LEVEL OF PARTICIPATION OF SMALL-SCALE CROP FARMERS IN AGRO-PROCESSING IN GAUTENG PROVINCE OF SOUTH AFRICA

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ABSTRACT

Agro-processing is becoming more popular and practiced by farmers to reduce post-harvest losses, add value to farm products and increase farm income. This paper presents the small-scale crop farmers' level of participation in agro-processing in the Gauteng province of South Africa. Data were collected from 255 small-scale crop farmers selected by random sampling using a semi-structured questionnaire. Statistical Package for Social Sciences (SPSS version 23 of 2015) was used to analyse data. Descriptive statistics (in form of percentages) were used to analyse the background characteristics of the farmers, whereas the multinomial logit model was further used to show the level of participation amongst the small-scale crop farmers. With respect to agro-processing, results indicated that 47.1% of the small-scale crop farmers participated partly, 40.8% of them participated fully while 12.2% did not participate at all. Results of the multinomial analyses indicated that, educational level ($p<0.05$), size of the field ($p<0.05$), distance to the market ($p<0.01$), and access to credit ($p<0.01$) had positive significant influence on small-scale crop farmers' choice to participate fully in agro-processing. Gender, regarding male participation ($p< 0.05$), and age of farmer ($p<0.01$) had significant influence on farmers' choice to fully participate in agro-processing. Furthermore, the results of the multinomial analyses showed that size of the field ($p<0.01$) owned by the farmer and access to credit ($p< 0.05$) had positive influence on the farmers' choice to participate partly in agro-processing whereas older farmers ($p< 0.05$), widows ($p< 0.1$) and farmers with more number of fields ($p<0.01$) were less likely to participate partly in agro-processing activities. These results have implications for the development of small-scale farmers venturing into agro-processing in the Gauteng province. Young females should be encouraged to join the agricultural sector as they are likely to participate in agro-processing activities which in turn results in improved income and food security at the household level. Furthermore, new agricultural education programmes should be encouraged in the area households as educated farmers are more likely to participate in the value addition activities of agro-processing.

Key words: Agro-processing, small-scale farmers, crop farmers, multinomial analyses and participation

INTRODUCTION

Crop-based agro-processed products such as peanut butter, fruit jam and maize meal are sold to the consumer in most supermarkets in South Africa. Agro-processing, which is the practice of transforming agricultural commodities into different forms that improve handling, increase shelf-life and value to product [1], is a process that encompasses all operations from the stage of harvest till the material reaches the end users in the desired form, packaging, quality, quantity and price [2]. It may bring a range of benefits to enterprising people in developing countries, including the potential for adding value to basic agricultural produce, thereby facilitating access to wider markets, improving the income-earning ability of small-scale producers and entrepreneurs, allowing improved use and control of local resources; and creating employment, particularly in the rural areas [3]. Estimates show that agro-processing adds value to the original products over and above the price by means of what is often a simple operation using relatively affordable machinery and equipment [4]. Agro-processing activities are divided into two major categories [5,6], including primary and secondary operations. Primary operations involve activities such as crop drying, shelling or threshing, cleaning, grading and parking. These activities are carried out mainly on the farm with the aim to transform the commodity into a slightly different form prior to storage, marketing and further processing. Secondary processing operations involve increasing the nutritional or market value of the commodity, where the physical form or appearance of the commodity is often totally changed compared to the original. Secondary processing operations involve activities such as milling grains to flour; grinding ground nuts to make peanut butter; pressing oil from vegetable seeds; pressing juice from fruits and making cheese from milk, with equipment and tools used varying at each stage of processing.

To be able to supply supermarkets, large agro-processing is needed and, therefore, small-scale farmers need to be trained and organised to meet the challenges of supplying to those supermarkets and international players [7]. Additionally, due to the complexity of the agro-processing industry in terms of the regulations and technological requirements, it is dominated by large, established companies in South Africa. Therefore, small-scale farmers have limited access to the agro-processing industry. This study refers to farmers operating less than 3 Hectares (8 acres) as small-scale farmers. However, small-scale crop farmers could still benefit from processing their produce by reducing post-harvest losses and wastage, increasing the shelf-life of their produce resulting in value addition and higher income transfer [8]. Minimising post-harvest losses is important because often, perishable agricultural products are produced in large quantities that cannot be consumed in time, and therefore they require processing to extend their storage period [9].

Agro-processing also offers investment opportunities for small investors operating simple hand tools [10], therefore, by encouraging and expanding agro-processing, the activities of small-scale farming entrepreneurs are not only propelled by developmental objectives, but also by changing food taste and preference consumption patterns emanating from population growth and increased urbanisation, coupled with growth in the middle class whose food patterns are skewed towards quality processed food that is convenient [11,12]. Small-scale agro-processing industries, therefore, need to be

promoted, and to improve efficiency and quality by upgrading their agro-processing skills, bettering product design, using materials more efficiently and improving marketing organisations [13]. Despite all opportunities available for adding value, minimising post-harvest losses, promoting price stability and increasing demand for agricultural produce, limited information exists about the level of participation of the small-scale farmers' venturing into the agro-processing enterprise. This paper aimed at reporting the level of participation of small-scale farmers venturing into crop agro-processing enterprises and their background determinants. This will enable farmers to identify various factors that are having influence on small-scale crop farmers' level of participation.

MATERIALS AND METHODS

Study area

The study was carried out in the Gauteng Province of South Africa. It has the largest population of all the provinces in South Africa, with 11.2 million people making up 22.4 percent of South Africa's total population. It is the smallest of South Africa's nine provinces at 17 010 square kilometres, which take up 1.4 percent of the country's land area. With a gross domestic product (GDP) valued at R811 billion ($54 billion), Gauteng generates 33.9 percent of South Africa's GDP and 10 percent of the total GDP of the entire African continent.
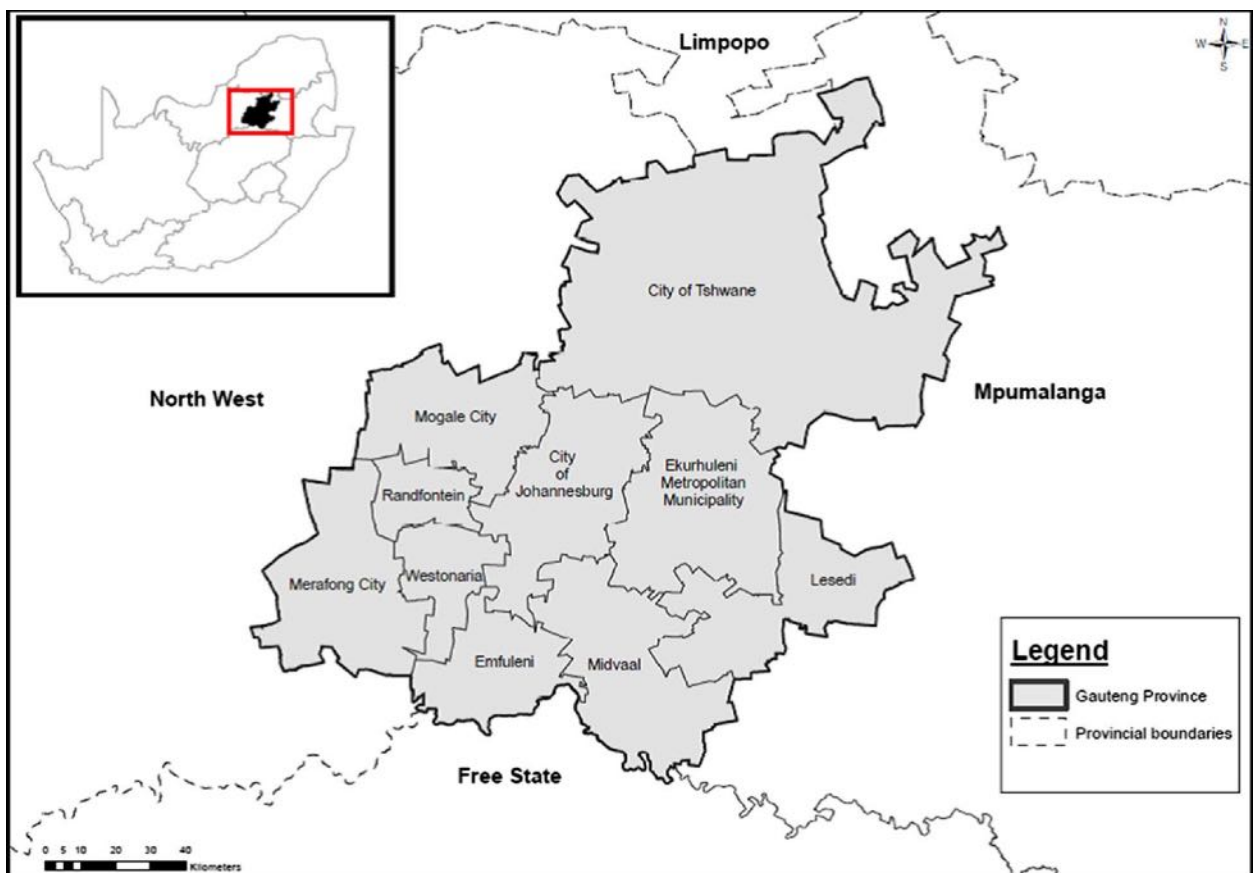

Figure 1: Map of the study area (Gauteng province) *Source:* [14]

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Sampling and Data collection
There were 966 small-scale farmers in the Gauteng province according to the list obtained from the Gauteng Department of Agriculture and Rural Development in 2017. These farmers were involved in different enterprises at different scales, such as animal production, mixed farming, fruit production and vegetable production. This study concentrated only on small-scale crop farmers. Therefore, purposive sampling was used to select all the 500 small-scale crop farmers in the whole province, who were involved in the production of crops, including citrus, groundnuts, grain and vegetables as the sample pool. From the sample pool, a random sampling technique was used to select 255 small-scale crop farmers as the sample size for this study. Random sampling was used to eliminate any bias and to give all participants an equal chance to participate in the study; this was done by selecting any names of farmers on the list with no order. Following the Krejcie and Morgan [15] method of determining a sample size, revised by Rahi [16], in a population of 500, a sample at least 217 or above can ensure the reliability of the data collected. In this study, 255 questionnaires were used to collect data from small-scale crop farmers in the five district municipalities of the Gauteng province and captured for data analysis. A semi-structured questionnaire was used to collect the data, among them the background characteristics of small-scale farmers, their level of participation in agro-processing, their access to agricultural services and the challenges and opportunities the small-scale farmers in the area faced. A team of three researchers administered the questionnaires through face–to-face interviews with the farmers. The questionnaires were in English, but direct translation to the small-scale farmers' preferred language was done where needed.

Data analysis and model specification
Data were coded according to the different variables and entered using Statistical Package for Social Sciences (SPSS version 23 of 2015), then analysed. Descriptive statistics (the percentage frequencies in particular) were used to analyse the background characteristics of the small-scale crop farmers including age, gender, household income, marital status, household size and the level of education. A multinomial logit model was used to assess factors influencing the level of participation by small-scale crop agro-processors. The model permits the use of a categorical dependent variable. In this model there are a number of alternatives that generate the probability [17]. The model test consisted of three possibilities, P_j $(j = 1,\dots,3)$, associated with the three levels of participation. The probability of a small-scale crop farmer participating partly will be P_1, farmers participating partly refer to those who do not process all their products, but only process a portion of their products; the probability of a small-scale farmer participating fully will be P_2, farmers participating fully are the small scale farmers who process all of their products; and the probability of a small-scale farmer not participating will be P_3, those a farmers who do not process their products. Following the multinomial logit equation (below) used by Nielsen [18].

$$log_e \left(\frac{p_j}{p_1}\right) = \alpha_{j+ \beta_{jk} X_{ki} + \mu_{ji}} \tag{1}$$

Where:

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J = 1,2,3 categories (levels of participation by the small-scale crop agro-processors);
i = 1,….,n observations;
α = intercepts;
β = coefficients;
X_k = 1,….,m explanatory variables ;
μ = error terms.

The estimation procedure generates the coefficients of the probabilities of an observation falling into three categories, respectively. Alternative comparisons of other probabilities with different bases can be derived from:

$$log_e \left(\frac{p_j}{p_k}\right) i = log_e \left(\frac{p_j}{p_1}\right) i - log_e \left(\frac{p_h}{p_1}\right) i \tag{2}$$

Where j = 3 and h = 2, with j not equal to h simultaneously, and by using:

$$log_e \left(\frac{p_j}{p_1}\right) i = \left(\alpha_j - \alpha_h\right) + \left(\beta_{jk} - \beta_{hk}\right)X_{ki} \tag{3}$$

The first set of estimated coefficients were used to calculate the three probabilities of the linkages between small-scale farmers and the level of their participation in agro-processing industries.

Model fitness information revealed an approximate Chi-Square of 347.101 with 36 degrees of freedom, which was significant at $p < 0.001$ (Table 1)**.** Therefore, the multinomial model was considered an appropriate technique for further analysis of the data.

RESULTS AND DISCUSSION

Background characteristics analyses

The results of the background characteristics (Table 2) reveal that half (51%) of the small-scale crop farmers were female. Agro-processing which is mostly undertaken by women has the capacity of uplifting their status, and ultimately empower them [19]. Crop farming is concentrated within the productive age (31-60 years), who constituted 80.8%, compared to the younger (<30 years) age groups who constituted 11.4%. Farmers above 60 years constituted 7.8% of the sample. It is worth noting that the elderly farmers are not much productive due to the drudgery nature of agricultural activities hence fewer farmers were above 60 years of age in the study. According to [20], farmers over 30 years old were the ones dominating in agro-processing activities in South Africa.

Small-scale crop farmers with formal education from primary, secondary and tertiary contributed to 95.3%, majority (50.6%), of them had secondary school education, with only 4.7% having informal and other forms of education such as indigenous knowledge and agricultural extension education. However, a study [21] stated that majority of the

small-scale agro-processors are illiterate or semi-illiterate and have no formal training, whose source of knowledge on processing and skills is apprenticeship.

In the African context, household membership is a matter of importance as it is regarded as a source of labour [22]. However, the results of this study showed that a household with more than eight members constituted the lowest percentage (14.1%) and households with three to five members comprised the most (49.9%). A large family size (>8 members) has higher economic implications, hence the compelling need to empower the families through an agro-processing entrepreneurial venture [9]. Among the small-scale crop farmers, 51% were single (had never been married), compared to 38.8% of who were married, 5.1% having separated and 5.1% having been widowed. The majority of the small-scale crop farmers (45.9%) earned between R5 000 and R10 000 per month, with 7.0% of who earned more than R15 000 per month (R15.14 = 1 US$ as of 30th January 2021).

Level of participation of the small-scale crop farmers as agro-processing entrepreneurs

The results (Table 3) reveal that 40.8% of the small-scale crop farmers fully processed their farm produce, while 47.1% partly did, and only 12.2% sold their farm products in the original form to the consumers. Similarly, a study on farm households' livelihood diversification into processing activities in Ghana [19] reported that 19.6 % of the farmers did not diversify or process their agricultural produce. Farmers who engaged in diversifying and processing their products were 80.4%. This result implies that more small-scale crop farmers do not rely on the primary output of their crop cultivation only but are also involved and participating in processing their crop.

Factors that influence small scale crop farmers' levels of participation in agro-processing

Table 4 shows the results of multinomial logit on the choice of the small-scale crop farmers to participate fully or partly in the agro-processing entrepreneurship.

Gender of the small-scale crop farmers was observed to have a negative, significant influence at 95% confidence level on the choice of fully participating in agro-processing (coefficient = -0.976). This implies that the male small-scale crop farmers were less likely to participate fully in agro-processing compared to their female counterparts. Likewise, a study on the potential of agro-industry revealed that more than 80% of participants in agro-processing industries were women [22]. As an increasing number of women are engaging in trading or business today, there is a need to get a little more sophisticated by engaging in agro-processing in order to build strong and sustainable enterprises [9]. Education also plays a role in the development and transformation capacity of entrepreneurs by equipping them with literacy and managerial skills [23]. The results in this study concur with this observation. The (coefficient = 0.609) of the education was positive at 1% significance level. This means that small-scale crop farmers with a higher education level are more likely to participate fully in agro-processing. According to Khoza et al. [20] a farmer with secondary education can have the ability to access information from the print and electronic media and they can easily apply processing techniques.

Age of the small-scale crop farmers had a significant negative influence (p<0.001, coefficient = -1.452) on the choice of fully participating in agro-processing. The older the small-scale crop farmers, the less likely they were to participate fully in agro-processing. The widow marital status had a negative significant influence on the choice of a small-scale crop farmer partly participating in the agro-processing (p<0.000, coefficient = -0.909). This implies that, married, small-scale crop farmers are more likely to participate partly in agro-processing. Married people have the responsibility to provide, process and market food items for the household, as well as to sell fresh fruits and processed agricultural products to earn an income [9]. This indicates that married small-scale crop farmers are likely to partly participate in agro-processing since they have other responsibilities.

The size of the field was also observed to have a positive significant influence (p<0.001) on the small-scale crop farmers choosing to participate both fully and partly in agro-processing. Its coefficient was positive implying that the small-scale crop farmers were more likely to participate fully and partly in the agro-processing entrepreneurship, provided they had lager size of land. Number of fields owned by the small-scale crop farmers showed a negative significant influence (p<0.000, coefficient = -3.721) on the choice of partly participating in agro-processing, suggesting that the more planting fields the small-scale crop farmers owned, the less likely they were to participate partly in agro-processing. Distance to the market had positive significant influence (p<0.000, coefficient = 0.040) on the small-scale crop farmers choosing to participate fully in agro-processing. The longer the distance to the market, the more likely it was for a small-scale crop farmer to participate fully in the processing of farm produce. Agro-processing of the farm produce could be done to increase the shelf life of the products before taking them to the market. Access to credit was also observed to have positive significant influence (p<0.000, coefficient = 7.259) on the small-scale crop farmers choosing to participate fully in agro-processing, and significant influence (p<0.010, coefficient = 1.827) on the choice of partly participating in agro-processing. Lack of credit constrains farmers to accumulate capital, expand production to enhance productivity [24].

CONCLUSION

Regarding farmers' full participation, the variables: size of field, distance to market and access to credit had a positive significant influence on farmers' choices. The variables: gender (with regards to males) and age of the farmer, had a negative significant influence on farmers' full participation. The variables size of the field, distance to market and access to credit had a positive significant influence on farmers' choice to participate partially in agro-processing. Number of fields owned by the small-scale crop farmers showed a negative significant influence on partial participation. The widow marital status also had a negative influence on partial participation of farmers in agro-processing.

The level of participation for small-scale crop farmers in agro-processing in the study area is fairly high. This implies that small-scale farmers are not only interested in marketing their products in the primary form, rather they are also interested in marketing their products in a processed form. Though the level of partial participation is high, there

is need to improve those who engage in diversification and processing fully to guard against production, marketing and financial risks. Taking into consideration the important role played by women in agricultural production and food security, evidence from the study shows that there is need for continuous support to female farmers as they can fully participate in agro-processing activities more so than their male counterparts. Though males were less likely to participate, they should also be encouraged to participate fully or partially. Widows should be offered institutional support so that they also participate in the agro-processing activities and improve their income and household food security. Furthermore, agricultural education programmes should be stimulated for the small-scale crop farmers as educated farmers are able to grasp and adopt the use of new technology for sustainable agricultural production. The government should use the land reform policy to avail more land to small-scale farmers. There is also need for the government to scale up financial assistance and credit programmes to the small-scale farmers as access to credit is important for agricultural development. The findings in this study are applicable in developing countries where small-scale farmers contribute significantly to national food security; the agro-processing activities are important for value addition, reduction of post-harvest losses and income generation.

ETHICAL ASPECTS

This study took several ethical considerations into account, to ensure it was conducted in an appropriate manner. Permission to collect data from small-scale crop farmers within the vicinity of the Gauteng Province was obtained from the Gauteng Department of Agriculture and Rural Development (GDARD). Ethical clearance to conduct the research was obtained from Ethics Committee of the University of South Africa (UNISA) prior to data collection. During data collection, consent was requested from the farmers to participate in the study and participation was voluntary. Farmers were also informed that the data will be used for the purpose of the study only.

Table 1: Model fitting information

Model	Likelihood	Chi-Square	df	sig
Intercept only	598.434			
Final	251.332	347.101	22	
	0.000			

Source: Own calculations based on the survey (2018–2019)

Table 2: Socioeconomic characteristics of the small-scale crop farmers

Variables	Percentages
Gender of the small-scale crop farmers	
0 = Female	51.0 %
1 = Male	49.0 %
Age of the small-scale crop farmers	
18–30 years old	11.4%
31–40 years old	30.2%
41–50 years old	25.5%
51–60 years old	25.1%
Over the age of 60 years	07.8%
Educational level of the small-scale crop farmers	
Primary education	14.1%
Secondary education	50.6%
Tertiary education	30.6%
Informal education	04.3%
Other	00.4%
Household size of the small-scale crop farmers	
Less than 2 members	11.4%
3 – 5 members	49.9%
6 – 8 members	25.1%
More than 8 members	14.1%
Marital status of the small-scale crop farmers	
Single	51.0%
Married	38.8%
Separated	05.1%
Widow	05.1%
Household income (monthly) of the small-scale crop farmers	
Less than R5 000	37.3%
R5 000 – R10 000	45.9%
More than R10 000 – R15 000	09.0%
More than R15 000	07.8%

Source: Own calculations based on the survey (2018–2019), N = 255

Table 3: Level of participation of the small-scale crop farmers as agro-processing entrepreneurs

Level of participation	Frequency	Percentage
Fully participating	104	40.8%
Partly participating	120	47.1%
Not participating	31	12.2%

Source: Own calculations based on the survey (2018–2019), N = 255

Table 4: Multinomial logit regression estimates of factors influencing the choice of small-scale crop farmers to participate fully or partly in agro-processing entrepreneurship

Participation	Variables	Coefficient	Standard error	Wald	P-value
Fully	**Gender** (1 = Male; 0 = Female)	-0.976	0.426	3.490	0.022
	Age 1 = < 30 years 2 = 31-40 years 3 = 41-50 years 4 = 51-60 years 5 = > 60 years	-1.452	0.233	5.255	0.000***
	Education 1 = Primary 2 = Secondary 3 = Tertiary 4 = Informal 5 = Other	0.609	0.281	4.692	0.031**
	Household size 1 = < 2 people 2 = 3-5 people 3 = 5-7 people 4 = > 7 people	-0.543	0.414	1.721	0.190
	Marital status 1 = Single 2 = Married 3 = Separated 4 = Widow	0.036	0.408	0.008	0.929

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	Household income Less than R5000 R5000 – R10000 >R10000 – R15000 >R15000	0.548	0.489	1.258	0.262
	Size of the field (continues)	0.686	0.331	4.295	0.038**
	Number of fields (continues)	-0.378	1.549	0.060	0.807
	Number of labourers (continues)	-0.420	0.288	2.126	0.145
	Distance to the market (continues)	0.205	0.040	26.287	0.000***
	Experience (continues)	-0.246	0.345	510	0.475
	Access to credit (1 = Yes, 0 = No)	7.259	2.529	8.238	0.004***

Participation	Variables	Coefficient	Standard error	Wald	P-value
Fully	**Gender** (1 = Male; 0 = Female)	-0.588	0.432	38.975	0.173
	Age 1 = < 30 years 2 = 31-40 years 3 = 41-50 years 4 = 51-60 years 5 = > 60 years	-0.379	0.203	1.854	0.062*
	Education 1 = Primary 2 = Secondary 3 = Tertiary 4 = Informal 5 = Other	-0.120	0.284	.177	0.674
	Household size 1 = < 2 people 2 = 3-5 people 3 = 5-7 people 4 = > 7 people	0.298	0.283	1.110	0.292

Marital status 1 = Single 2 = Married 3 = Separated 4 = Widow	-0.909	0.301	9.102	0.003***
Household income Less than R5000 R5000 – R10000 >R10000 – R15000 >R15000	0.226	0.282	.645	0.422
Size of the field (continues)	0.739	0.285	6.725	0.010**
Number of fields (continues)	-3.721	1.255	8.796	0.003***
Number of labourers (continues)	-0.174	0.188	.860	0.354
Distance to the market (continues)	0.067	0.037	3.210	0.073
Experience (continues)	-0.210	0.227	.855	0.355
Access to credit (1 = Yes, 0 = No)	1.827	0.709	6.637	0.010*

Source: Own calculations based on the survey (2018–2019), ***$P < 0.000$ = 1%, **$P < 0.001$= 5%.*p<0.010; N = 255

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