

Furthermore, the personal estimation of physical activity based on the IPAQ-score before and after measuring walking activity, has also dropped by 25% based on the mean value of the scores (see Table I). The significance of the drop is also supported by the 95% confidence interval hypothesis test.

In case of the BMI of the students, no significant difference is indicated by the hypothesis test, where the null hypothesis has been accepted. Also, the estimated difference in mean value is only 0.02 kg/m^2, which can be assumed as the same BMI value.

Therefore, the variables for IPAQ-score and counted steps support the assumption of the physical decrease of the physical activity during the lockdown. The body mass index has shown to have no significant change.

In the further analysis, the hypotheses around distributions in counted steps, IPAQ-score and the BMI values for students with different housing conditions (living alone/with peers or with parents) have been tested for both 2019 and 2020 with 95% confidence interval. Contrary to the initial

assumptions,the hypotheses have been rejected for all of the used variables. There have been no significant difference indicated between the case of living with parents and the case of living alone or with peers.
For the hypothesis tests, related to living situation, most of the distributions were skewed from the normal distribution. The reason for such a deviation from normal distribution would possibly be due to only around one hundred data-points per distribution plot, therefore the lack of data-points could have led to this type of a skew.

V. Conclusion

It was demonstrated by the hypothesis testing of the provided data, that while there is indeed a significant decrease in estimated physical activity between 2019 and 2020, which is indicated in the previous studies and is indicated from the data used in this research, the assumption of the lockdown having stronger impact, in form of decreased physical activity, on the students living with parents then on students living alone or with peers, is rejected. Therefore, whether the students live alone, with peers of with their parents does not show to play a significant role in a change in daily physical activity among students, according to the data used.
The performed research can be used for future analysis of the behaviour changes among demographic groups during the lockdown conditions. This research can also be used in the future study of the correlation between the social factors and the physical activity among students and related social groups.

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References

[1] H. Zhu, L. Wei, and P. Niu, "The novel coronavirus outbreak in wuhan, china." *Global health research and policy*, vol. 5, p. 6, 2020. [Online]. Available: https://doi.org/10.1186/s41256-020-00135-6

[2] D. Ding, M. Cheng, and B. del Pozo Cruz, "How covid-19 lockdown and reopening affected daily steps: evidence based on 164,630 person-days of prospectively collected data from shanghai, china." *Int J Behav Nutr Phys Act*, no. 18, 2021. [Online]. Available: https://doi.org/10.1186/s12966-021-01106-x

[3] G. Maltoni, M. Zioutas, G. Deiana, G. B. Biserni, A. Pession, and S. Zucchini, "Adolescent males suffered from reduced physical activity and increased bmi during covid- 19 pandemic," *Nutrition, Metabolism and Cardiovascular Diseases*, 2021. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S093947532100140X

[4] K. M. Di Sebastiano, T. Chulak-Bozzer, L. M. Vanderloo, and G. Faulkner, "Donât walk so close to me: Physical distancing and adult physical activity in canada," *Frontiers in Psychology*, vol. 11, p. 1895, 2020. [Online]. Available: https://www.frontiersin.org/article/10.3389/fpsyg.2020.01895

[5] H. McCarthy, H. W. W. Potts, and A. Fisher, "Physical activity behavior before, during, and after covid-19 restrictions: Longitudinal smartphone-tracking study of adults in the united kingdom," *J Med Internet Res*, vol. 23, no. 2, p. e23701, Feb 2021. [Online]. Available: https://www.jmir.org/2021/2/e23701

[6] R. Cancello, D. Soranna, G. Zambra, A. Zambon, and C. Invitti, "Determinants of the lifestyle changes during covid-19 pandemic in the residents of northern italy," *International Journal of Environmental Research and Public Health*, vol. 17, no. 17, 2020. [Online]. Available: https://www.mdpi.com/1660-4601/17/17/6287

[7] C. Romero-Blanco, J. RodrÃguez-Almagro, M. D. Onieva-Zafra, M. L. Parra-FernÃ¡ndez, M. d. C. Prado-Laguna, and A. HernÃ¡ndez-MartÃnez, "Physical activity and sedentary lifestyle in university students: Changes during confinement due to the covid-19 pandemic," *International Journal of Environmental Research and Public Health*, vol. 17, no. 18, 2020. [Online]. Available: https://www.mdpi.com/1660-4601/17/18/6567

[8] C. Craig, A. Marshall, M. SjÃ¶strÃ¶m, A. Bauman, M. Booth, B. Ainsworth, M. Pratt, U. Ekelund, A. Yngve, J. Sallis, and P. Oja, "International physical activity questionnaire: 12-country reliability and validity," *Med Sci Sports Exerc.*, 2003.

[9] C. Boot, C. Rietmeijer, P. Vonk, and F. Meijman, "Perceived health profiles of dutch university students living with their parents, alone or with peers," *International journal of adolescent medicine and health*, vol. 21, pp. 41–9, 03 2009.

Appendix

A. Matlab Code for Figure 1 and Table 1

```
DataTable = readtable('Data_IER.csv'); % Read the provided table data
stepapp = DataTable(:, [29:35]) % Steps data from smartphone app
stepomron = DataTable(:, [43 47 51 55 59 63 67]) %Steps data from OMRON
ipaq1 = DataTable(:, 19) %IPAQ data prior to measurement
ipaq2 = DataTable(:, 94) %IPAQ data after the measurement
bmi = DataTable(:,4) %BMI data
stepapp = table2array(stepapp) % Changing Tables to arrays to make them
stepomron = table2array(stepomron) % readable for statistical test functions
ipaq1 = table2array(ipaq1)
ipaq1 = ipaq1.'
ipaq2 = table2array(ipaq2)
ipaq2 = ipaq2.'
bmi = table2array(bmi)
bmi = bmi.'
stepappavg = nanmean(stepapp.') %7-day avarage of the App Step Data
stepomronavg = nanmean(stepomron.') %7-day avarage of OMRON Step Data

%Make a reduced table with the relevant variables
relevant = [DataTable(:, [1 2 5]) array2table([stepappavg.' stepomronavg.' ipaq2.' ipaq1.' bmi.'])]

%Make sorted data lists for further analysis
data2019= relevant(1:94,:) % Separate the data from 2019
data2020 = relevant(95:193,:) % Separate the data from 2020
```

```
living2019 = sortrows(data2019,3)    %Sort rows for each year by living situation
living2020 = sortrows(data2020,3)

parents2019 = living2019(1:50,:)     %list of students living with parants in 2019
alonepeers2019 = living2019(51:94,:)%list of students living alone/with peers in 2019
parents2020 = living2020(1:58,:)     %list of students living with parants in 2020
alonepeers2020 = living2020(59:99,:)%list of students living alone/with peers in 2019


%%
%Plot the figure with tesing the hypotheses of the overall decrease from
%before to during the lockdown
figure(1)
%OMRON

u1= table2array(living2019(:,5))
v1 = table2array(living2020(:,5))
group = [ ones(size(v1)); 2 * ones(size(u1))];
subplot(5,1,1);
boxplot([u1; v1],group)
title('a. Overall Steps Distribution OMRON')
set(gca,'XTickLabel',{'2019','2020'})
set(gcf,'color','w');
%THIS BOXPLOT RESEMBLED NORMAL DISTRIBUTION
[h1,p1,ci1,stats1] = ttest2(u1,v1)
meanOMRON19 = mean(u1,'omitnan')
stdOMRON19 = std(u1,'omitnan')
meanOMRON20 = mean(v1,'omitnan')
stdOMRON20 = std(v1,'omitnan')
%APP
u2= table2array(living2019(:,4))
v2 = table2array(living2020(:,4))
group = [ ones(size(v2)); 2 * ones(size(u2))];
subplot(5,1,2);
boxplot([u2; v2],group)
title('b. Overall Steps Distribution APP')
set(gca,'XTickLabel',{'2019','2020'})
set(gcf,'color','w');
%THIS BOXPLOT RESEMBLED NORMAL DISTRIBUTION
[h2,p2,ci2,stats2] = ttest2(u2,v2)
meanAPP19 = mean(u2,'omitnan')
stdAPP19 = std(u2,'omitnan')
meanAPP20 = mean(v2,'omitnan')
stdAPP20 = std(v2,'omitnan')
%IPAQ1
u3= table2array(living2019(:,7))
v3 = table2array(living2020(:,7))
group = [ ones(size(v3)); 2 * ones(size(u3))];
subplot(5,1,3);
boxplot([u3; v3],group)
title('c. Overall Distribution IPAQ1')
set(gca,'XTickLabel',{'2019','2020'})
set(gcf,'color','w');
%THIS BOXPLOT RESEMBLED NORMAL DISTRIBUTION
[h3,p3,ci3,stats3] = ttest2(u3,v3)
meanIPAQ119 = mean(u3,'omitnan')
stdIPAQ119 = std(u3,'omitnan')
meanIPAQ120 = mean(v3,'omitnan')
stdIPAQ120 = std(v3,'omitnan')

%IPAQ2
u4= table2array(living2019(:,6))
v4 = table2array(living2020(:,6))
group = [ ones(size(v4)); 2 * ones(size(u4))];
subplot(5,1,4);
boxplot([u4; v4],group)
title('d. Overall Distribution IPAQ2')
set(gca,'XTickLabel',{'2019','2020'})
set(gcf,'color','w');
%THIS BOXPLOT RESEMBLED NORMAL DISTRIBUTION
[h4,p4,ci4,stats4] = ttest2(u4,v4)
meanIPAQ219 = mean(u4,'omitnan')
stdIPAQ219 = std(u4,'omitnan')
meanIPAQ220 = mean(v4,'omitnan')
stdIPAQ220 = std(v4,'omitnan')

%BMI
u5= table2array(living2019(:,8))
v5 = table2array(living2020(:,8))
group = [ ones(size(v5)); 2 * ones(size(u5))];
subplot(5,1,5);
boxplot([u5; v5],group)
title('d. Overall Distribution BMI')
set(gca,'XTickLabel',{'2019','2020'})
set(gcf,'color','w');
%THIS BOXPLOT RESEMBLED NORMAL DISTRIBUTION
[h5,p5,ci5,stats5] = ttest2(u5,v5)
meanBMI19 = mean(u5,'omitnan')
stdBMI19 = std(u5,'omitnan')
meanBMI20 = mean(v5,'omitnan')
stdBMI20 = std(v5,'omitnan')
```

B. Matlab Code for Figure 2

```
DataTable = readtable('Data_IER.csv'); % Read the provided table data
stepapp = DataTable(:, [29:35])          % Steps data from smartphone app
stepomron = DataTable(:, [43 47 51 55 59 63 67]) %Steps data from OMRON
ipaq1 = DataTable(:, 19)          %IPAQ data prior to measurement
ipaq2 = DataTable(:, 94)          %IPAQ data after the measurement
bmi = DataTable(:,4)              %BMI data
stepapp = table2array(stepapp)     % Changing Tables to arrays to make them
stepomron = table2array(stepomron) % readable for statistical test functions
ipaq1 = table2array(ipaq1)
ipaq1 = ipaq1.'
ipaq2 = table2array(ipaq2)
ipaq2 = ipaq2.'
bmi = table2array(bmi)
bmi = bmi.'
stepappavg = nanmean(stepapp.')     %7-day avarage of the App Step Data
stepomronavg = nanmean(stepomron.') %7-day avarage of OMRON Step Data

%Make a reduced table with the relevant variables
relevant = [DataTable(:, [1 2 5]) array2table([stepappavg.' stepomronavg.' ipaq2.' ipaq1.' bmi.'])]

%Make sorted data lists for further analysis
data2019= relevant(1:94,:)          % Separate the data from 2019
data2020 = relevant(95:193,:)        % Separate the data from 2020
living2019 = sortrows(data2019,3)    %Sort rows for each year by living situation
living2020 = sortrows(data2020,3)

parents2019 = living2019(1:50,:)     %list of students living with parants in 2019
alonepeers2019 = living2019(51:94,:)%list of students living alone/with peers in 2019
parents2020 = living2020(1:58,:)     %list of students living with parants in 2020
alonepeers2020 = living2020(59:99,:)%list of students living alone/with peers in 2019



%%
%Plot the figure with all the boxplots of the hypotheses
%from the research question
%The order is random, as more data has been added later during the research
%The resulting figure gives an orderly representation

%YEAR 2019
%OMRON DATA BOXPLOT

x1= table2array(parents2019(:,5))
y1 = table2array(alonepeers2019(:,5))
group = [ ones(size(x1)); 2 * ones(size(y1))];

figure(2)
subplot(5,2,1);
boxplot([x1; y1],group)
title('a. Steps Distribution OMRON 2019 ')
set(gca,'XTickLabel',{'Living with parents','Living alone/with peers'})
set(gcf,'color','w');
%THIS BOXPLOT RESEMBLED NORMAL DISTRIBUTION
[h1,p1,ci1,stats1] = ttest2(x1,y1)


%%
%APP DATA BOXPLOT
x2= table2array(parents2019(:,4))
y2 = table2array(alonepeers2019(:,4))

%BOXPLOTS
group = [ ones(size(x2)); 2 * ones(size(y2))];

subplot(5,2,3);
boxplot([x2; y2],group)
title('c. Steps Distribution App 2019 ')
set(gca,'XTickLabel',{'Living with parents','Living alone/with peers'})
set(gcf,'color','w');

%Omron Stepcount value test 2019 pars alone
[h2,p2,ci2,stats2] = ttest2(x2,y2)

%%
%IPAQ2 DATA 2019
x3= table2array(parents2019(:,6))
y3 = table2array(alonepeers2019(:,6))
```

```
group = [ ones(size(x3)); 2 * ones(size(y3))];

subplot(5,2,7);
boxplot([x3; y3],group)
title('g. IPAQ2 Score Distribution 2019')
set(gca,'XTickLabel',{'Living with parents','Living alone/with peers'})
set(gcf,'color','w');
%ipaq2 value test 2019 and 2020
%BOXPLOT SKEWED FROM NORMAL DISTRIBUTION
MEANparentsipaq2mean2019 = nanmean(x3)
MEANaloneipaq2mean2019 = nanmean(y3)
[p3,h3,stats3] = ranksum(x3,y3)


%%
%IPAQ1 2019
x7= table2array(parents2019(:,7))
y7 = table2array(alonepeers2019(:,7))

group = [ ones(size(x7)); 2 * ones(size(y7))];

subplot(5,2,5);
boxplot([x7; y7],group)
title('e. IPAQ1 Score Distribution 2019')
set(gca,'XTickLabel',{'Living with parents','Living alone/with peers'})
set(gcf,'color','w');
%ipaq2 value test 2019 and 2020
MEANparentsipaq1mean2019 = nanmean(x7)
MEANaloneipaq1mean2019 = nanmean(y7)
[p7,h7,stats7] = ranksum(x7,y7)

%%
%YEAR 2020
%Smartphone App Steps 2020

x4= table2array(parents2020(:,5))
y4 = table2array(alonepeers2020(:,5))


group = [ ones(size(x4)); 2 * ones(size(y4))];

subplot(5,2,4);
boxplot([x4; y4],group)
title('d. Steps Distribution OMRON 2020')
set(gca,'XTickLabel',{'Living with parents','Living alone/with peers'})
set(gcf,'color','w');

% NO NORMAL DISTIBUTION FROM BOXPLOT
[p4,h4,stats4] = ranksum(x4,y4)


%%
% OMRON STEPS 2020
x5= table2array(parents2020(:,4))
y5 = table2array(alonepeers2020(:,4))

group = [ ones(size(x5)); 2 * ones(size(y5))];

subplot(5,2,2);
boxplot([x5; y5],group)
title('b. Steps Distribution App 2020')
set(gca,'XTickLabel',{'Living with parents','Living alone/with peers'})
set(gcf,'color','w');

%NO NORMAL DISTIBUTION FROM BOXPLOT
[p5,h5,stats5] = ranksum(x5,y5)
%%

%IPAQ2 Distribution 2020
x6= table2array(parents2020(:,6))
y6 = table2array(alonepeers2020(:,6))
group = [ ones(size(x6)); 2 * ones(size(y6))];

subplot(5,2,8);
boxplot([x6; y6],group)
title('h. IPAQ2 Score Distribution 2020')
set(gca,'XTickLabel',{'Living with parents','Living alone/with peers'})
set(gcf,'color','w');

YYYparentsipaq2mean2020 = nanmean(x6)
YYYaloneipaq2mean2020 = nanmean(y6)
[p6,h6,stats6] = ranksum(x6,y6)

%%
%IPAQ1 Distribution 2020
x8 = table2array(parents2020(:,7))
y8 = table2array(alonepeers2020(:,7))
group = [ ones(size(x8)); 2 * ones(size(y8))];

subplot(5,2,6);
boxplot([x8; y8],group)
title('f. IPAQ1 Score Distribution 2020')
set(gca,'XTickLabel',{'Living with parents','Living alone/with peers'})
set(gcf,'color','w');

IPAQ1parentsmean2020 = nanmean(x8)
IPAQ1alonemean2020 = nanmean(y8)
[p8,h8,stats8] = ranksum(x8,y8)
```

```
%BMI Distribution 2020
x9 = table2array(parents2020(:,8))
y9 = table2array(alonepeers2020(:,8))
group = [ ones(size(x9)); 2 * ones(size(
    y9))];

subplot(5,2,10);
boxplot([x9; y9],group)
title('j. BMI Score Distribution 2020 ')
set(gca,'XTickLabel',{'Living with
    parents','Living alone/with peers'})
set(gcf,'color','w');

MEANparentsipaq2mean2020 = nanmean(x9)
MEANaloneipaq2mean2020 = nanmean(y9)
[p9,h9,stats9] = ranksum(x9,y9)

%bmi Distribution 2019
x10 = table2array(parents2019(:,8))
y10 = table2array(alonepeers2019(:,8))
group = [ ones(size(x10)); 2 * ones(size(
    y10))];

subplot(5,2,9);
boxplot([x10; y10],group)
title('i. BMI Score Distribution 2019 ')
set(gca,'XTickLabel',{'Living with
    parents','Living alone/with peers'})
set(gcf,'color','w');

MEANparentsipaq2mean2020 = nanmean(x10)
MEANaloneipaq2mean2020 = nanmean(y10)
[p10,h10,stats10] = ranksum(x10,y10)

%%
%Comparing years
```