

Gorelax: A User-Ergonomically Designed Backpack for Stress Prone Millennials in the Philippines

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Abstract

In the Philippines, Generation Y or called “millennials” dominate the population as it constitutes 60% of it. Millennials are most likely to experience the highest stress level which grew by 36% in 2012. Further assessment shows that Millennials share the highest percentage as they account for 75% of the workforce. With this, employee’s absenteeism and productivity were largely affected and in return, it yields to an estimated cost to an employer of \$300B annually. With an aim to relieve stress caused by different variables, researchers formulate an ergonomically designed product which intends to deal and cope up with chronic stress. After a keen assessment which was based on 120 random samples, it is found in the normal distribution that the average height of Asian men is 162-164cm while Asian women with 150-153cm through the aid of anthropometry principle. The recommendation presented in this research is an ergonomic design backpack which has an intention to promote relaxation through massage support system more particularly dealing with pressure points of the human body, thus reducing stress level and help person function effectively and efficiently in any way possible.

Keywords

Backpack, Work Stress, Back pressure points, millennials, ergonomics

1. Introduction

Population is vastly increasing among Asian countries and millennials (people born between early 1980’s, mid-1990 and early 2000’s) dominate as it constitutes a quarter of Asia’s population, which is approximately 60% of the world population [1]. In addition, the United States Bureau of Labor predicts that by the year 2030, the tech-savvy generation will constitute 75% of the workforce. [2] Also, according to the 2015 survey conducted by PSA, it lies that almost half of labor force population of the Philippines were millennials [3] These people belong to different group of consumers comprising of diverse customer segments which varies depending on the industry, location and culture they belong to [4] It is also evident that these people rank the highest percentage of work martyrs due to strenuous work, working long hours and minimal vacation leaves. Over the years, further studies show that millennials experience the highest stress levels as compared to other generations in the working force, evident with an increased rate of 36%. [5]

Based on a recent survey conducted by ComPsych, work stress experienced by these people is shown to be attributable to the heavy workload (36%), people issues (31%), work-life balance (20%), and job security (8%). [6] These stress-occurring reasons leading to occupational stress is associated with effects on labor absenteeism, health-related concerns (ie. low back pain), and low worker productivity which may result to an estimated company profit loss of US\$300 billion annually. [7] With occupational stress seems to be prevalent, it greatly affects humans physically and psychologically as it directly brings impact on their health, well-being, and relationships towards others. People

experiencing this, feel a lower sense of morale, the dissatisfaction of job, moods variation and more likely to develop serious health conditions (e.g headaches, anxiety, depression, muscular aches/pains, etc.) as a result. [8] Heavy work demands, repeated rotation of trunk, a task which requires lifting/lowering, pushing/pulling, holding and carrying heavy objects seem to be highly correlated with a high risk of back pain occurrence. [9] An article published states that thirty-five percent (35%) or around 30, 000 of 85,483 occupational diseases reported in companies with at least twenty (20) workers was the occurrence of back pain. [10] With the occurrence of a heavy workload at work, the prevalence of back pain seems to be persistent. Low back pain is considered as common pain among workers as it places significant demands on the back and makes a certain person hard to concentrate in an individually assigned job. Low back pain is prevalent with workers as its prevalence rate is 35.8% and with the lifetime prevalence rate of 63.9%. [11] As the amount of work is an issue, prevalence rate tends to increase, which in return leads to potential health conditions whether physically and psychologically and do bring negative impact to the environment, millennials are moving and working on. Indeed, continuing stress generally affects the human body physically, thoughts, feelings, and behavior towards something.

In order to reduce the stress level experienced by the millennial workforce, it is a must to assess what greatly affects them physically which leads to experience chronic stress and consequently develop an ergonomic product which intends to promote the reduction of pain, enabling muscle relaxation and improve both moods and quality of sleep of a person. The study will limit its focus on the reduction of stress level among millennial workforce generation in the Philippines. Stress-related tips and stress management will not be tackled out in this study. Hence, reduction of stress level and improvement of user's feeling will mostly take part.

2. Literature Review

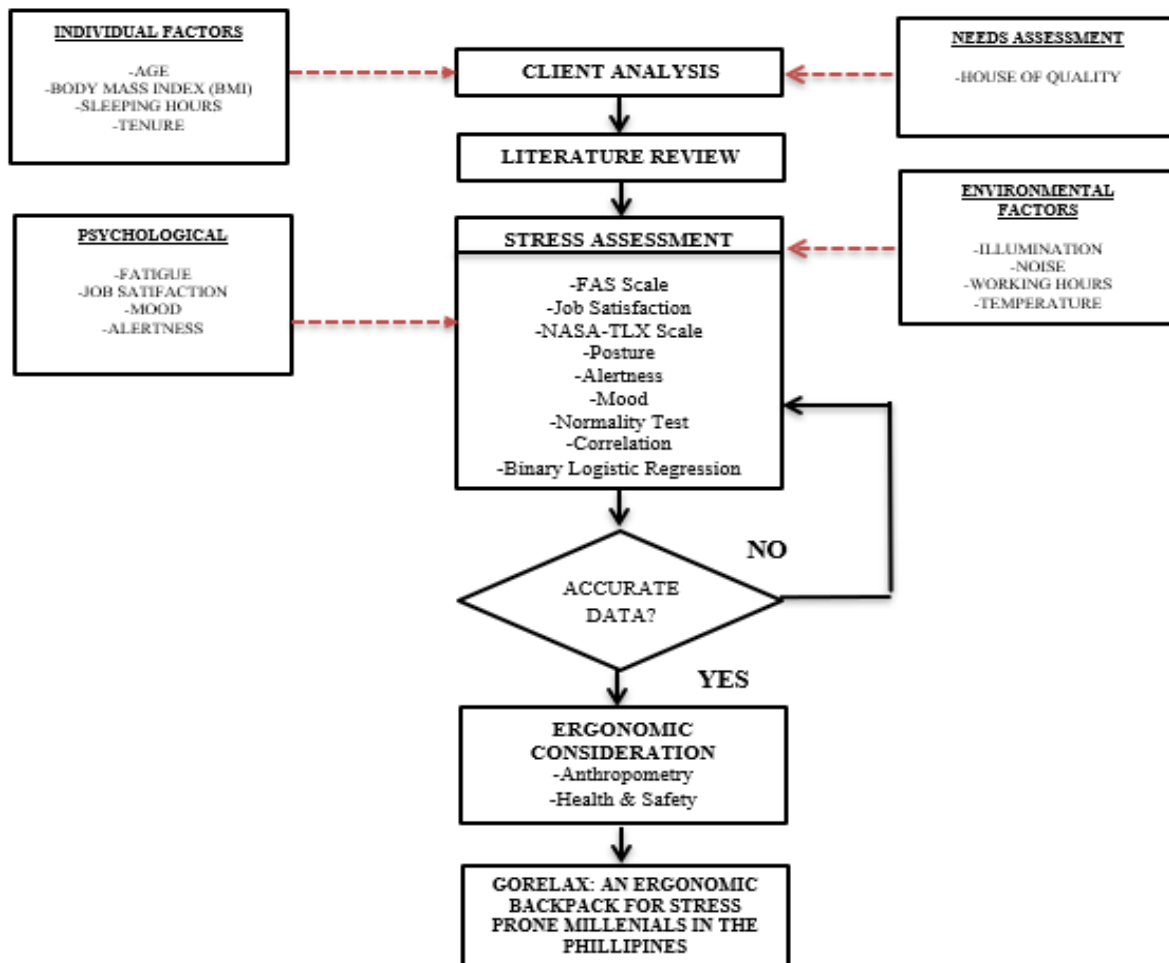
Millennials are bothered by the work stress levels which grew by 27% compared to other generations. Stress has been a cause of high absences in various organizations as it grew by 37%. [12] Stress arises when the demand of work exceeds the capacity of the workers limit and the capability to cope with. Having a high workload and job stress draws a negative effect on the performance of worker productivity and increases in occupational health hazards. [13] Work overload or having too much work is a common issue nowadays. Majority of us felt such an obligation to the task. Work overload occurs when a certain individual is assigned to excessive job task. [14] Worker's mood causes fatigue, sleep problems, social withdrawal and loss of interest in work which results in non-satisfaction, early retirement, and job migration. [15] Fatigue is dangerous in the workplace as it affects the worker's capability/capacity to think rationally and respond properly and as such has been one of the leading causes of workplace injury. It is a hazardous factor at work as it may lead to less motivation and alertness, and inevitably the possibility of accidents and injuries. [16] NIOSH lifting equation was used to determine the recommended weight limit and lifting index for each task. It also reveals that there is greater room for ergonomic improvement associated with horizontal and frequency task factors and to decrease stress level. [17] Poor workplace posture is a major cause of back pain, workplace stress and can largely lead to repetitive strain injuries. In return, it results in poor employee health and low morale which will ultimately lead on to reduced productivity, lost time and higher business costs. [18] Physical conditions in the workplace such as illumination, temperature, noise, and humidity had a significant impact on worker productivity. If in case, workers were provided with optimum environmental conditions, their work rate and performance would inevitably improve, thus stress will somewhat be eliminated and reduced. [19] The physical work environment can be considered as a source of stress for workers/employees. Occupational noise, even when it is not at a level that requires action to prevent hearing loss, can be a stressor. [20] Although workers can acclimatize themselves to different levels of heat, every identical worker has an upper limit for heat stress beyond which that work can become a heat casualty. In return, the worker's capability to focus attention and its reaction times can be dramatically reduced by even a 2 percent dehydration level due to heat stress. [21]

Occupational stress can affect both men and women. Nevertheless, women may be disproportionately exposed to stressors. Women have greater exposure to monotonous tasks than men, are less likely to do jobs which involves problem solving/learning, are less likely to be able to choose when to take a break in their work, and are more likely to be interrupted with unexpected tasks. [22] There are several reasons to know the importance of age as a factor of work stress. Findings of the role of age in terms of reactivity to daily stress are varied although there is a strong evidence that the rate of exposure to everyday stressors tends to decrease with age. [23] Some organizations give heavy emphasis and priority for the development of a healthy lifestyle and balanced BMI. Thus, they promote the health of workers since obesity and stress can interfere in their performance. [24] The influence of work stress can severely affect not just the worker but also its organization. The organization may be unable to reach certain goals that

they are aspiring and the worker may experience work dissatisfaction and become a financial loss to the organization. [20]

3. Research Design and Methodology

Through data collection, researchers' multiple variables needed to be considered in order to develop the product for it to become usable to the person who intends to use it. Stress Assessment (e.g. FAS Scale, NASA-TLX Scale, etc.) and House of Quality are utilized in this manner in order to assess a person's behavior towards the product and consequently prevent waste incurred during the process.



**Basis of sequence model was done from Jumadiao (2017)*

Figure 1. Sequence Flow Model

A. Needs Analysis/Assessment

Needs Analysis covers the needs of potential users. In assessing the problem being catered, researchers utilized House of Quality (HOQ) to facilitate the development process/phase and to be able to generate specific solution to a specific problem through consideration of the needs of the client.

B. Individual Factors

The individual factors are covering the basic information associated with millennials who are prone to stress exposure at work. It mainly includes the age of worker, body mass index (BMI), sleeping hours do they take, and tenure. These set of variables have a direct effect on the improvement of moods and reduction of stress level, since the said factors will significantly help in outlining a usable product which intends to promote users to physically relax while utilizing the product.

C. Psychological Factors

Psychological Variable presents the mental and emotional state of stress prone millennials in the workforce. This is correlated with fatigue, job satisfaction and alertness which is prevalent during the working process, job satisfaction, mood and alertness. These set of variables is relevant since it assessed how a certain millennial acts upon the process.

D. Environmental Factors

Environmental Variable covers the surroundings of millennial workforce are in. This is correlated with Illumination of the room being used upon work, noise being heard during work which largely affect their performance, working hours on how long millennials work, and temperature inside the workplace. These set of variables are measured through Digital Light Meter and Sound Level Meter. Values may vary depending on the quality of the workplace being observed.

4. Results and Discussion

4.1 Anthropometry

In formulating the design of the product, the proponents take into consideration anthropometric measurements of the human body that will be covered by the product concerning with its prospected users. These actions are made to determine the average size of human body since people have different anthropometric measurements. Proponents then formulate possible dimensions of the product concerning with the actual measures they gathered among its projected users. Anthropometry is a scientific way of obtaining precise measurements of a human body. Regarding with design, it is used to avoid mismatches between objects physical dimension and its corresponding user. The size of the back and shoulder is the primary factor to be considered due to individual's unique built of body. Proponents then gathered different results from 120 respondents to determine the physical dimension of the product needed to be generated/produced. In line with this, proponents measure the height of respondents randomly. The figure shown below was the basis of product's size, those are a.) back width b) back height c.) shoulder line d.) waistline and lastly e.) hip line.

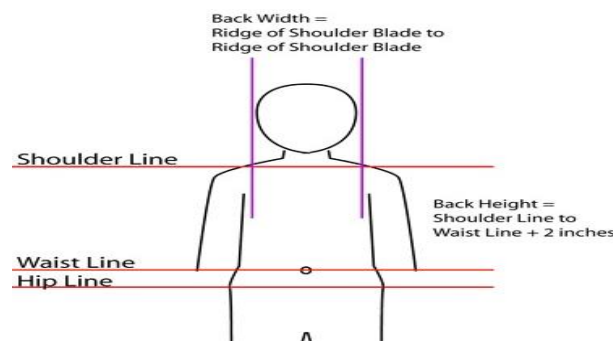


Figure 2. Measurement to be considered

Table 1. Actual Measurements

	ACTUAL MEASUREMENT	MEAN	STANDARD DEVIATION
A	Back Width	36.06 cm	3.9783 cm
B	Back Height	49.42 cm	2.9804 cm
C	Shoulder Line	43.6 cm	2.3292 cm
D	Waist Line	85.76 cm	15.0111 cm
E	Hip Line	96.7 cm	11.0786 cm

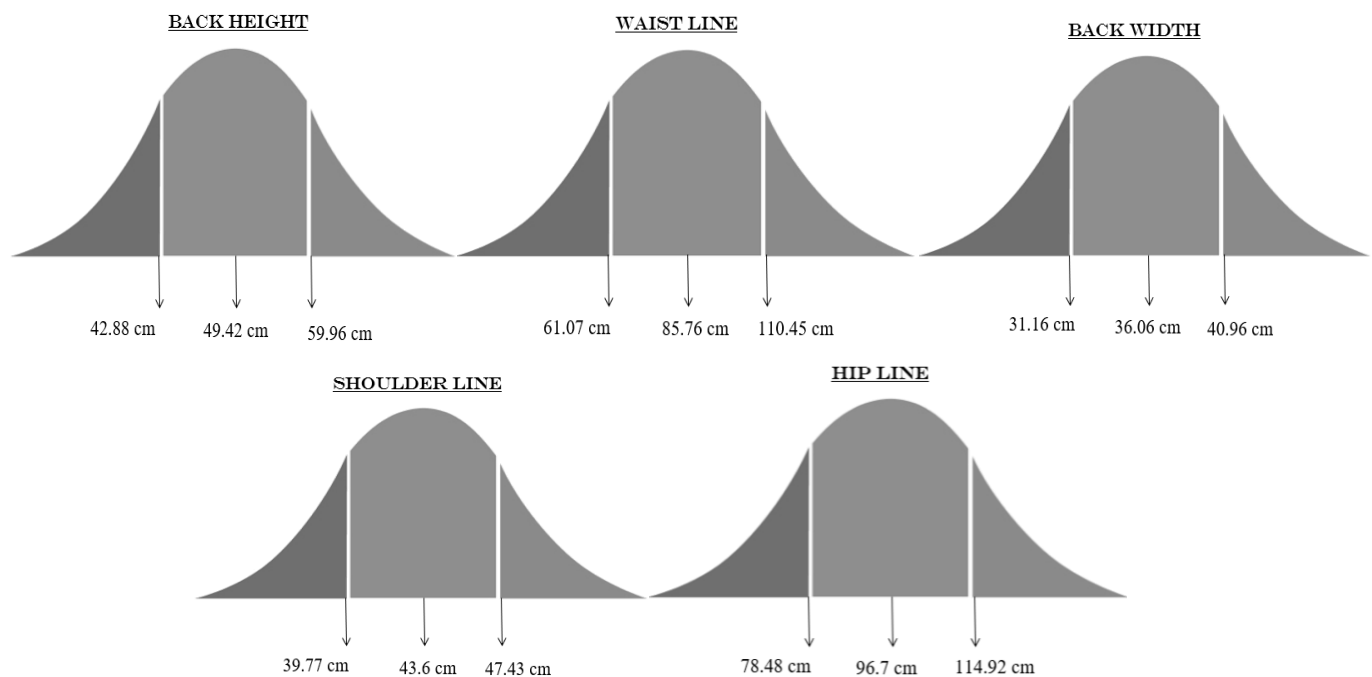


Figure 3. Normal Curve Distribution

The figure above shows the mean, standard deviation and normal curve distribution of the anthropometric measurements that the proponents gathered from their respondents. The proponents obtain the 5th, 50th and 95th percentile of each anthropometric measurements in order to assess the actual size of the product needed to generate. Through obtaining, it can attain the purpose of ergonomics, which is fitting a certain thing into its prospected user.

4.2 Health and Safety

In designing the product, it is necessary to consider safety, health and environmental issues of people who will use it. It must made in accordance with the following factors.

4.2.1 Safety

The product is considered safe to use, most especially for workers who carry experiences too much load on their work. It is also generally made in a way that it won't affect the user's spine curve shape through the use of lightweight components. With the use of soft materials like foam and cotton at the back part of the product, it reduces the load that the user is carrying. As the amount of weight is an issue, it is a challenge to overcome its weight capacity. In

doing so, posture analysis takes into consideration in this manner. The product is an ergonomically designed intended for the entire human body itself. As a consideration, American Chiropractic Association recommends a backpack weigh no more than 5% to 10% of a people's weight. This must be applied in developing the product. Therefore, it is safe to say that it won't affect the posture of its prospected users. To assess the proper posture, Rapid Upper Limb Assessment (RULA) and NIOSH lifting guide is also considered in this manner since there is only a limit for the amount of weight being carried by the user for them to obtain good posture.

4.3 Normality Test

The graph and tabulated data below determine if the sample data yields normal distribution or not. In this tool commonly known as Anderson- Darling Normality test, data can be concluded a normal distribution if its p-value resulted is greater than the alpha level of 0.05. As seen above, with the total of one hundred twenty (120) respondents, it resulted to a p-value of 0.009. With this connection, it can be concluded that the given sample possess a normal distribution.

Table 2. Minitab Result – Normality Test (Tabulated)

Factor	Frequency	Mean	Std. deviation	AD	P-Value
Stress	120	76.31	5.847	0.767	0.045

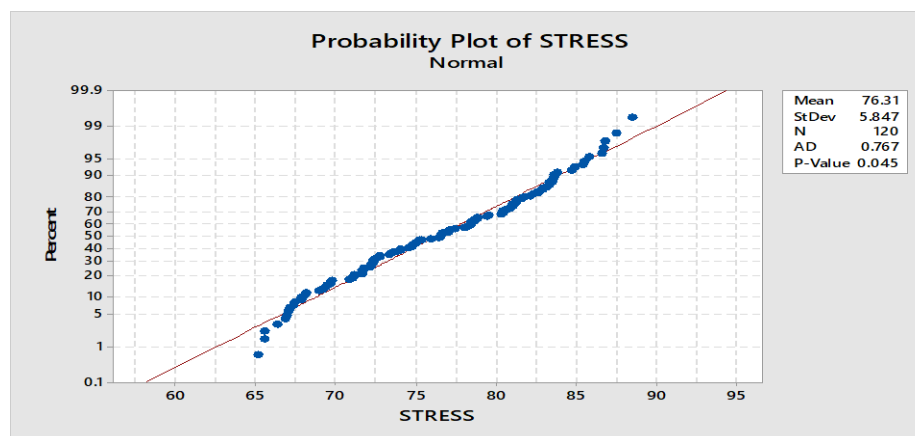


Figure 4. Normality Test Graph

The tabulated data below implies the correlation coefficient obtained through an aid of Minitab. As per the result, it ranges from positively weak which is Temperature, Tenure, Workload, Mood, Posture, Alertness and Working hours side up to positively strong which is Age, BMI, Illumination, Fatigue, and Job Satisfaction results to positive strong strength wherein they are the most significant factors in terms of children's learnability.

Table 3. Minitab Result – Correlation

FACTORS	CORRELATION COEFFICIENT	STRENGTH
Age	0.582	Positively Strong Correlation
Body Mass Index (BMI)	0.833	Positively Strong Correlation
Temperature	0.256	Positively Weak Correlation
Noise	0.345	Positively Moderate Correlation

Illumination	0.999	Positively Strong Correlation
Sleeping hours	0.401	Positively Moderate Correlation
Tenure	0.016	Positively Weak Correlation
Fatigue	0.566	Positively Strong Correlation
Job Satisfaction	0.970	Positively Strong Correlation
Workload	0.270	Positively Weak Correlation
Mood	0.166	Positively Weak Correlation
Posture	0.291	Positively Weak Correlation
Alertness	0.138	Positively Weak Correlation
Working hours	0.188	Positively Weak Correlation

4.4 Binary Logistic Regression

The tabulated data below implies the binary logistic correlation through the use of Minitab in which it determines if certain factors are considered significant or not. In this tool commonly known as “Binary Logistic Correlation”, data can be concluded significant if its p value resulted is less than 0.05. As seen above, temperature, sleeping hours, tenure, fatigue, workload and posture are the significant factors. Thus, these variables will highly be considered in developing the idea. Those sources of stress will be initially resolved by the developed product.

Table 4. Minitab Result – Binary Logistic Correlation

Deviance Table

Source	DF	Adj Dev	Adj Mean	Chi-Square	P-Value
Regression	16	56.591	3.5370	56.59	0.000
TEMPERATURE	1	11.689	11.6886	11.69	0.001
SLEEPING HOURS	1	7.285	7.2854	7.29	0.007
TENURE	1	5.346	5.3462	5.35	0.021
FATIGUE	2	8.830	4.4148	8.83	0.012
WORKLOAD	5	19.892	3.9784	19.89	0.001
POSTURES	6	23.798	3.9663	23.80	0.001
Error		103	102.184	0.9921	
Total			119	158.775	

Model Summary

Deviance	Deviance	
R-Sq	R-Sq(adj)	AIC
35.64%	25.57%	136.18

4.5 House of Quality (HOQ)

The figure below presents the house of quality (HOQ) on which the rankings of the considerations are relevant to the designers in order to formulate/develop backpack called as “GORELAX”. It was ranked as follows:

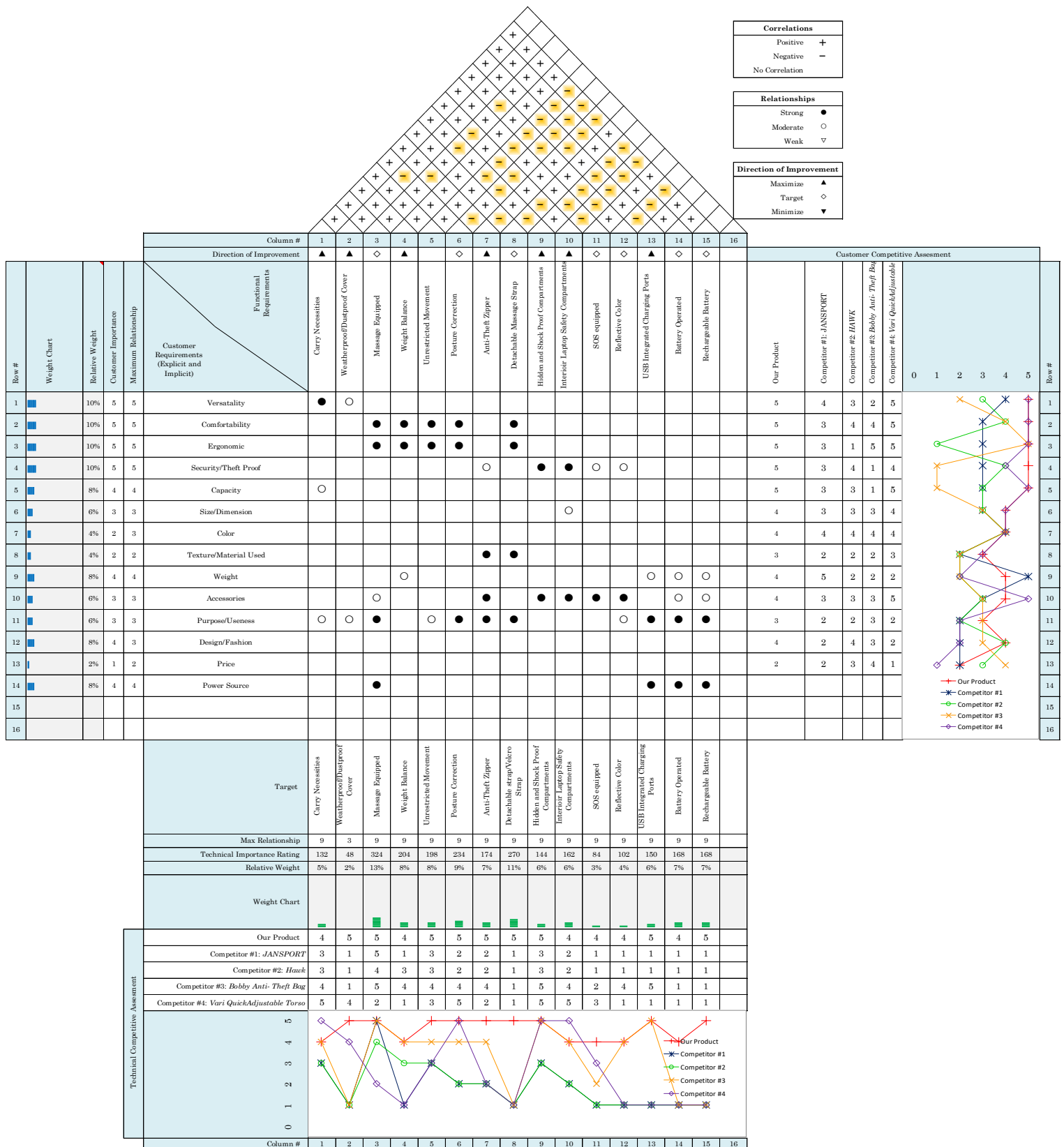


Figure 5. House of Quality

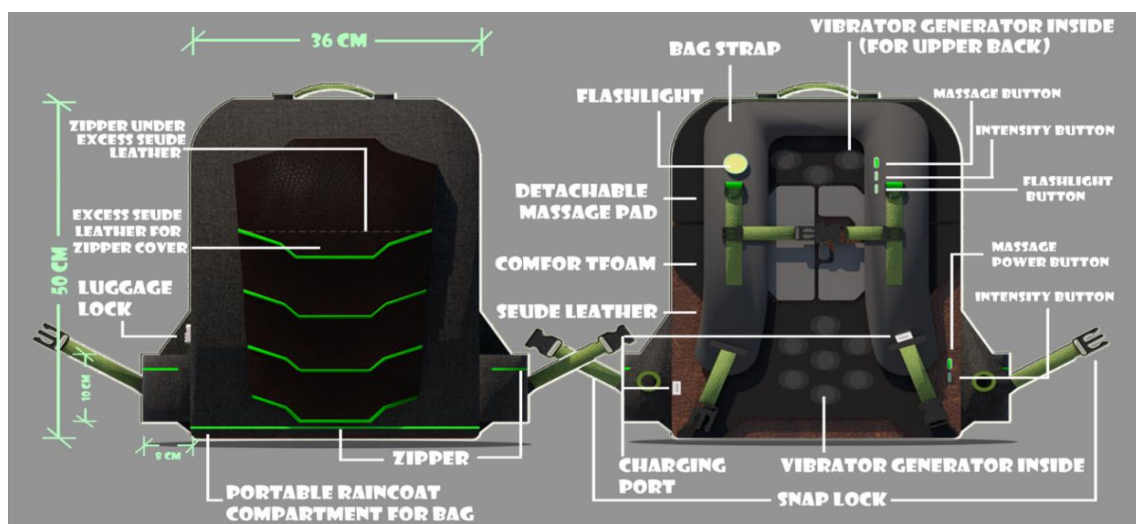
5. Conclusion

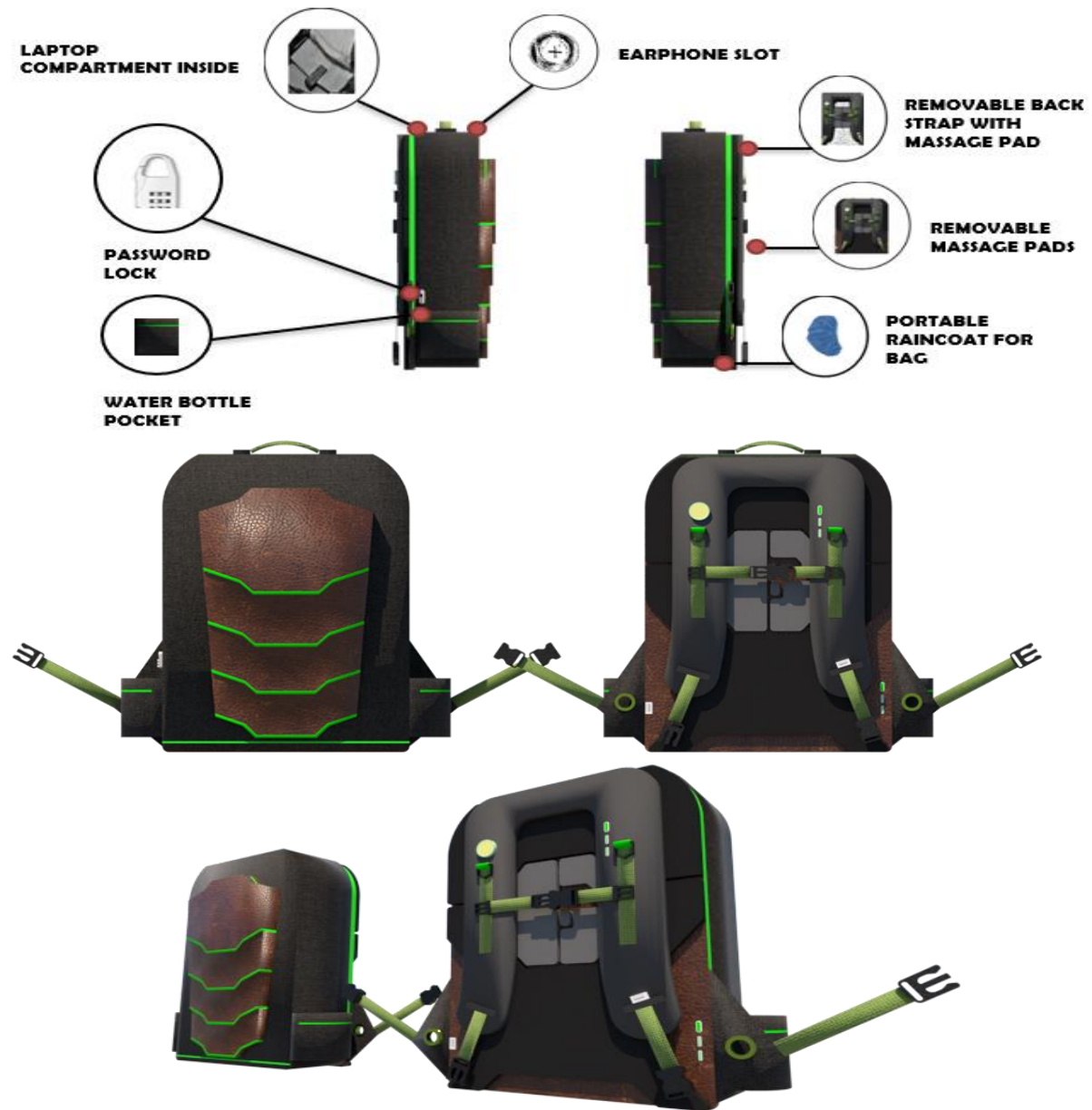
In this study, researchers applied different ergonomic principles in order to develop an ergonomic bag that is suitable for millennials who are prone to stress exposure. Defining the need and consideration of different ergonomic aspect triggers the starting point in developing the product called as “back pack” in order to reduce stress level and help them feel more comfortable therefore maximizing their productivity. This approach gives an advantage to employers and users as it reduces the loss of income due to absenteeism of each individual, thus it will enhance the capacity of employee to work as they will feel more comfortable upon using it. It also opens up opportunities for the future research that may be done in accordance with this area. Based on the different principles/techniques used upon the study, it lies that the average height of Asian men is 162-164cm while Asian women with 150-153cm. Through different statistical tools, it implies that the gathered data is normal as it obtains a p-value of 0.190 which is greater than 0.05 alpha level. The factors that were highly considered are Temperature (0.001), Sleeping Hours (0.007), Tenure (0.021), Fatigue (0.012) and Workload (0.001). Thus, these factors were clearly the main problem why millennials were considered to be stressed out. Therefore, these actual data were a big contribution upon developing/formulation of the idea of creating a backpack that will fit to any user.

6. Recommendation

The name of the product is simply “GORELAX” which is a backpack intended for millennial workforce who are prone to stress exposure. It is derived from term “GO” which means going from one point to another, and “RELAX” which is simply to feel relaxed while experiencing chronic stress. Basically, it is a storage of things ergonomically designed to massage mainly the back part of the body which causes them to feel relaxed due to chronic stress they are experiencing. When used, the user will not feel the amount/weight they are carrying but instead feel relaxed due to the effort they exert while doing so much work. Basically, it is not only the back part of the body is covered by the product, as it is made detachable in order to massage different parts of the human body.

The product is composed of durable and lightweight materials since it is not designed to add weight to the user instead it is made to enable users to relax physically through back massage support system. The product strap part is a detachable type to allow the user to change straps since they are the downside of the existing bags in the market. It also enables a user to cover the entire bag in rainy season through the use of waterproof fabric. Regarding with the outside appearance, the color of the product has a lining of mint green and base color of black, since calming colors helps relieve stress and make people feel relaxed.





The figure above shows the three-dimensional design of the GORAELEX backpack. It also includes the actual measurements of the product and its intended features than can be used in order to utilize the product by the prospected users.

References

- [1] United Nations ESCAP, "2013 ESCAP Population Data Sheet", ESCAP, October 02, 2013, SDD-PUB_Datasheet-2013
- [2] Fry, R., "Millennials are the largest generation in the U.S. labor force", Fact Tank, April 11, 2018, Available: <http://www.pewresearch.org/fact-tank/2018/04/11/millennials-largest-generation-us-labor-force/>

- [3] Philippine Statistics Authority, "Employment Situation in October 2015 (Final Results)", Labor and Employment, Labor Force, June 7, 2016, 2016-067, Retrieved from: <https://psa.gov.ph/content/employment-situation-october-2015-final-results>
- [4] Merriam Webster, "Definition of Millennial", Merriam Webster Incorporated, 2018, Available: <https://www.merriam-webster.com/dictionary/millennial>
- [5] American Psychological Association, "Stress by Generation, Stress in America", 2012, Available: <http://www.apa.org/news/press/releases/stress/2012/generations.aspx>
- [6] ComPsych. "Workplace stress undermining productivity: ComPsych survey", November 8, 2016, Business, Available: https://www.cleveland.com/business/index.ssf/2016/11/workplace_stress_undermining_p.html
- [7] APA, "Stress in America Coping with Change, 10th Edition, Part 1, American Psychological Association, February 25, 2017, Available: <https://www.apa.org/news/press/releases/stress/2016/coping-with-change.PDF>
- [8] Australian Psychological Society, "Stress and wellbeing in Australia survey 2013", viewed 13 December 2014, Retrieved from: <http://www.psychology.org.au/Assets/Files/Stress%20and%20wellbeing%20in%20Australia%20survey%202013.pdf>
- [9] Nur A' Tifah Jaffar and Mohd Nasrull Abdol Rahman 2017 IOP Conf. Ser.: Mater. Sci. Eng. 226 012035
- [10] Domingo, R. "Back pain top complaint of Filipino workers", Philippine Daily Inquirer, March 02, 2014, Retrieved from: <https://lifestyle.inquirer.net/153027/back-pain-top-complaint-of-filipino-workers/>
- [11] Van Vuuren BJ, Becker Pj, Van Heerden HJ, Zinzen E, Meunisen R. "Lower back problems and occupational risk factors in a South African steel industry. Am J Ind Med 47:451-7, Available: https://www.google.com.ph/url?sa=t&source=web&rct=j&url=https://sajp.co.za/index.php/sajp/article/download/63/61&ved=2ahUKEwjgsu6lgqbeAhUEIIgKHeupDn04ChAWMAF6BAGIEAE&usg=AOvVaw0ccDoLe06V3cVF0P_uVDo9C
- [12] McCance, D. "Millennials more affected by stress than baby boomers", Economia, News, May 14, 2018, Retrieved from: <https://economia.icaew.com/news/may-2018/millennials-more-affected-by-stress-than-baby-boomers>
- [13] Koch, J. L., Tung, R., Gmelch, W., & Swent, B. (1982). "Job stress among school administrators: Factorial dimensions and differential effects", Journal of Applied Psychology, 67(4), 493-499.
- [14] Zohar & Dov, "When things go wrong: The effect of daily work hassles on effort, exertion, and negative mood". Journal of Occupational and Organizational Psychology, 1999
- [15] M.Zhang, L.A Murphy, D.Fang, and A.J Caban-Martinez, "Influence of fatigue on construction workers' physical and cognitive function", US National Library of Medicine, National Institute of Health, February 20 2015, Available: <https://www.ncbi.nlm.nih.gov/pubmed/25701835>
- [16] Choi, SD, Borchardt, JG, Proksch, TL, "Translating Academic Research on Manual Lifting Tasks Observations into Construction Workplace "Good Practices", Journal of Safety, Health & Environmental Research;2012, Vol. 8 Issue 1, p3, Academic Journal, March 2012, Available: <http://connection.ebscohost.com/c/articles/83473182/translating-academic-research-manual-lifting-tasks-observations-construction-workplace-good-practices>
- [17] Clarke, D. "Workplace Posture and Ergonomics", The Physio Company, Chartered Physiotherapy & Sports Injury Clinic, May 3, 2012

- [18] Silvester, J, Konstantinou, E, “Lighting, Well-being and Performance at Work”, Lighting, Well-being and Performance at Work, City University London, 2010, Available: https://www.cass.city.ac.uk/_data/assets/pdf_file/0004/363217/lighting-work-performance-cass.pdf
- [19] European Agency for Safety and Health at Work. “The impact of noise at work”, European Agency for Safety and Health at Work, 2005, Available: <https://osha.europa.eu/en/tools-and-publications/publications/factsheets/57>
- [20] Baker,B, Ladue, J. “How Heat Stress Affects Performance”, Occupational Health & Safety, May 1, 2010, Available: <https://ohsonline.com/Articles/2010/05/01/How-Heat-Stress-Affects-Performance.aspx>
- [21] Paoli et al. “Third European Survey on Working Conditions 2000. Office for Official Publications of the European Communities; Luxembourg, Luxembourg: 2001.
- [22] Almeida & Horn, “The Daily Inventory of Stressful Experiences (DISE): An interview based approach for measuring daily stressors, 2004
- [23] Ribeiro et al. “Body composition and overweight of liver transplant recipients”, US National Library of Medicine, National Institute of Health, October 27, 2011, Available: <https://www.ncbi.nlm.nih.gov/pubmed/21869739>
- [24] Bemana & Moradi et al. “The relationship among job stress and job satisfaction in municipality personnel in Iran”, World Applied Sciences Journal 22(2):233-238, January 2013, Available: https://www.researchgate.net/publication/288047862_the_relationship_among_job_stress_and_job_satisfaction_in_municipality_personnel_in_Iran

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