Analysis of the Behavior of Breathable Particulate Matter in University Bike Users in Route OverEngativa, Bogota.

Sonia Menesses[1], Christian Alarcon[2], Rodrigo Infante[3], María Fernanda Albornoz[4]
[1]*Libre University MasterIndustrial Engineering, Faculty of Engineering Department of Industrial Engineering, Colombia.*
[2]*Libre University Industrial Engineering, Faculty of Engineering Department of Industrial Engineering, Colombia.*
[3]*Libre University Industrial Engineering, Faculty of Engineering Department of Industrial Engineering, Colombia.*
[4] *Libre University Industrial Engineering, Faculty of Engineering Department of Industrial Engineering, Colombia.*
Corresponding Author: Sonia Meneses.

ABSTRACT
Bicycle is one of the means of transportation that provides the most significant benefits for human life quality such as economic savings, physical activity and in a city like Bogotá that has a high vehicular flow, time saving. Due to those reasons many citizens choose to use bicycle. However, bicycling as an activity is exposed to the air pollution, this has brought negative aspects for the health of the population, causing premature deaths, cardiovascular and respiratory diseases. When seeing this problem, it was necessary to investigate what is the breathable dose that a user bike can receive on its journey, this experiment was carried out specifically with the Universidad Libre students on the route they use most frequently, in times with high vehicular traffic called "rush hours", taking daily samples with a specialized gear (GilAir3) during six months, under the NIOSH 600 standard, which indicates that a person cannot exceed 5µg per cubic meter. For this, it was considered that the experiment was carried out under uncontrolled environmental aspects (variables), such as temperature, humidity, wind speed, wind direction, running time, and atmospheric pressure. Once the data was obtained, it was processed in R (statistical software) to statistically analyze the problem, the results show a relationship between the variables determining that the ones that influences are atmospheric pressure and the cyclist journey duration, to finally conclude that this route does not present risks to the health of cyclists.
Key words
Bike path, Bike users, Breathable dose, Data analysis, Particulate matter (PM), R software.

Date of Submission: 10-07-2020 Date of acceptance: 26-07-2020

I. INTRODUCTION

In Bogota 880.367 out of 13.359.728 people move daily using bicycle as a mean of transportation, figures obtained from the mobility department (2019), considering the hours of greatest mobility called "rush hours" that are from 4:00 a.m. to 8:00 a.m. where is evident that the vehicular flow increases and therefore more particulate matter is produced, this study was conducted in order to determine the amount of breathable daily dose that a "bike user" receives during their journey, specifically the *Universidad Libre´s* bike users.
Particulate matter is defined by Mészáros, 1999, as the set of solid and/or liquid particles except for the pure water present in suspension in the atmosphere. In this research, the particulate matter is studied as the breathable dose that is defined as the amount of solid and liquid particles that a person can breathe-in during a certain period. When these particles invade the environment, the air quality drops, which indicates that is an aggravating factor in the worker's health, in this case student's health, due to the continuous exposure and doses out of the limits of the WHO guideline jeopardizes student's well-being and health. WHO, 2005. On the particulate matter measurement scale, the most frequent in cities like *Bogotá* is the PM10 (Parts per million, measured in microns). These particles are less than 10 microns in size, caused by industrial activities, volcanic emissions, fires, etc., these particles are easily recognizable since they are identified as a dust in the

environment, Falagan. M, 2001. In parts of the city such as highways, main streets, areas where industries are crowded the most common particulate matter is the PM2.5 which is caused by combustion generally from diesel engines and are fine particles or also called ultrafine, not noticeable to the naked eye, these demonstrate a stronger association of risk factors for health. In Bogotá, PM2.5 constitutes up to 90% of PM10, that is, of the total particles of parts per million taken, 90% corresponds to 2.5. Rojas &Galvis. According to the WHO (World Health Organization), these particles cause cardiovascular and respiratory diseases, generating a high risk for the population, especially the population that mobilizes daily.

The aforementioned diseases represent a health risk in people, therefore, this research focuses on industrial hygiene, which is defined as the science of anticipating, identifying, evaluating and controlling risks that originate in or in relation to the workplace and that may endanger the health and well-being of workers. Robert F, 2012. Industrial hygiene is of great importance in this research because it helps to determine if the chosen route represents a health risk for the bike users in terms of the breathable dose of particulate matter, for this reason the practice of this science attends to the importance of anticipating and preventing all kinds of health risks, providing resolution against exposure assessment.

Colombia works under risk management systems, there are several companies that are dedicated to the study of the work environment of a specific job to determine the risk conditions in which individuals work, an example of this is the SGS company, which helps determine risk limitation, streamline processes and operate in a more sustainable way. Taken from the Official Website: SGS, 2020. Another company dedicated to industrial hygiene is prevencionar.com.co which guides organizations to develop their processes with good practices, measuring the risk of the work area to minimize hazards in a work environment; however, all of that is adapted to a specific job, under controlled environmental conditions; In this research, an industrial hygiene study is carried out under uncontrolled environmental conditions such as temperature, humidity, pressure, direction and wind speed, considering that the breathable dose of the particulate matter to which the bike user is frequently exposed is measured. In Colombia, very few studies have been carried out that show the relationship between mobility by bicycle and the exposure of particulate matter on its routes, which affect and put at risk the health of the “bike user”.

The investigations that have been carried out are based on data from the measurement of the environmental particulate matter, however there is no breathable dose, an evidence of this is the *EAN University*. Franco, Segura & Mura, 2016., which investigated the health damage generated by particles found in the environment, that is to say, particles from mobile emission sources such as vehicles that use diesel fuel. On the other hand, *The National University* determined the statistical correlation between the levels of particulate matter in the air with the findings in the lung function of people who perform physical activity in the air using the bicycle in the city of Bogotá, in the neighborhood of Kennedy, Cortes Sergio, 2018. Finally, *The Francisco Jose de Caldas District University* carried out a project along the 7^{th} Avenue, that is one of the streets in Bogotá that has a high vehicular flow as well as bike paths, which is why they decided to study the behavior of particulate matter in this area and how it affects people who frequently travel this corridor, Torres, C & Galindo O, 2017.

Considering the previous studies, the complexity of the experiment is demonstrated since the sampling is carried out under uncontrolled conditions in an open space, during the bike ride. Another aspect that stands out from this experiment is that the breathable dose of the bicycle users on a given route is measured, with the sampling being done over a period of 6 months.

In the measurement there were 2 key aspects to parameterize the experiment, which were the hour with the highest flow of users to the university and the route most passed by the cyclists to reach the university in that hour, as a result the hour with the highest flow of users to the university is 7 am, due to the massive entrance of students and one of the most passed routes by the cyclists at this time is (Carrera 96- Calle 63- Av Boyacá cll 63-53- Universidad Libresedebosque) to arrive, with this the study route is parameterized, with an approximate length of 4 kilometers (2. 51 miles) of travel, this route is coupled to the use of exclusive lanes for bicycles except for the section "calle 53- universidadlibre" where the road is shared with vehicles; the information was taken from a survey conducted within the institution by Jiménez Castro, J., DíazAnacona, T., &MenesesVeloza, S., 2017 (see figure 1).

Figure 1: Route to study source: google maps

Breathable particulate matter was obtained by measuring the respirable dose, which is provided by equipment that simulates the average breathing of a person, collecting the particles to which an individual is exposed. In order to determine the dose of particulate matter to which a cyclist is exposed, a sampling pump (GIL- AIR 3) was used, parameterized based on the international standard NIOSH 0600, which explains how to collect total particulate matter in samples.

II. METHODOLOGY

Preparation of filters and equipment

In order to obtain the samples, first the PVC filters (which retain the particles) and filter holders were prepared from the cassette, leaving them separately in individual sachets in a dryer with silica gel ($SiO2$), this gel removes the humidity from the filter and the filter holder, after 24 hours inside the dryer, they were passed to a 6-digit scale, where the initial weight of the filter was obtained and recorded in a log, after which a 3-part cassette with the PVC filter and a filter holder must be assembled (see figure 2), then connected to a cyclone, the effect of the cyclone separates the heavy particles from the fine ones by the action of centrifugal force, housing the particles smaller than 10 micrograms per cubic meter in the filter, in this way the samples of the experiment can be obtained (this hose should be as close as possible to the airways), finally the hose should be connected to the cyclone and the cassette to the equipment (sampling pump), this should be calibrated before the measurement with a flow of 2 liters per minute to start collecting the sample.

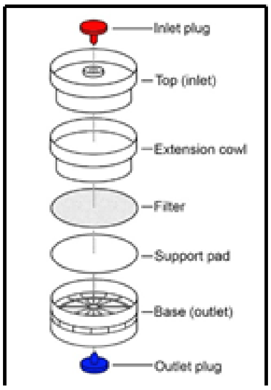


Figure 2. Cassette with filter, Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6101061/figure/F1/

Sample definition

The sample of particulate matter to be collected is total breathable particulate matter, due to the suction action of the sampling pump (2liters per minute) and the effect of the centrifugal force of the cyclone, allow to obtain the particulate material breathed by a user bike on the route of study, these samples were collected only if the following conditions were met:

- Day between Monday and Friday not including holidays.
- Dry weather, no rain.
- Daytime, between 6 and 7 in the morning.
- The tour should last about 45 minutes.

Physical-sample drawing in the field

For the collection of the samples in the field, the route began at approximately 6:20 am at the starting point (carrera 96 - calle 63), before starting the route the equipment was placed on the body (see figure 3), leaving the sampling pump in a backpack and the cyclone as close as possible to the airways, ending the route after 7 am the sampling pump is turned off, separating the cassettes so that the particulate material obtained is perpendicular to the ground, after this they are taken to the laboratory for storage.

Figure 3. Assembly process of equipment to take samples in the field, source: Made by the author.

Each route had to keep a logbook, in which the variables that can influence the concentration of particulate matter are recorded, these variables are wind direction, wind speed, humidity, temperature and air pressure, in turn recorded the time of start and end of the tour.

In total, 70 samples were collected for each participant. These cassettes had to be kept vertically to keep the particulate material in the PVC filter, were disassembled after 12 hours of storage and then deposited in a dryer filled with silica gel ($SiO2$), This is to remove the humidity lodged in the filter during the journey, the filter had to remain inside the dryer for 24 hours, finally the filter was weighed on a 6-digit scale in order to obtain the amount of particulate material collected that day, this concentration is also recorded in the logbook along with the other variables.

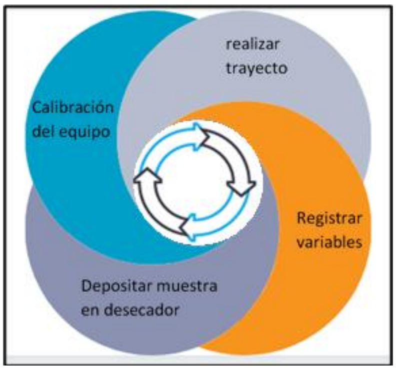


Figure 4. Process of obtaining the samples, source: made by the author

The concentrations recorded in the experiment log are compared with the "threshold limit value" (TLV) which is the maximum allowable concentration value to which a person may be exposed, this "TLV" according to NIOSH 0600 is 5 micrograms per cubic meter, the concentrations obtained from the samples in each run showed that none of the samples exceeds the "TLV" specified in NIOSH 0600 (see Figure 5) which indicates that the population running along the route (under the conditions of the experiment) is not at risk.

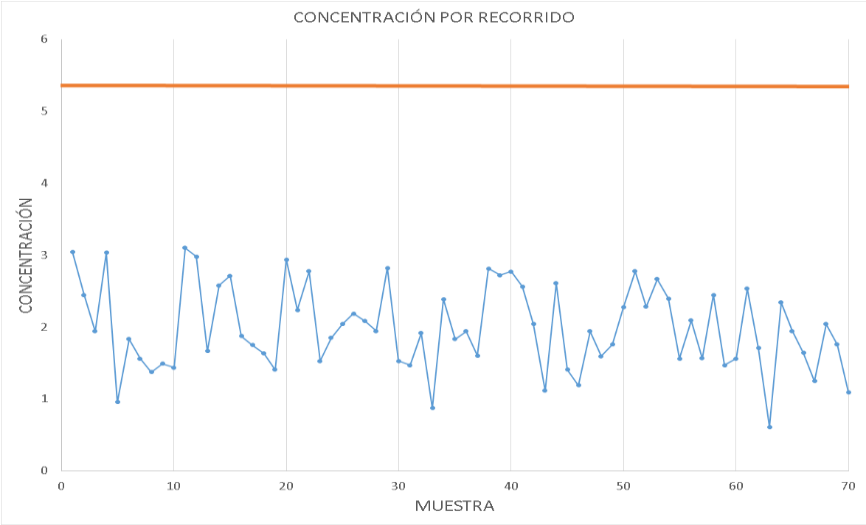


Figure 5. Concentration by route, made by the author

III. RESULTS AND DISCUSSION

Once the concentrations were obtained together with the variables, the average concentration of the total sampling period was determined (see Figure 4) and the weighted average concentration referred to 8 hours "ED" (Figure 5), being the latter the average concentration of the chemical agent in the worker's breathing zone, in this case students, measured or calculated in a weighted way with respect to the time of the real working day or referred to a standard 8-hour day. Falagan J, 2005. In order to have all the necessary data of the experiment to be treated later in the software R, the obtained values were registered in the logbook.

$$C_i = \frac{\sum C_i * t_i}{\sum t_i}$$

Formula 1. Time-weighted average concentration for the sampling period, Source: Falagán J. 2005

Being: "C_i" Concentration per route
"t_i" Travel time in hours

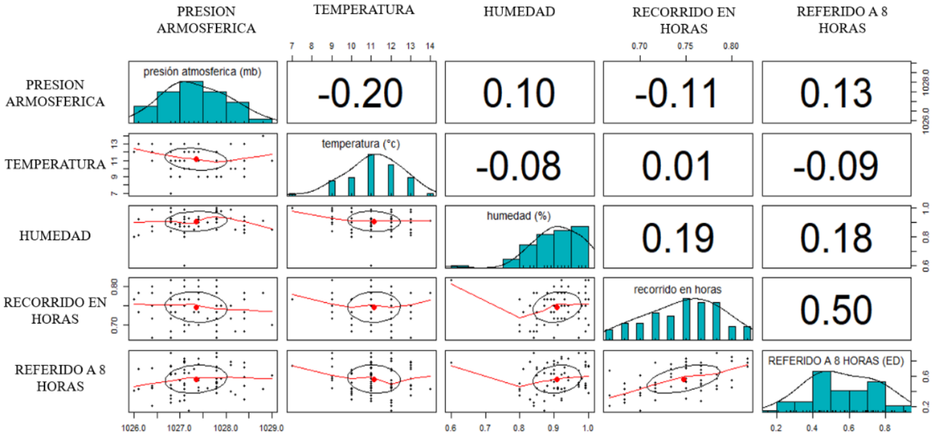
$$ED = C_i * \frac{T}{8} \qquad T = Total\ sampling\ time$$

Formula 2. Daily exposure, Source: Falagan J. 2005

Being:"C_i" i-th concentration
"T" exposure time, in hours, associated with each valor "C_i"

After collecting the data on the route, the data is processed and then analyzed. In the first instance it is used in software R since this allows us to quickly visualize and apply statistical tests as required. The first step is the correlation of spearman, the method of pearson is not used because being Spearman a non-parametric technique is free of probabilistic distribution (Luis f Restrepo,2017).

Table 1: linear correlation table between source variables: made by the author



In the graph (table 1) we can observe the strength and importance of the variables. We find that the variables that show more strength and a positive linear direction are "traveled in hours and referred to 8 hours" with a moderately linear relation equal to 5. We will convert it into a "dummy" variable that takes values between 0 and 1, but it will be considered.

To be able to prove that the relationships are statistically significant we must perform a test of normality in our response variable which from now on will be the variable "referred to 8 (ED)" is chosen because it presents a greater relationship of force previously. We carry out a QQ-PLOT test and its histogram (see Figure 6). Where we can easily check if this has normality in the residues this is done in order to check if the data are asymmetric or include outliers.

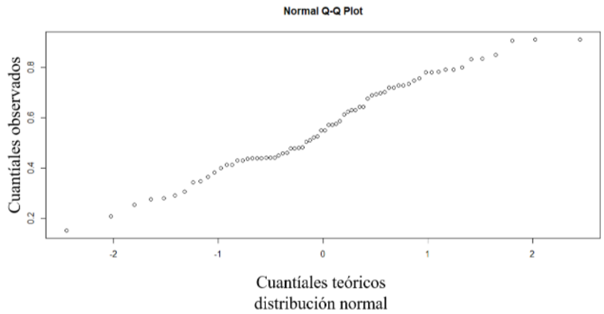


Figure 6. Normal QQ-PLOT, source made by the author

The graph complies with the assumption that the line is diagonal approaching 45 degrees and that there are outliers at the end of the curve (see figure 7).

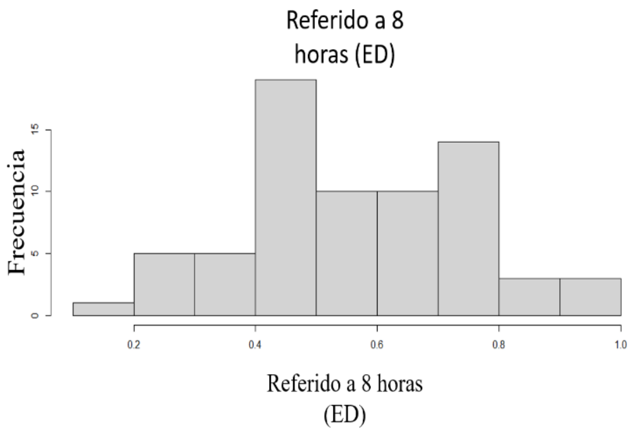


Figure 7: Histogram of normality, source: made by the author

When observing the histogram we can see that the residues are similar to the distribution of the normal that we had already noticed in the previous QQ-PLOT the outliers fit in the quartiles therefore we happened to make the multiple linear regression to evaluate the influence that have the predictors that is our set of independent variables is possible to clarify that the calculations made were used the tool R.

$$Y_i = (\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_n X_{ni}) + e_i$$

Formula 3: multiple linear regression. Source: JoaquínAmat, 2016.

β0: is the ordinate at the origin, the value of the dependent variable YY when all predictors are zero
βi: is the average effect that the increase in one unit of the predictor variable XiXi has on the dependent variable YY, with the rest of the variables remaining constant. They are known as partial regression coefficients.

Yi: referred to 8 hours
(X1, X2, X3, X4):travel in hours, humidity, temperature, atmospheric pressure (independent variables)
When performing the regression, we obtain 12 parameters associated to variables where 8 of these are associated to the wind direction variable since being a categorical variable with 9 categories this is transformed into 8 parameters (dummy variable). We can observe that we obtain an adjusted R of 25.12%, although it is a low R. It should be clarified that this shows us a low relationship between the variables, but that it exists. It will not be useful for us to be able to use this model as a predictive model, In order to determine which variables can be added to the previous relationship, the goodness of fit of the statistical model is determined, that is to say, commonly speaking, about the accuracy and complexity of the model. We use R to perform the operations (see formula 4).

$$AICc = AIC + \frac{2k(k+1)}{N-k-1} = \frac{2 \times N \times k}{N-k-1} - 2 \times \ln(L)$$

N: is the sample size
K: model parameter numbers
Formula 4: Formula AIC model. source: JoaquínAmat, 2016

As we can see we start using all the variables starting with an AIC= 245.3, then we calculate all the possible AIC by removing each of the existing variables looking to select the variable that provides a lower AIC. Once selected we repeat this same process until there is a minor change in the AIC, as a final model we include as variables the atmospheric pressure and the travel in hours to explain our response variable that we remember is "referred to 8 hours (ED)", See (table 2).

Table 2: AIC software R script, source: made by the author

```
Step:  AIC=-257.96
`REFERIDO A 8 HORAS (ED)` ~ `presión atmosferica (mb)` + `recorrido en horas`

                             Df Sum of Sq    RSS     AIC
<none>                                    1.6122 -257.96
- `presión atmosferica (mb)`  1   0.08016 1.6924 -256.57
- `recorrido en horas`        1   0.69866 2.3108 -234.76

Call:
lm(formula = `REFERIDO A 8 HORAS (ED)` ~ `presión atmosferica (mb)` +
    `recorrido en horas`, data = bitacora_experimento)

Coefficients:
              (Intercept)  `presión atmosferica (mb)`       `recorrido en horas`
                -53.80512                     0.05107                    2.54960
```

After obtaining the variables that are most related to our response variable (see table 4), we go on to evaluate the 3 conditions of the model in which the residues are evaluated and when these are not met they do not have quality criteria that are assumed to be normality, homogeneity and the independence of the data.

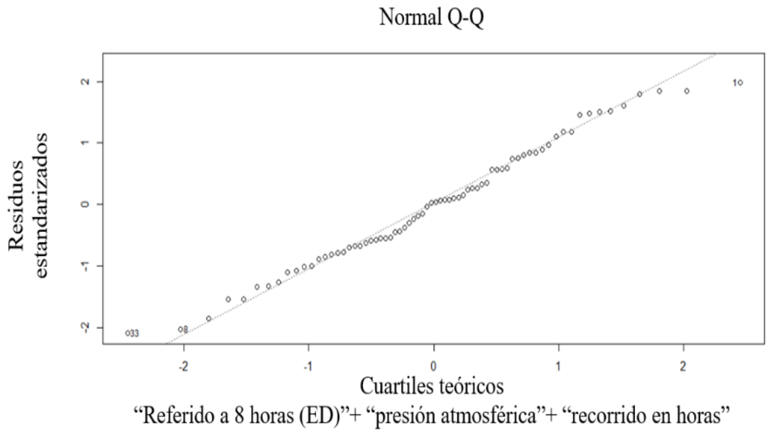


Figure 8: Normal QQ-PLOT, Source: made by the author

In the QQ-PLOT graph, we can observe a behavior of the residues where they are at 45 degrees and in a straight line we obtain again some atypical data at the beginning and at the end of the tail, we go on to observe the quartiles in the histogram to verify that it complies with the shape of the normal graph.

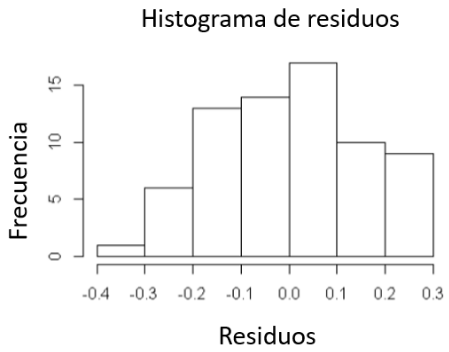


Figure 9. Histogram of residues, Source made by the author

Normality is initially verified graphically with the QQ-plot (see figure 8) and the histogram (see figure 9), the QQ- in the case of the histogram we see that it is close to a normal distribution. In addition, a Kolmogorov-Smirnov test is performed. This test is taken because more than 50 data were taken, there is another test called Shapiro Wilk but only up to 50 data are used, this to test the hypothesis that the residues are normally distributed.

$$D = \max_{1 \leq j \leq n} \left\{ \frac{j}{n} - F(y_{(j)}),\ F(y_{(j)}) - \frac{j-1}{n} \right\}$$

Formula 5: Kolmogorov-Smirnov's Formula, Patricia Kisbye.2010

P value < α H0 is rejected
P value > α H0 is not rejected

Given the p value of 0.8415, this hypothesis is not rejected. A Durbin-Watson test was performed (see formula 6) to evaluate if there is an autocorrelation in the linear regression, this in order to know if the values present a dependency in terms of the order of obtaining, it is sought that the n-1 residue is not related to the n residue (detect if there is the presence of autocorrelation in the residues of a regression analysis).

$$H_0 = \ p = 0$$

$$H_1 = \ p \neq 0$$

$$d = \frac{\sum_{t=2}^{T} (e_t - e_{t+1})^2}{\sum_{t=1}^{T} e_t^2}$$

Formula 6. Durbin-Watson's statistical formula interpretation,Source: Lopéz M. 1994

Where: H0 the autocorrelation is zero
H1 Non-zero autocorrelation
e1 Waste in time t

When we carry out the Durbin-Watson test we obtain a value of d=1.8685 and a p- value=0.2839, giving as an answer that the null hypothesis is rejected, that is, there is no autocorrelation in the data, this indicates that it meets the conditions of data independence.
Finally, a Breusch-Pagan test was carried out to find out if the residues should have a constant variance so that they do not change. When the test is finished, it confirms that the residues are homoscedastic, which means that the model variance vs. the independent variables remains constant. (See formula 6)

$$BP \ = n \ * R_{aux}^2 \sim X_{s-1}^2$$

Formula 7. Interpretation of Breush-Pagan's statistical formula, Source: University Complutense Madrid. Mauritius A. 2013. Multiple Linear Regression II.

n = Number of data
R_{Aux}^2 = Regression determination coefficient
X_{s-1}^2 = Square Chi with s degrees of freedom
A T-student test is performed to test the concentration limit hypothesis (see formula 8). This formula was described by William S. Gosset (1908).

$$t = \frac{X - \ \mu}{s/\sqrt{n}}$$

Formula 8. Representation of T-student formula, William S. Gosset (1908).

µ= average of the population: In this case we take 5 as the exposure limit
X=average data distribution
S=Standard error.
n= sample size, in this case we have 69 data because the formula is n-1

We find that the p-value < 2.2e-16 alternative hypothesis is true because it is less than 5 and the significance level is 5% this significance level is chosen according to the quality factor of the test where the probability interval would be 95%. In the linear regression model there is a relationship between the atmospheric pressure and the time traveled in hours, with our concentration referred to 8 hours which is our response variable. The relationship between the variables is directly proportional, the concentration referred to 8 hours is increased by one unit for every 0.05107 units of change in atmospheric pressure or for every 2.54960 overtime hours traveled. The atmospheric pressure, although it has a degree of correlation, does not have a great influence on the low concentrations of PM2.5 inhaled during the trip. In other words, the route is safe for free university cyclists in the course of the morning.

IV. CONCLUSIONS

The present investigation shows the importance of studying the behavior of the particulate matter that the bike users of the free university breathe daily, focused on the breathable dose, this in order to verify if one of the main routes of access by bicycle to the university presents risks for the health of its passers-by.

The main challenge when initiating this investigation in the first instance was the collection of data since when observing studies one notices the insufficiency in the sampling issue, referring to few samples and alarming results of the same, it was possible to determine with this study when making a significant sample collection (more than 50 samples), as an observation the samples collected were only made in days that did not have rain because the equipment could get to present/display damages, the route significantly influences the risk of exposure, more variables must be taken into account than the environmental variables, this in order to perhaps be able to predict the amount of particulate matter that the user may breathe as a result of the previous analysis that determines a relationship between the variables but not a predictable form that can be applied to another route.

To the satisfaction of the members of the *Universidad Libre* who travel this route, it is concluded that it is safe for their health, that is to say, that the route studied does not present any risk since it does not exceed 5µg m3, according to the NIOSH 600 standard.

In the branch of industrial hygiene it had a great incidence for future investigations because it was determined the level of risk faced by *Universidad Libre* bike users on a specific route under uncontrolled conditions, this contributes greatly to take other routes that are highly transited and investigate the level of risk to exposure of particulate material in respirable doses.

Within the linear regression, two variables were highlighted: atmospheric pressure and travel in hours. The model shows a level of 10% significance and taking into account that the relationship between the variables is directly proportional, in other words, it increases by one unit of the concentration referred to 8 hours for every 0.05107 units in atmospheric pressure or for every 2.54960 overtime hours traveled, it should be noted that atmospheric pressure does not have a great influence because PM2.5 is present in low concentrations that are inhaled during travel.

REFERENCES

[1]. Mészáros, E. (1999). Fundamentals of Atmospheric Aerosol Chemistry. AkadémiaiKiado.

[2]. Organización Mundial de la Salud. (2005). Guías de Calidad del Aire de la OMS Relativas al material Particulado, el ozono, el dióxido de nitrógeno y el dióxido de Azufre. (OMS)

[3]. Falagán, J. (2001). Higiene Industrial Aplicada.

[4]. Rojas & Galvis (2005). Relación entre PM2.5 y PM10 en la ciudad de Bogotá. Revista de ingeniería, (22), p.55.

[5]. Robert F. (2012). Enciclopedia de Salud y seguridad en el trabajo Higiene Industrial.

[6]. SGS Higiene industrial y ocupacional (2020), https://www.sgs.co/es-es/health-safety/quality-health-safety-and-environment/health-and-safety/occupational-and-industrial-hygiene

[7]. Prevencionar.com.co (2020), http://prevencionar.com.co/

[8]. Secretaria de distrital de movilidad. (2019), https://www.movilidadbogota.gov.co/files/paginas/22-04-2020/20191216_presentacion_encueta_v2.pdf

[9]. DANE,(2012).https://www.dane.gov.co/files/images/eventos/ods/presentaciones/Prosperidad/4-tasa-de-mortalidad-atribuida-a-contaminación-atmosférica.pdf

[10]. Juan F. Franco, Julián F. Segura e Ivan Mura. (2016). Air Pollution alongside Bike-Paths in Bogotá-Colombia. Universidad EAN.

[11]. Cortes Sergio, (2018). Material particulado en el aire y su correlación con la función pulmonar en personas que realizan actividad física en la cicloruta en la localidad kennedy en Bogotá: estudio descriptivo transversal. Universidad Nacional de Colombia.

[12]. Torres, C & Galindo O. (2017). Comportamiento del material particulado y su incidencia en los usuarios de la ciclovía recreativa de la carrera séptima en Bogotá D.C. Universidad Distrital Francisco José de Caldas de Colombia.

[13]. Jiménez Castro, J., Díaz Anacona, T., & Meneses Veloza, S. (2017). Caracterización de los riesgos de movilidad en bicicleta en una institución de educación superior en la localidad de Engativá. AVANCES: Investigación en Ingeniería, 14, 46-61. doi.org/10.18041/1794-4953/avances.1.1282.

[14]. Lopéz, M. (1994). Especialidad en Métodos estadísticos “Análisis de Residuales en regresión”, p. 15.

[15]. Juan Vicente G. (2017). Modelización y estadística en biología.https://jgrubalcaba.wordpress.com/autor/ jgrupalcaba/

[16]. Falagán J. (2005). Higiene Industrial Aplicada “Ampliada”.

[17]. Joaquín Amat Rodrigo, 2016, Introducción a la regresión lineal múltiple, p.2.

[18]. Mohamad,2016 Apendice B Criterio de informacion Akaike AIC), https://support.numxl.com/hc/es/articles/215531083-Apéndice-B-Criterio-de-Información-Akaike-AIC-

[19]. Mauricio, J. (2013). Regresión Lineal Múltiple.

[20]. William S. Gosset (1908). The probable error of a mean.

[21]. Patricia Kisbye,2010, test de Kolmogórov Smirnov, famat, p. 8.https://www.famaf.unc.edu.ar/~kisbye/mys/clase17_pr.pdf

Sonia Meneses., et. al." Analysis of the Behavior of Breathable Particulate Matter in University Bike Users in Route OverEngativa, Bogota." *International Journal of Computational Engineering Research (IJCER*), vol. 10, no.6, 2020, pp 41-50.