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Assessment of physical and physiological parameters among the male and female bakery workers from Palpa district of democratic Nepal

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ABSTRACT

Nepal continues as one of the least developed economies of the world till date. The frequent changes in governance and political instability have contributed to the lack of entrepreneurial dynamism needed for stronger economic growth. Nowadays, bakery industries are the fastest growing small agro-industries leaving the footprint on day to day life in Palpa district. The male and female bakery workers of these industries experience some exigent conditions which prompted us to explore the physical, physiological, and nutritional health status of these bakery workers, with a special reference to the socio-political scenario in Nepal. This study was conducted in the Palpa district of Nepal. 78 male and 44 female bakery workers aged between 30-39 years were chosen for the study, as the young adults are more in this occupation. 38 healthy male and 26 female Bakery workers were chosen as control subjects for the study having same age group. All of them mostly were working as shopkeepers and housewives respectively from the same locality. All the different parameters were examined according to standard methods and Student's t-test was executed to find out any significant difference ($P < 0.05$) between the selected variables. Both the workers were noticeably healthy. But most of the female bakery workers were having obesity with significantly high obesity related parameters. Again, both the workers exhibited poor cardio-respiratory functions with significantly higher hypertension and peak expiratory flow rate and poor Physical fitness index (PFI) scores. The result suggested that both male and female bakery workers showed abominable conditions, especially the female bakery workers. Hence, there must be some acts to save them by introducing some occupational aids or planned work designs for sustainable economic development.



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INTRODUCTION

The Kingdom of Nepal, a landlocked country is situated in South Asia between India and China. Geographically, it is located between latitudes 26°22'N and 30°27'N and longitudes 80°4'E and 88°12'E (Sengupta and Bhattacharya, 2012). Nepal at present is a democratic republic after the successful Jan Andolon in 2006. A new constitution has also been drafted by the Nepali Constituent Assembly in September 2015. Nepal has finally passed a new constitution after years of political turmoil guaranteeing the various socio economic rights to its citizens (Time magazine, September, 2015).

At this threshold of socio-political happenings, the economic concerns of a least developed state become the call of the hour. It is a proven fact that the small and medium scale industries play a crucial role in economic advancement of any developing society, yet this also necessitates the pursuit of a positive role by the state for maintaining industrial safety and good health. Nepal's growth to democracy over the years coincides with the gradual need for a comprehensive policy for industrial health and safety of its workers, which is quite compelling for its own economic survival (Khadka, 2007, Shrestha, 2010).

India's independence in 1947 encouraged the Nepalese democratic forces. However, Nepal's democratic experience failed in 1960 and a new constitution came to be effective since 1962, which envisaged a party less Panchayat system under the direct control of King Mahendra.

While the Congress government of Mrs. Gandhi assumed power in 1980, in India, a national referendum was held in the same year to decide whether partyless Panchayat system under monarchy or a multiparty democratic system should prevail in Nepal (Muni, 2009). The prevailing socio-economic condition of the people under the Panchayat system led to the triggering of people's movement, "Jan Andolan I" for democracy a political liberalization. Finally, King Birendra announced in 1990 the reintroduction of political parties and the end of the Panchayati system (Muni D, 2009).

However, the character of Nepali monarchy changed with the palace massacre, in June 2001, Gyanendra, the new monarch drifted away from the constitutional status and finally assumed direct power in February 2005. The King's take over in 2005 and Maoist insurgency unleashed the second people's uprising in Nepal as "Jan Andolan II" in 2006. Finally, peace was restored and the parliament was reinstated following a proclamation by King Gyanendra and subsequently Nepal was declared a federal republic synthesizing features of a republican government and a parliamentary structure in 2008 (Muni, 2009).

The preamble to the new constitution, drafted in 2015, guarantees 'civil liberties, fundamental rights and human rights'. Article 33(2) in the third part of the constitution, dealing with fundamental rights, holds that every citizen shall have the right to choose employment, Article 34 holds the Right to Labour, Article 34(1) holds that "every labourer shall have the right to fair labor practice", according to Article 35, every citizen shall have the right to free basic health services from the state and Article 30 protects the right of every citizen to live in a clean and healthy environment (Constitution of Nepal 2015).

Nepal continues as one of the least developed economies of the world, till date. The frequent political instability has contributed to the lack of entrepreneurial dynamisms needed for stronger economic growth. Moreover, corruption and state regulatory system slow the progress of private sector expansion and investments. Micro, small and medium scale enterprises (MSMEs) (Ghimire, 2011) are the starting point of development for the new nations towards a more structured growth of industries and economy. The United Nations Development Organization (UNDO) also considers that in developing nations, along with economic liberalization and democratization the development of private economy is essential. Though these enterprises have fewer employees, limited access to capital and usually operates in the informal sector of the economy, yet the contribution of the MSME to employment growth and sustainable development is widely acknowledged (UNTAD 2001).

Nepal has an agrarian economy, characterized by poverty and illiteracy. The Nepal labour force survey estimated that the employment in MSMEs is more than a million people during the last decade. Mostly these enterprises are agro based, forest based, metal based and weaving etc. Bakery industries in Nepal fall under this category of small and medium scale enterprises. Although it generates employment and contributes to economic growth, its modus operandi falls in the informal sector of the economy. This results in to various health and safety hazards for its workers.

Nepal being a least developed economy, the bakery industry has immense possibility towards economic growth. However, the bakery industry suffers from certain economic and physiological constraints. The economic limitations include demand supply chain, price sensitivity of the market, government regulations, rising price of the ingredients, as well as governmental regulations and packaging standardization. So far as the physical and physiological challenges are concerned, these include breathing problems of the employees, allergies and asthma. Dust also is another problem for bakery units as this generates from flour and sugar in many bakery factories. These are generated at grinders, stiffers and mixers. Heat is another source of stress related to health risk as the employees are exposed to high temperature causing heat stress while working near ovens.

The present study was conducted in Palpa district, a part of Lumbini zone, with a total area of 1,373 km². The total population of the district is 268,558 according to 2001 census. Currently the overall literacy rate (for population aged 5 years and above) has increased from 54.1% in 2001 to 65.9% in 2011. The male literacy rate being 75.1%

and it is higher than female literacy rate which is only 57.4% in Palpa district (National Population and Housing Census, 2011).

The local economy of Palpa district depends mainly on agriculture, animal husbandry, small industries, tourism and remittance. In recent years, fastest growing bakery industries are one of the small agro industries making an impact of daily life in Palpa district. Bakery products are being used on large scale as daily food items in developing countries like Nepal.

Male and female both the employers of various age groups are found in Bakery industries of Palpa district. They are always being exposed to the hot environment of blast furnace as well as flour dust and in the micro environment of leaving agents of baking. Reliable information of different health related issue of a population constitutes one of the most essential pre-requisites for formulate health care system as well as to address health needs effectively (Medhi et al., 2006). Bakery workers of Palpa district may be experiencing a health transition which may pose a great challenge to its health system may be due to the changes in health needs of the population.

There may be some occupation induced health problems like obesity, hypertension, chronic pulmonary dysfunctions etc. in the employees. Previously few reports are available regarding health issues and nutritional standing among the bakery workers which are not adequate for proper public health planning. In fact, there is no such valid data given for physical and physiological status of male and female bakery workers. Previously a small scale assessment was conducted on physical, physiological and nutritional status only among the female workers of the bakery from the same district in Nepal (Datta et al., 2014). Hence, the present study focuses on the physical, physiological and nutritional status of both the male and female bakery workers of Palpa district in Nepal may give a significant input contributing to the public health and occupational safety and thus may help in the productivity and the economic growth of the country.

MATERIALS AND METHODS

Participants

This study was performed in Palpa district of Nepal. 78 male and 44 female bakery workers, of aged 30–39 years, were chosen randomly. All of them were employee of bakery factories since more than two years. 38 healthy male and 26 female subjects were chosen as control subjects for the study and was having same age group, all of them mostly were working as shopkeepers and housewives re-

spectively from the same locality. All the individuals (Male and female bakery workers and control subjects), had no earlier report of systemic diseases.

Measurement of height

Anthropometric rod was used to measure the height of subjects by allowing them to stand straight on a plane surface (Damon, 1966). During the measurement, subjects were directed to look forward.

Measurement of weight

A conventional weighing pan was used to measure weight (kg) of each subject (Damon, 1966). During this measurements also, subjects were directed to look forward as well as the weighing pan was reset to zero before every measurement.

Calculation of body surface area (B.S.A.) and body mass index (B.M.I.) and fat percentage

Calculation of body surface area of each individual was measured by height – weight nomogram (McArdle et al. 1991). The body mass index (or Quetelet Index) is the statistical measure which compares a person's weight and height by the following formula (Sengupta, 2014, Chaudhuri et al., 2012): $BMI = \text{mass (kg)} / (\text{Height in m})^2$. According to the WHO, a BMI of less than 18.5 considers as underweight and may indicate malnutrition, an eating disorder, or other health problems, while a BMI score greater than 25 is considered overweight whereas above 30 is considered obese. Adult body fat % = $(1.20 \times BMI) + (0.23 \times \text{Age}) - (10.8 \times \text{Sex}) - 5.4$. Where Sex= 1 (for male) Sex=0 (for female) (Sengupta, 2014).

Measurement of MUAC, Waist and Hip Circumference and Waist-Hip ratio

Mid upper arm circumference, waist circumference and hip circumference all these three anthropometric parameters are important for nutritional assessment. Waist to hip ratio (W:H) can be calculated by making a ratio between waist circumference and hip circumference (Sengupta and Krajewska-Kulak, 2014).

Measurement of heart rate

By using a stop watch for 60 seconds, the heart rate (beats/min) of each subject was measured by feeling the palpation of radial artery in seating condition after 15mins of rest (Datta et al., 2014).

Measurement of systolic and diastolic blood pressure

Both the systolic and diastolic blood pressures (mm-Hg) of the subjects were measured with the help of auscultatory method (Booth J, 1977, Pur-

kait and Bhattacharya, 2017) by using the sphygmomanometer and by placing the stethoscope on the cubital fossa area to auscultate the sounds of brachial artery in seating position after 15mins of rest.

Physical fitness index (PFI)

PFI was calculated by measuring HR after performing Harvard's Step Test (HST) (Brouha, 1943). HST was developed in the Harvard Fatigue Laboratories using long form PFI equation. However, the following modified HST under Indian condition, using a stool of 51 cm height stepping up and down, with a rate of 30cycles/min for 3mins or up to exhaustion. Exhaustion is defined as when the subject cannot maintain the stepping rate for 15sec (Ryhming, 1953). The recovery heart rates taken after the completion of stepping counted at 1-1.5, 2-2.5 and 3-3.5 minutes of recovery. Long Form Equation Fitness index = $[100 \times \text{test duration in seconds}] / [2 \times \text{recovery HRs (1-1.5 min + 2-2.5 min + 3-3.5 min)}]$. The cut-off values of PFI are: Very poor (<50), poor (50-60), fair (60-70), and good (70-80) and excellent (>80) (Sengupta and Krajewska-Kulak, 2014, Purkait and Bhattacharya, 2017).

Measurement of peak expiratory flow rate (PEFR)

Peak expiratory flow rate or PEFR was examined with the help of an armed peak-flow meter by holding it horizontally on standing position (Datta et al., 2014). After a proper rest the subject was allowed to take a deep breath and exhale as forcefully as possible in one single blow into the instrument and it was repeated for thrice. The best reading out of those three was considered.

Statistical Analysis

By using SPSS v.15.0 all the represented data were analyzed statistically on MS-Excel v.2013 sheet. If significant differences between the groups were established, the values of the examined groups were compared with those of the control group by a modified t-test. Level of statistical significant was selected as $P < 0.05$ (Das and Das, 2005).

RESULTS

There was no significant difference of height (cm) in between Male bakery workers and the control subjects. But their body weight (Kg) and BSA (m^2) both were found significantly higher ($P < 0.02$) than the control peoples (Table 1) but BMI was insignificant. Their respiratory rate (breaths/min) showed significantly higher value than control subjects also (Table 1). But we did not get any significant differences of Waist Circumference (cm), Hip circumference (cm), Waist/Hip ratio, Mid-upper arm circumference (cm) and Total body fat percentage (%) in between control subjects and

male bakery workers (Table 1). Systolic and diastolic blood pressure (mmHg) were found to be significantly higher ($P < 0.02$) than control subjects (Figure 1). Surprisingly we found significantly ($P < 0.002$) good physical fitness index (PFI) score of male bakery workers in respect to the control subjects (Figure 1). Peak expiratory flow rate (l/min) has been presented in Figure 2, which shown significantly lower ($P < 0.002$) value in contrast to the control subjects.

On the other hand, height was higher in female bakery workers as compared to control subjects and that was statistically insignificant. But body weight (Kg), BSA (m^2) and BMI (Kg/m^2) were relatively higher in female bakery workers as well as they were statistically significant at the level of $P < 0.02$ (Table 2). Similar to the result of male bakery workers, the normal respiratory rate (breaths/min) of female bakery workers was significantly higher ($P < 0.003$) compared to the control subjects (Table 2). Hip circumference of the female workers was found to be higher than the control subjects ($P < 0.002$). Waist circumference and Waist/Hip ratio were statistically insignificant. Similarly, significantly higher ($P < 0.02$ and $P < 0.002$, Systolic and diastolic respectively) results for blood pressure were found in female bakery worker also than control subjects (Figure 3). But we found significantly ($P < 0.002$) poor physical fitness index (PFI) score of female bakery workers in respect to the control subjects (Figure 3). Mid upper arm circumference (MUAC) and total body fat percentage (%) were also significantly higher (Figure 4) than the control female subjects ($P < 0.03$). Peak expiratory flow rate (l/min) of female bakery workers has been presented in Figure 5, which shown significantly poor ($P < 0.02$) value in contrast to the control subjects.

DISCUSSION

A relatively large number of the population in Palpa is dependent on this occupation because of their challenging life against the socio-economic status (Cox, 1994). Our study has focused on obesity in high impact. The females were found with their endomorphic structure having solid and generally soft body type due to presence of easily gained fat with short height also having noticeable round physic, thick arms and legs. The female workers having this type of body with hypothyroidism (Khatiwada et al., 2015, Sengupta et al., 2015), insulin resistance (Pokharel et al., 2014) and disruption in hormonal milieu may also interfere in female reproductive function (Bhattacharya et al., 2014, Bhattacharya, 2013, Chaudhuri et al., 2016, Sengupta et al., 2013, Sengupta et al., 2017). It was found that the male bakery worker has got a non-significant higher BMI but a significantly

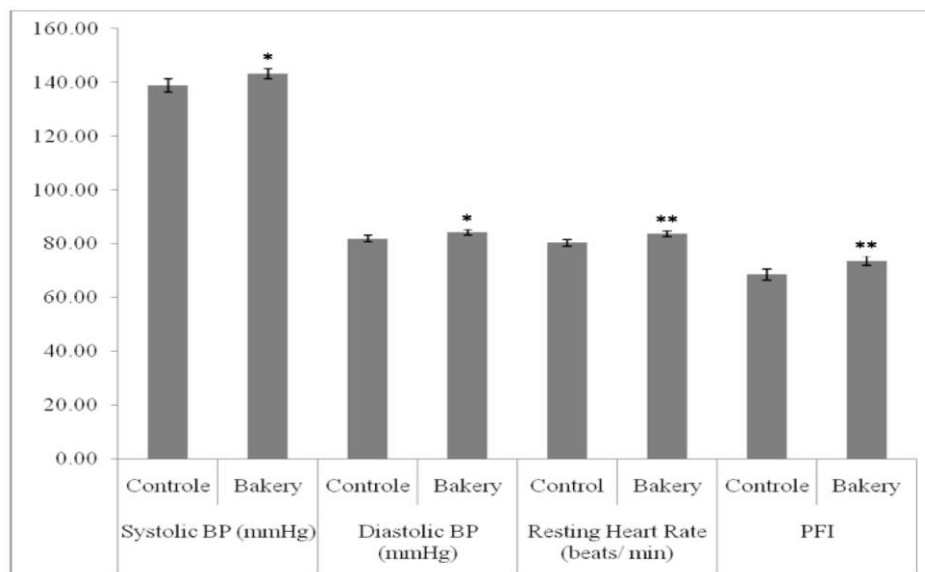
Table 1: Observation of anthropometric parameters in male bakery workers

Parameters	Control Subjects (n=38)		Male bakery workers (n=78)		Level of Significance
	Mean	SD	Mean	SD	
Height (cm)	163.04	±7.65	163.76	±5.25	NS
Weight (kg)	62.30	±7.00	66.07	±8.56	P<0.02
BSA (m ²)	1.69	±0.10	1.81	±0.13	P<0.02
BMI (Kg/m ²)	23.63	±3.78	24.68	±3.34	NS
Respiratory rate (breaths/min)	15.03	±2.07	15.94	±1.92	P<0.02
Waist Circumference (cm)	75.24	±6.37	77.48	±5.72	NS
Hip circumference (cm)	90.35	±4.01	84.53	±10.12	NS
Waist/Hip ratio	0.84	±0.09	0.93	±0.13	NS
Mid upper arm circumference (cm)	23.90	±0.79	27.09	±1.68	NS
Total body fat %	24.99	±4.97	26.69	±4.52	NS

NS: Not significant

Table 2: Observation of anthropometric parameters in female bakery workers

Parameters	Control Subjects (n=26)		Female bakery workers (n=44)		Level of Significance
	Mean	SD	Mean	SD	
Height (cm)	148.51	±3.01	149.60	±4.17	NS
Weight (kg)	60.71	±6.77	64.09	±5.35	P<0.02
BSA (m ²)	1.51	±0.08	1.59	±0.08	P<0.02
BMI (Kg/m ²)	25.46	±3.21	28.94	±2.07	P<0.02
Respiratory rate (breaths/min)	15.04	±1.87	16.34	±1.61	P<0.003
Waist Circumference (cm)	72.96	±2.93	86.45	±5.72	NS
Hip circumference (cm)	91.67	±4.18	94.65	±3.44	P<0.002
Waist/Hip ratio	0.80	±0.05	0.91	±0.06	NS

**Figure 1: Systolic and diastolic blood pressure (mmHg), resting heart rate (beats/min) and PFI of control (n= 38) and male bakery workers (n= 78)**

Two tail Student t test was performed to determine significant difference. *P<0.02, **P<0.002

higher BSA. BSA is scaling for the extracellular fluid volume in obesity (Peters and Glass, 2010). Thus, it can be said that the male workers have obesity with endomorphic structure bearing noticeable thick arms and legs which make them challenging to the nature in Nepal. Since both the bakery workers work in hot air environment and in the presence of hot furnace and with enough physical activity continuously for a long time in a day for several

years, they adapt themselves to that environment. May be due to that reason, we got a higher resting heart rate as well as higher resting respiratory rate. Dust particles have also an impact to increase the respiratory rate as flour dust is being used in bakery industries and which is also having approximately same particle diameter like the pure the flour (dust particle) which make the dust particle easy to take entry inside the respiratory tract as a

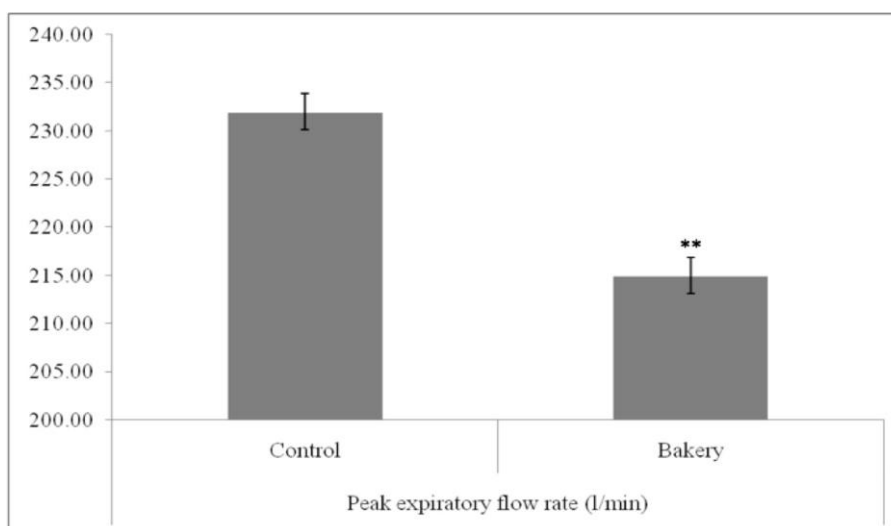


Figure 2: Peak expiratory flow rate (l/min) of control (n= 38) and male bakery workers (n= 78)

Two tail Student t test was performed to determine significant difference **P<0.002

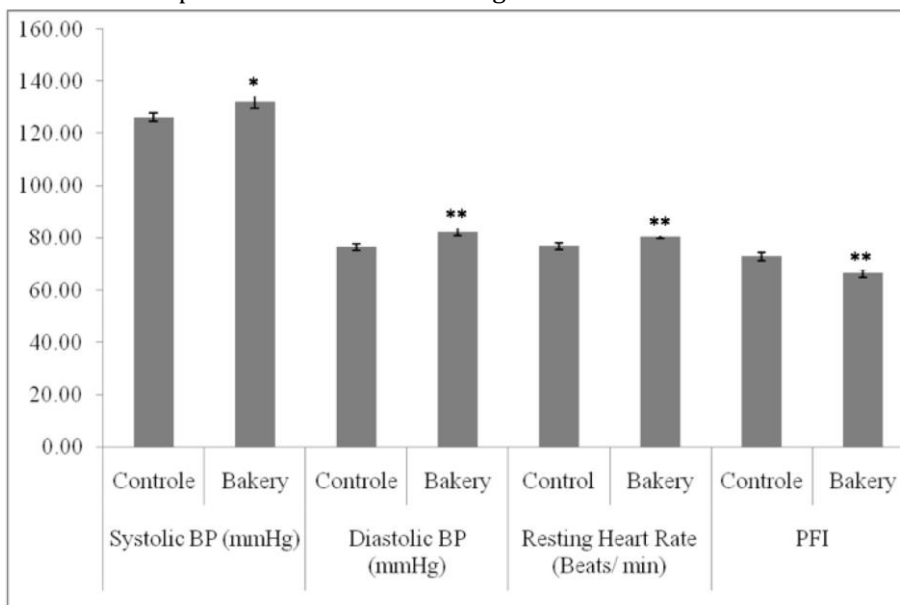


Figure 3: Systolic and diastolic blood pressure (mmHg), Resting heart rate (beats/min) and PFI of control (n= 26) and female bakery workers (n= 44)

Two tail Student t test was performed to determine significant difference *P<0.02, **P<0.002

heterogeneous substance with different respiratory effects like sensitizing and irritating properties, exposure to flour during mixing and baking processes may induce acute or chronic respiratory ailments too (Hamdy et al., 2013). Normally due to this flour dust inhalation, the sensory receptors present in respiratory tract get stimulated which initiate sneezing reflex to dislodge the inhaled flour dust from the respiratory passage. But in case of long term exposure to flour dust for several months or years as seen in bakery workers, the flour dust which gets lodged into the respiratory passage may cause the airway obstruction (airway hyper-responsiveness) leading to less supply of air (O₂) into lungs alveoli. This may lead to increase in rate (tachypnea) and depth of the respiration to

meet more O₂ demand (Datta et al., 2013). Thus, PEFR is also showed a changed score than the normal. It is also believed that the inverse relationship between BMI with PEFR may indicate an important risk factor known as obesity associated with reduced airflow or lung function (Gundogdu and Eryilmaz, 2011).

PFI scores are known to be an important measure for fitness after a strenuous exercise as well as a cardio-respiratory fitness measure. Physical fitness has generally three main aspects as well: first one is static fitness which is related to absence of disease, second one is dynamic fitness which is related to ability to perform strenuous work and third one or last one is motor skills fitness. Out of these three, dynamic fitness is very important on

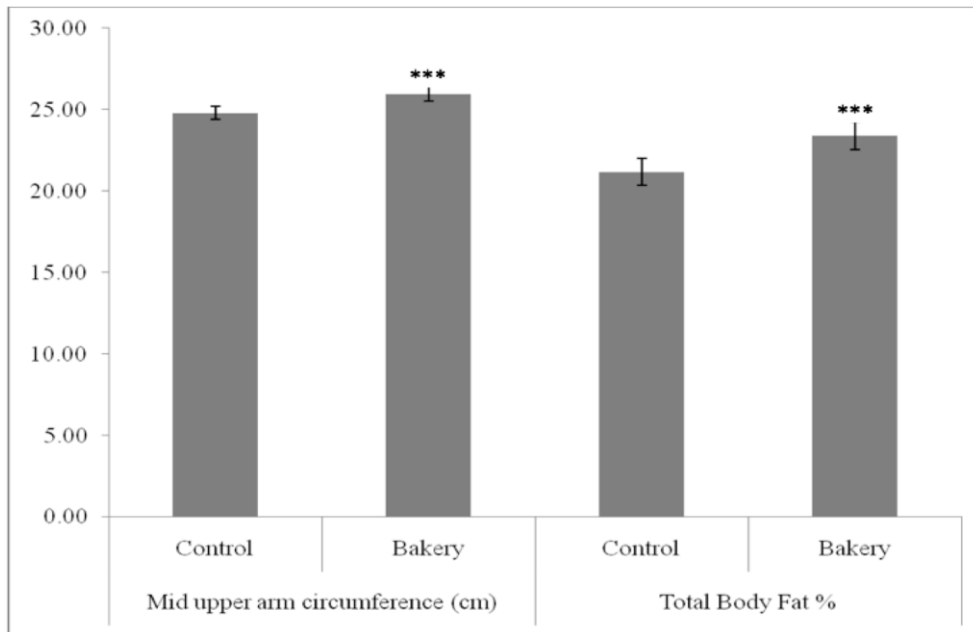


Figure 4: Mid upper arm circumference and total body fat percentage (%) of control (n= 26) and female bakery workers (n= 44)

Two tail Student t test was performed to determine significant difference ***P<0.03

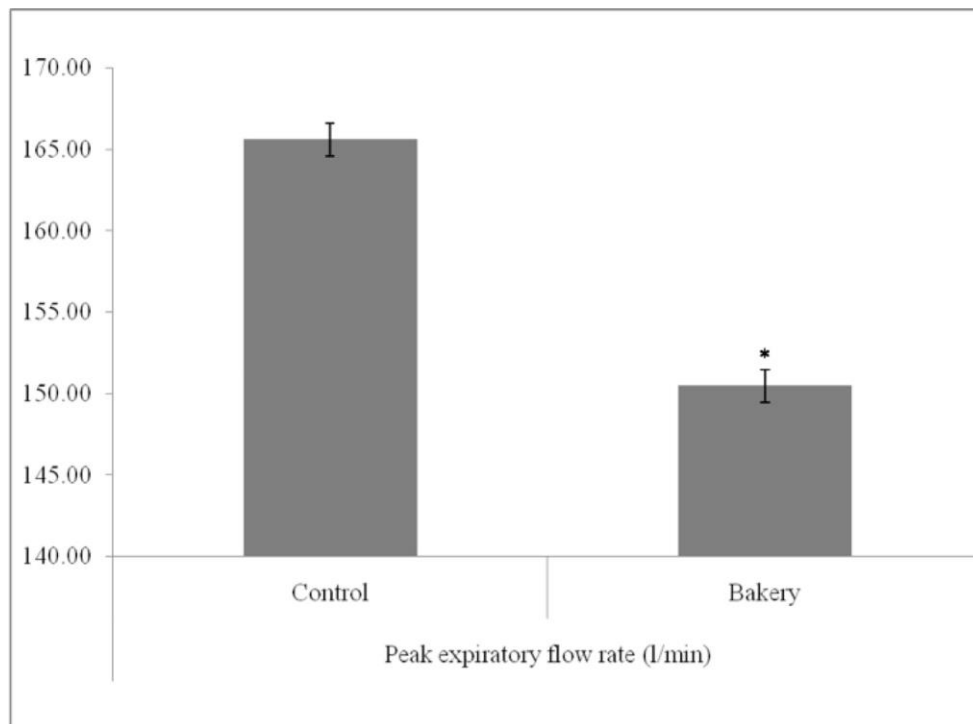


Figure 5: Peak expiratory flow rate (l/min) of control (n= 26) and female bakery workers (n= 44)

Two tail Student t test was performed to determine significant difference *P<0.02

physical and physiological basis and can be measured by modified Harvard Step Test (Datta et al., 2013, Purkait and Bhattacharya, 2017, Brouha et al., 1943). During the measuring of physical fitness, their recovery pulse rates were recorded quite slowly; which was an indicator of poor fitness as well as poor cardio-respiratory function among the female bakery workers, and thus, reflected in PFI as there is a relation between obesity and PFI:

higher the values of BMI were associated with declined physical fitness, independent of age (Dumith et al., 2010).

An increased waist circumference value is also associated with several health related problems such as type 2 diabetes (Feller et al., 2010), heart disease (Siani et al., 2002) and high blood pressure (Siani et al., 2002). The waist-hip ratio has been

used as an indicator or measure of various developing serious health conditions. It also may correlate with fertility as WHR is a result of impaired metabolism thus interrupting various normal endocrine functions (Chaudhuri et al., 2014). It can be said that hip circumference is associated with reduced risk factors for several life-threatening diseases like diabetes and cardiovascular disease as it correlates with the waist circumference, the ratio of these two circumferences and its value can give an idea about the scenario of a population's health, lower value may indicate the lower risk factors. As we found a significantly higher value of this parameter in female bakery workers in comparison with the control sedentary females as well as the male bakery workers, we can say that the female bakery workers are spending their life in danger. They are having a chance of significant cardio vascular disease and diabetes as it has been proved that Nepalese are suffering from diabetes (Joshi et al., 2014). Thus, the female bakery workers also showed a tendency of mild hypertension as systolic blood pressure more than 140 mmHg and/or diastolic blood pressure 90 mmHg or above can be considered as hypertension (Hazarika et al., 2002). But on the other hand, we did not get any results in waist circumference, W/H ratio being significantly high indicate a propensity of obesity as we discussed earlier. Thus, it showed hypertensive character according to the definition of hypertension (Hazarika et al., 2002). MUAC is an important nutritional parameter to estimate the circumference of bone and muscle area of the upper arm which gives the idea about energy storage. Percentage of fat also can interfere with its value as the subcutaneous fat surrounds the muscle and bone. Fitness level of an individual depends on body fat percentage which is the only body measurement and without regard to height or weight we can directly calculate a person's relative body composition. In our study, we got the percentage of fat and mid-upper arm circumference significantly higher in the female than male. It indicates that more stored energy is present in female than the male which made the female bakery workers obese. BMI provides a measure of adiposity in individuals of different heights and weights (Fewtrell and Wells, 2006); as there is a direct proportional relationship between BMI and adiposity. This may be due to the differences in body composition (like MUAC and fat percentage) and thus the body fat may give more accurate results. From our current study, we can prognosticate that both the

population is in life threatening condition. But more awful conditions prevail with regard to the female bakery workers.

CONCLUSION

Occupational health is an integral part of the world economic enterprises, especially in the emerging economies of the world. Nepal being a part of this process, must conform to positive steps and measures for ensuring a better work environment for small and medium scale industries in general and bakery industry in particular. In this present study, both the male and female bakery workers showed abominable conditions especially the female bakery workers. This necessitates planned work designs and introduction of some occupational aids for the bakery workers of the region. More investigations in this field are the calling of the day. It is imperative for any society, irrespective of its position in the socio-economic growth index to engage in sustainable growth of both physical capital and working capital for its survival and development. The new constitution of Nepal has promised a new genre of health, labor and environmental rights to its citizens. The study in Palpa district emphasizes this cause and its early realization will indeed bring a steady and healthy society and economy.

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