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Research Article

Comparative Analysis of Multiple Comparison Tests for Radiation Exposure Subgroups Among Dental Workers At Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, Nigeria

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Abstract

Post-hoc analysis is a crucial statistical technique employed to identify specific group differences following a significant ANOVA result. This study delves into the comparative analysis of three commonly used post-hoc tests - Tukey's HSD, LSD, and Scheffe's method - to determine significant differences in radiation exposure levels among dental workers at Usman Danfodiyo University Teaching Hospital, Sokoto, Nigeria. Dental professionals are routinely exposed to ionizing radiation, primarily from X-ray machines. Excessive exposure can lead to various health risks, including cancer. Hence, accurate assessment and comparison of radiation exposure levels among different categories of dental workers are essential for effective radiation protection measures. In this study, the researchers calculated the critical values for each post-hoc test at a significance level of 0.05. The results indicated that the LSD method had the smallest critical value (0.674), followed by Tukey's HSD (1.304) and Scheffe's method (1.566). A lower critical value generally implies a higher sensitivity in detecting significant differences between groups. By conducting pairwise comparisons, the study found that the LSD method was the most effective in identifying statistically significant differences in radiation exposure levels among the dental workers. This suggests that the LSD method is a suitable choice for post-hoc analysis in this specific context. The findings of this study have significant implications for radiation protection practices in dental settings. By employing appropriate post-hoc analysis methods, healthcare institutions can accurately assess radiation exposure risks and implement targeted interventions to minimize exposure and protect the health of dental workers.

Keywords

Post Hoc, Least Significant Difference, Honestly Significant Difference Scheffes, Effective Dose, Collective Dose

1. Introduction

In the field of dental healthcare, radiation exposure is an occupational hazard that necessitates meticulous monitoring and evaluation to ensure the safety of dental workers. Understanding the differential exposure levels among subgroups of dental workers is crucial for implementing effective protective measures and minimizing health risks. This

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study focuses on the comparative analysis of three prominent post hoc statistical tests. Tukey's Honest Significant Difference (HSD), the Least Significant Difference (LSD), and Scheffe's method to identify significantly different radiation exposure levels among dental workers at Usman Danfodiyo University Teaching Hospital in Sokoto, Nigeria [1].

Post hoc analysis serves as a pivotal tool in statistical analysis by providing detailed insights into the specific differences between group means after an ANOVA has indicated overall significance [2]. These analyses are critical in identifying specific pairs of groups that exhibit significant differences, thereby offering more precise guidance for targeted interventions. Each post hoc test has unique strengths and limitations that make them suitable for different research contexts.

2. Literature Review

The analysis of variance (ANOVA) is a crucial statistical tool used in medical research to compare mean differences among groups. Post-hoc tests, such as Tukey's Honest Significant Difference (HSD), Least Significant Difference (LSD), and Scheffé's method, are commonly employed to further investigate which specific group means are significantly different from each other after finding a significant overall F-test in ANOVA. This literature review explores these three post-hoc tests, focusing on their application in the context of identifying significant differences in radiation exposure among dental workers. The comparative analysis aims to determine the most appropriate post-hoc test for the given scenario, taking into consideration the statistical power, control of Type I error, and the specific characteristics of the data.

3. Tukey's Honest Significant Difference (HSD) Test

Tukey's HSD test is a widely used post-hoc analysis technique that controls the familywise error rate (FWER) when making multiple comparisons. It is particularly effective in scenarios where the sample sizes are equal across groups. According to [3], Tukey's HSD test is advantageous because it is conservative in nature, meaning it has a lower likelihood of identifying a significant difference when one does not exist. This is particularly important in medical research, where the implications of false positives can be severe. The test is also robust to violations of assumptions of normality, making it suitable for the complex data often encountered in radiation exposure studies.

In the context of radiation exposure among dental workers, the Tukey HSD test is beneficial due to its ability to maintain the overall Type I error rate across multiple comparisons. Given that radiation exposure data can exhibit variability, the conservative nature of Tukey's test ensures that the results are reliable and not prone to false alarms.

4. Least Significant Difference (LSD) Test

The Least Significant Difference (LSD) test, developed by Fisher, is one of the simplest post-hoc tests available. It does not control for the familywise error rate, which can lead to an inflated Type I error rate when multiple comparisons are made. However, its simplicity and ease of use make it a popular choice in situations where the number of comparisons is limited or where researchers are primarily interested in exploratory analysis rather than confirmatory hypothesis testing [4]. In the case of identifying subgroups with significantly different radiation exposure among dental workers, the LSD test may provide more significant results due to its lower threshold for significance. However, the lack of control for multiple comparisons means that these results should be interpreted with caution, especially in a medical setting where the cost of Type I errors can be high. The test is more appropriate in preliminary analyses or when the number of comparisons is small and the focus is on identifying potential areas of interest for further investigation.

5. Scheffé's Test

Scheffé's test is another method for controlling the FWER in post-hoc analyses. It is particularly flexible because it can be applied to all possible contrasts, not just pairwise comparisons, making it a powerful tool when the researcher is interested in testing a wide range of hypotheses. [5] noted that Scheffé's test is more conservative than Tukey's HSD, meaning it is less likely to find significant differences unless they are truly present.

For the study of radiation exposure among dental workers, Scheffé's test offers the advantage of flexibility and rigorous control of the Type I error rate, even when multiple and complex comparisons are being made. This makes it particularly useful in a comprehensive analysis where all possible group differences need to be explored. However, the increased conservativeness may lead to fewer significant findings, which could be a limitation when the goal is to identify all potential differences in exposure levels.

6. Comparative Analysis in Medical Research

Comparing Tukey, LSD, and Scheffé tests in the context of medical research, particularly in analyzing radiation exposure, reveals distinct strengths and weaknesses for each method. [6] Highlights that while Tukey's HSD and Scheffé's test provide robust control over Type I error, they may be less sensitive in detecting true differences compared

to the LSD test. However, the LSD test's susceptibility to Type I error inflation makes it less reliable in studies involving multiple comparisons, which is a common scenario in medical research involving multiple subgroups.

The choice of post-hoc test depends on the specific research goals. For example, if the objective is to identify all possible differences with a high level of confidence, Scheffé's test would be appropriate. If the focus is on detecting as many differences as possible, even at the risk of increased Type I errors, the LSD test might be used. Tukey's HSD test offers a middle ground, providing a balance between sensitivity and error control, making it a suitable choice for many medical research applications, including the study of radiation exposure.

7. Application in Radiation Exposure Studies

The assessment of radiation exposure among dental workers at Usmanu Danfodiyo University Teaching Hospital in Sokoto, Nigeria, presents a real-world case where these statistical methods can be applied. [7] emphasized the importance of accurate statistical methods in occupational exposure studies to ensure reliable results that can inform safety guidelines and protocols. The choice of post-hoc test can significantly impact the conclusions drawn from the data, influencing the recommendations for radiation safety.

Using a robust test like Scheffé's would provide a conservative estimate of differences in radiation exposure, ensuring that any significant findings are likely to represent true differences. This is crucial in settings where worker safety is concerned. However, if the goal is to explore potential differences more broadly, perhaps to guide future studies or interventions, the LSD test might offer more insights, albeit with the caveat of a higher risk of false positives.

8. Methodology

8.1. Research Methodology

8.1.1. Study Design

This study employs a cross-sectional design to compare the efficacy of three post hoc statistical tests Tukey's Honest Significant Difference (HSD), Least Significant Difference (LSD), and Scheffe's method in identifying subgroups with significantly different radiation exposure among dental workers at Usman Danfodiyo University Teaching Hospital, Sokoto, Nigeria.

8.1.2. Study Population

The study population consists of 20 dental workers at Usman Danfodiyo University Teaching Hospital. This includes dentists, dental nurses, dental hygienists, and dental assistants who are routinely exposed to radiation during diagnostic and therapeutic procedures.

8.1.3. Sample Size and Sampling Technique

A total of 20 dental workers were selected using stratified random sampling to ensure representation across different job roles. The sample size was determined based on the Cochran formula for sample size estimation in a finite population, adjusted for an expected response rate of 90%.

8.2. Data Collection

8.2.1. Radiation Exposure Measurement

Radiation exposure data were collected using personal dosimeters worn by the dental workers for a period of three months. The dosimeters were analyzed monthly to record cumulative radiation exposure in millisieverts (mSv).

8.2.2. Demographic and Occupational Data

Additional data were collected through structured questionnaires, including demographic information (age, gender, years of experience) and occupational data (job role, hours of work per week, use of protective equipment).

8.3. Data Analysis

8.3.1. ANOVA

An initial one-way ANOVA was conducted to determine if there were statistically significant differences in radiation exposure among the different subgroups of dental workers.

8.3.2. Post Hoc Tests

Upon finding a significant F-ratio in the ANOVA, three post hoc tests were applied to identify which pairs of subgroups had significantly different radiation exposure levels.

8.3.3. Data Management and Statistical Software

Data were entered, cleaned, and analyzed using IBM SPSS Statistics software version 25. Descriptive statistics were used to summarize the demographic and occupational data. The ANOVA and post hoc tests were conducted using the appropriate modules within the software [8].

To compare the effective doses of Dental medical radiation workers, a post hoc analysis was conducted. The first post hoc test used was the LSD test. Fisher initially devised this test to compare all possible pair-wise mean differences within a factor using multiple t-tests. This approach was known as the Least Significant Difference (LSD) test. The LSD between two means is calculated by the following formula:

$$LSD = \mathrm{t} \times \sqrt{\frac{2MSE}{n^*}} \quad (1)$$

Here, t represents the critical t-distribution value associated with MSE (mean square error), and n* is the number of scores used to calculate the relevant means.

Another post hoc test employed was Tukey's HSD test. This was developed as an improvement over the LSD test, and it effectively maintains the desired alpha levels if underlying statistical assumptions like normality, homogeneity, and independence are met. Although designed for situations with equal group sample sizes, Tukey's HSD can be adapted for unequal sizes as well (using the harmonic mean of sample sizes as n*). The formula for Tukey's HSD is as follows:

$$H.nSD = \mathrm{q} \times \sqrt{\frac{MSE}{n^*}} \quad (2)$$

Where q = the relevant critical value of the studentized range statistic and n* is the number of scores used in calculating the group means of interest.

Scheffe's test. Scheffe's procedure is perhaps the most popular of the post hoc procedures, the most flexible, and the most conservative. Scheffe's procedure corrects alpha for all pair-wise or simple comparisons of means, but also for all complex comparisons of means as well. Complex comparisons involve contrasts of more than two means at a time. As a result, Scheffe's is also the least statistically powerful procedure. Scheffe's is presented and calculated below for our pair- wise situation for purposes of comparison and because Scheffe's is commonly applied in this situation, but it should be recognized that Scheffe's is a poor choice of procedures unless complex comparisons are being made [9].

For pair-wise comparisons, Scheffe's can be computed as follows:

$$\text{Sheffe} = \sqrt{(K-1)F}\ \sqrt{\mathrm{MSE}\,(1/\mathrm{n1} + 1/\mathrm{n2})} \quad (3)$$

9. Results and Discussion

9.1. Results

Table 1. LSD ANOVA for the comparisons.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17.172[a]	13	1.321	1.150	.340
Intercept	46.284	1	46.284	40.289	.000
Dental	17.172	13	1.321	1.150	.340
Error	64.332	56	1.149		
Total	127.788	70			
Corrected Total	81.504	69			

a. R Squared = .211 (Adjusted R Squared = .027)

The table above showed that the mean square within the group for the comparisons is 1.149, $F_{critical = 1.150}$ within 70 degree of freedom with significant value of 0.182, greater than the p-value of 0.05, this meant that the probability for the comparisons is greater than 5%, which made the comparisons statistically not significant [10].

Table 2. LSD Post hoc Analysis Test for Dental Medical workers.

LSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
DN01	DN18b	.9000	.67788	.190	-.4579	2.2579
	DN19b	.8520	.67788	.214	-.5059	2.2099

LSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN20b	.7960	.67788	.245	-.5619	2.1539
	DN24	.1400	.67788	.837	-1.2179	1.4979
	DN36	.9020	.67788	.189	-.4559	2.2599
	DN05	-.5680	.67788	.406	-1.9259	.7899
	DN5b	.4720	.67788	.489	-.8859	1.8299
	DN06	.6400	.67788	.349	-.7179	1.9979
	DN09	-.3480	.67788	.610	-1.7059	1.0099
	DN10	-.0860	.67788	.900	-1.4439	1.2719
	DN11	-.2040	.67788	.765	-1.5619	1.1539
	DN17	.3080	.67788	.651	-1.0499	1.6659
	DN17b	.8840	.67788	.198	-.4739	2.2419
	DN01	-.9000	.67788	.190	-2.2579	.4579
	DN19b	-.0480	.67788	.944	-1.4059	1.3099
	DN20b	-.1040	.67788	.879	-1.4619	1.2539
	DN24	-.7600	.67788	.267	-2.1179	.5979
	DN36	.0020	.67788	.998	-1.3559	1.3599
	DN05	-1.4680*	.67788	.035	-2.8259	-.1101
DN18b	DN5b	-.4280	.67788	.530	-1.7859	.9299
	DN06	-.2600	.67788	.703	-1.6179	1.0979
	DN09	-1.2480	.67788	.071	-2.6059	.1099
	DN10	-.9860	.67788	.151	-2.3439	.3719
	DN11	-1.1040	.67788	.109	-2.4619	.2539
	DN17	-.5920	.67788	.386	-1.9499	.7659
	DN17b	-.0160	.67788	.981	-1.3739	1.3419
	DN01	-.8520	.67788	.214	-2.2099	.5059
	DN18b	.0480	.67788	.944	-1.3099	1.4059
	DN20b	-.0560	.67788	.934	-1.4139	1.3019
	DN24	-.7120	.67788	.298	-2.0699	.6459
	DN36	.0500	.67788	.941	-1.3079	1.4079
	DN05	-1.4200*	.67788	.041	-2.7779	-.0621
DN19b	DN5b	-.3800	.67788	.577	-1.7379	.9779
	DN06	-.2120	.67788	.756	-1.5699	1.1459
	DN09	-1.2000	.67788	.082	-2.5579	.1579
	DN10	-.9380	.67788	.172	-2.2959	.4199
	DN11	-1.0560	.67788	.125	-2.4139	.3019
	DN17	-.5440	.67788	.426	-1.9019	.8139

LSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN17b	.0320	.67788	.963	-1.3259	1.3899
	DN01	-.7960	.67788	.245	-2.1539	.5619
	DN18b	.1040	.67788	.879	-1.2539	1.4619
	DN19b	.0560	.67788	.934	-1.3019	1.4139
	DN24	-.6560	.67788	.337	-2.0139	.7019
	DN36	.1060	.67788	.876	-1.2519	1.4639
	DN05	-1.3640*	.67788	.049	-2.7219	-.0061
DN20b	DN5b	-.3240	.67788	.635	-1.6819	1.0339
	DN06	-.1560	.67788	.819	-1.5139	1.2019
	DN09	-1.1440	.67788	.097	-2.5019	.2139
	DN10	-.8820	.67788	.199	-2.2399	.4759
	DN11	-1.0000	.67788	.146	-2.3579	.3579
	DN17	-.4880	.67788	.475	-1.8459	.8699
	DN17b	.0880	.67788	.897	-1.2699	1.4459
	DN01	-.1400	.67788	.837	-1.4979	1.2179
	DN18b	.7600	.67788	.267	-.5979	2.1179
	DN19b	.7120	.67788	.298	-.6459	2.0699
	DN20b	.6560	.67788	.337	-.7019	2.0139
	DN36	.7620	.67788	.266	-.5959	2.1199
	DN05	-.7080	.67788	.301	-2.0659	.6499
DN24	DN5b	.3320	.67788	.626	-1.0259	1.6899
	DN06	.5000	.67788	.464	-.8579	1.8579
	DN09	-.4880	.67788	.475	-1.8459	.8699
	DN10	-.2260	.67788	.740	-1.5839	1.1319
	DN11	-.3440	.67788	.614	-1.7019	1.0139
	DN17	.1680	.67788	.805	-1.1899	1.5259
	DN17b	.7440	.67788	.277	-.6139	2.1019
	DN01	-.9020	.67788	.189	-2.2599	.4559
	DN18b	-.0020	.67788	.998	-1.3599	1.3559
	DN19b	-.0500	.67788	.941	-1.4079	1.3079
	DN20b	-.1060	.67788	.876	-1.4639	1.2519
DN36	DN24	-.7620	.67788	.266	-2.1199	.5959
	DN05	-1.4700*	.67788	.034	-2.8279	-.1121
	DN5b	-.4300	.67788	.528	-1.7879	.9279
	DN06	-.2620	.67788	.701	-1.6199	1.0959
	DN09	-1.2500	.67788	.070	-2.6079	.1079

LSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN10	-.9880	.67788	.151	-2.3459	.3699
	DN11	-1.1060	.67788	.108	-2.4639	.2519
	DN17	-.5940	.67788	.385	-1.9519	.7639
	DN17b	-.0180	.67788	.979	-1.3759	1.3399
	DN01	.5680	.67788	.406	-.7899	1.9259
	DN18b	1.4680*	.67788	.035	.1101	2.8259
	DN19b	1.4200*	.67788	.041	.0621	2.7779
	DN20b	1.3640*	.67788	.049	.0061	2.7219
	DN24	.7080	.67788	.301	-.6499	2.0659
	DN36	1.4700*	.67788	.034	.1121	2.8279
DN05	DN5b	1.0400	.67788	.131	-.3179	2.3979
	DN06	1.2080	.67788	.080	-.1499	2.5659
	DN09	.2200	.67788	.747	-1.1379	1.5779
	DN10	.4820	.67788	.480	-.8759	1.8399
	DN11	.3640	.67788	.593	-.9939	1.7219
	DN17	.8760	.67788	.202	-.4819	2.2339
	DN17b	1.4520*	.67788	.037	.0941	2.8099
	DN01	-.4720	.67788	.489	-1.8299	.8859
	DN18b	.4280	.67788	.530	-.9299	1.7859
	DN19b	.3800	.67788	.577	-.9779	1.7379
	DN20b	.3240	.67788	.635	-1.0339	1.6819
	DN24	-.3320	.67788	.626	-1.6899	1.0259
	DN36	.4300	.67788	.528	-.9279	1.7879
DN5b	DN05	-1.0400	.67788	.131	-2.3979	.3179
	DN06	.1680	.67788	.805	-1.1899	1.5259
	DN09	-.8200	.67788	.231	-2.1779	.5379
	DN10	-.5580	.67788	.414	-1.9159	.7999
	DN11	-.6760	.67788	.323	-2.0339	.6819
	DN17	-.1640	.67788	.810	-1.5219	1.1939
	DN17b	.4120	.67788	.546	-.9459	1.7699
	DN01	-.6400	.67788	.349	-1.9979	.7179
	DN18b	.2600	.67788	.703	-1.0979	1.6179
	DN19b	.2120	.67788	.756	-1.1459	1.5699
DN06	DN20b	.1560	.67788	.819	-1.2019	1.5139
	DN24	-.5000	.67788	.464	-1.8579	.8579
	DN36	.2620	.67788	.701	-1.0959	1.6199

LSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN05	-1.2080	.67788	.080	-2.5659	.1499
	DN5b	-.1680	.67788	.805	-1.5259	1.1899
	DN09	-.9880	.67788	.151	-2.3459	.3699
	DN10	-.7260	.67788	.289	-2.0839	.6319
	DN11	-.8440	.67788	.218	-2.2019	.5139
	DN17	-.3320	.67788	.626	-1.6899	1.0259
	DN17b	.2440	.67788	.720	-1.1139	1.6019
	DN01	.3480	.67788	.610	-1.0099	1.7059
	DN18b	1.2480	.67788	.071	-.1099	2.6059
	DN19b	1.2000	.67788	.082	-.1579	2.5579
	DN20b	1.1440	.67788	.097	-.2139	2.5019
	DN24	.4880	.67788	.475	-.8699	1.8459
	DN36	1.2500	.67788	.070	-.1079	2.6079
DN09	DN05	-.2200	.67788	.747	-1.5779	1.1379
	DN5b	.8200	.67788	.231	-.5379	2.1779
	DN06	.9880	.67788	.151	-.3699	2.3459
	DN10	.2620	.67788	.701	-1.0959	1.6199
	DN11	.1440	.67788	.833	-1.2139	1.5019
	DN17	.6560	.67788	.337	-.7019	2.0139
	DN17b	1.2320	.67788	.075	-.1259	2.5899
	DN01	.0860	.67788	.900	-1.2719	1.4439
	DN18b	.9860	.67788	.151	-.3719	2.3439
	DN19b	.9380	.67788	.172	-.4199	2.2959
	DN20b	.8820	.67788	.199	-.4759	2.2399
	DN24	.2260	.67788	.740	-1.1319	1.5839
	DN36	.9880	.67788	.151	-.3699	2.3459
DN10	DN05	-.4820	.67788	.480	-1.8399	.8759
	DN5b	.5580	.67788	.414	-.7999	1.9159
	DN06	.7260	.67788	.289	-.6319	2.0839
	DN09	-.2620	.67788	.701	-1.6199	1.0959
	DN11	-.1180	.67788	.862	-1.4759	1.2399
	DN17	.3940	.67788	.563	-.9639	1.7519
	DN17b	.9700	.67788	.158	-.3879	2.3279
	DN01	.2040	.67788	.765	-1.1539	1.5619
DN11	DN18b	1.1040	.67788	.109	-.2539	2.4619
	DN19b	1.0560	.67788	.125	-.3019	2.4139

LSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN20b	1.0000	.67788	.146	-.3579	2.3579
	DN24	.3440	.67788	.614	-1.0139	1.7019
	DN36	1.1060	.67788	.108	-.2519	2.4639
	DN05	-.3640	.67788	.593	-1.7219	.9939
	DN5b	.6760	.67788	.323	-.6819	2.0339
	DN06	.8440	.67788	.218	-.5139	2.2019
	DN09	-.1440	.67788	.833	-1.5019	1.2139
	DN10	.1180	.67788	.862	-1.2399	1.4759
	DN17	.5120	.67788	.453	-.8459	1.8699
	DN17b	1.0880	.67788	.114	-.2699	2.4459
	DN01	-.3080	.67788	.651	-1.6659	1.0499
	DN18b	.5920	.67788	.386	-.7659	1.9499
	DN19b	.5440	.67788	.426	-.8139	1.9019
	DN20b	.4880	.67788	.475	-.8699	1.8459
	DN24	-.1680	.67788	.805	-1.5259	1.1899
	DN36	.5940	.67788	.385	-.7639	1.9519
DN17	DN05	-.8760	.67788	.202	-2.2339	.4819
	DN5b	.1640	.67788	.810	-1.1939	1.5219
	DN06	.3320	.67788	.626	-1.0259	1.6899
	DN09	-.6560	.67788	.337	-2.0139	.7019
	DN10	-.3940	.67788	.563	-1.7519	.9639
	DN11	-.5120	.67788	.453	-1.8699	.8459
	DN17b	.5760	.67788	.399	-.7819	1.9339
	DN01	-.8840	.67788	.198	-2.2419	.4739
	DN18b	.0160	.67788	.981	-1.3419	1.3739
	DN19b	-.0320	.67788	.963	-1.3899	1.3259
	DN20b	-.0880	.67788	.897	-1.4459	1.2699
	DN24	-.7440	.67788	.277	-2.1019	.6139
	DN36	.0180	.67788	.979	-1.3399	1.3759
DN17b	DN05	-1.4520*	.67788	.037	-2.8099	-.0941
	DN5b	-.4120	.67788	.546	-1.7699	.9459
	DN06	-.2440	.67788	.720	-1.6019	1.1139
	DN09	-1.2320	.67788	.075	-2.5899	.1259
	DN10	-.9700	.67788	.158	-2.3279	.3879
	DN11	-1.0880	.67788	.114	-2.4459	.2699
	DN17	-.5760	.67788	.399	-1.9339	.7819

LSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound

Based on observed means.

The error term is Mean Square (Error) = 1.149.

*. The mean difference is significant at the 0.05 level.

9.2. Analysis of Annual Effective Dose (AED) Among Dental Workers

In the study of Annual Effective Dose (AED) among dental workers, it was observed that the majority of pairwise comparisons for AED were not statistically significant. This conclusion was based on P-values exceeding the conventional threshold of 0.05. However, several notable exceptions were identified. Specifically, pairwise comparisons involving DN05 with DN17b, DN18b, DN19b, DN20b, and DN36 were statistically significant, as their P-values were less than 0.05. This statistical significance indicates a variation in radiation exposure interactions among these specific pairs [2].

9.3. Statistically Significant Comparisons

The statistically significant differences observed between DN05 and DN17b, DN18b, DN19b, DN20b, and DN36 suggest that these dental workers experience different levels of radiation exposure. This variation can be attributed to multiple factors such as differences in their roles, the duration of exposure, and the protective measures in place.

9.4. Pairwise Mean Comparison with LSD Critical Value

When comparing the pairwise mean differences with the Least Significant Difference (LSD) critical value of 0.674, it was further observed that the mean values for the comparisons involving DN05 and the aforementioned dental workers exceeded the critical LSD value. This reinforces the initial finding of significant differences in AED among these specific groups of dental workers. The critical value of 0.674 serves as a threshold to determine whether the observed differences in mean values are substantial enough to be considered significant. In these comparisons, the means being greater than the LSD value indicates a genuine difference in radiation exposure levels [5].

Table 3. HSD Post hoc test for Dental Medical Workers.

Tukey HSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
DN01	DN18b	.9000	.67788	.986	-1.4759	3.2759
	DN19b	.8520	.67788	.991	-1.5239	3.2279
	DN20b	.7960	.67788	.995	-1.5799	3.1719
	DN24	.1400	.67788	1.000	-2.2359	2.5159
	DN36	.9020	.67788	.986	-1.4739	3.2779
	DN05	-.5680	.67788	1.000	-2.9439	1.8079
	DN5b	.4720	.67788	1.000	-1.9039	2.8479
	DN06	.6400	.67788	.999	-1.7359	3.0159
	DN09	-.3480	.67788	1.000	-2.7239	2.0279

Tukey HSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN10	-.0860	.67788	1.000	-2.4619	2.2899
	DN11	-.2040	.67788	1.000	-2.5799	2.1719
	DN17	.3080	.67788	1.000	-2.0679	2.6839
	DN17b	.8840	.67788	.988	-1.4919	3.2599
	DN01	-.9000	.67788	.986	-3.2759	1.4759
	DN19b	-.0480	.67788	1.000	-2.4239	2.3279
	DN20b	-.1040	.67788	1.000	-2.4799	2.2719
	DN24	-.7600	.67788	.997	-3.1359	1.6159
	DN36	.0020	.67788	1.000	-2.3739	2.3779
	DN05	-1.4680	.67788	.654	-3.8439	.9079
DN18b	DN5b	-.4280	.67788	1.000	-2.8039	1.9479
	DN06	-.2600	.67788	1.000	-2.6359	2.1159
	DN09	-1.2480	.67788	.848	-3.6239	1.1279
	DN10	-.9860	.67788	.970	-3.3619	1.3899
	DN11	-1.1040	.67788	.931	-3.4799	1.2719
	DN17	-.5920	.67788	1.000	-2.9679	1.7839
	DN17b	-.0160	.67788	1.000	-2.3919	2.3599
	DN01	-.8520	.67788	.991	-3.2279	1.5239
	DN18b	.0480	.67788	1.000	-2.3279	2.4239
	DN20b	-.0560	.67788	1.000	-2.4319	2.3199
	DN24	-.7120	.67788	.998	-3.0879	1.6639
	DN36	.0500	.67788	1.000	-2.3259	2.4259
	DN05	-1.4200	.67788	.701	-3.7959	.9559
DN19b	DN5b	-.3800	.67788	1.000	-2.7559	1.9959
	DN06	-.2120	.67788	1.000	-2.5879	2.1639
	DN09	-1.2000	.67788	.880	-3.5759	1.1759
	DN10	-.9380	.67788	.980	-3.3139	1.4379
	DN11	-1.0560	.67788	.950	-3.4319	1.3199
	DN17	-.5440	.67788	1.000	-2.9199	1.8319
	DN17b	.0320	.67788	1.000	-2.3439	2.4079
	DN01	-.7960	.67788	.995	-3.1719	1.5799
	DN18b	.1040	.67788	1.000	-2.2719	2.4799
	DN19b	.0560	.67788	1.000	-2.3199	2.4319
DN20b	DN24	-.6560	.67788	.999	-3.0319	1.7199
	DN36	.1060	.67788	1.000	-2.2699	2.4819
	DN05	-1.3640	.67788	.754	-3.7399	1.0119

Tukey HSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN5b	-.3240	.67788	1.000	-2.6999	2.0519
	DN06	-.1560	.67788	1.000	-2.5319	2.2199
	DN09	-1.1440	.67788	.912	-3.5199	1.2319
	DN10	-.8820	.67788	.988	-3.2579	1.4939
	DN11	-1.0000	.67788	.967	-3.3759	1.3759
	DN17	-.4880	.67788	1.000	-2.8639	1.8879
	DN17b	.0880	.67788	1.000	-2.2879	2.4639
	DN01	-.1400	.67788	1.000	-2.5159	2.2359
	DN18b	.7600	.67788	.997	-1.6159	3.1359
	DN19b	.7120	.67788	.998	-1.6639	3.0879
	DN20b	.6560	.67788	.999	-1.7199	3.0319
	DN36	.7620	.67788	.997	-1.6139	3.1379
	DN05	-.7080	.67788	.999	-3.0839	1.6679
DN24	DN5b	.3320	.67788	1.000	-2.0439	2.7079
	DN06	.5000	.67788	1.000	-1.8759	2.8759
	DN09	-.4880	.67788	1.000	-2.8639	1.8879
	DN10	-.2260	.67788	1.000	-2.6019	2.1499
	DN11	-.3440	.67788	1.000	-2.7199	2.0319
	DN17	.1680	.67788	1.000	-2.2079	2.5439
	DN17b	.7440	.67788	.998	-1.6319	3.1199
	DN01	-.9020	.67788	.986	-3.2779	1.4739
	DN18b	-.0020	.67788	1.000	-2.3779	2.3739
	DN19b	-.0500	.67788	1.000	-2.4259	2.3259
	DN20b	-.1060	.67788	1.000	-2.4819	2.2699
	DN24	-.7620	.67788	.997	-3.1379	1.6139
	DN05	-1.4700	.67788	.652	-3.8459	.9059
DN36	DN5b	-.4300	.67788	1.000	-2.8059	1.9459
	DN06	-.2620	.67788	1.000	-2.6379	2.1139
	DN09	-1.2500	.67788	.846	-3.6259	1.1259
	DN10	-.9880	.67788	.970	-3.3639	1.3879
	DN11	-1.1060	.67788	.930	-3.4819	1.2699
	DN17	-.5940	.67788	1.000	-2.9699	1.7819
	DN17b	-.0180	.67788	1.000	-2.3939	2.3579
	DN01	.5680	.67788	1.000	-1.8079	2.9439
DN05	DN18b	1.4680	.67788	.654	-.9079	3.8439
	DN19b	1.4200	.67788	.701	-.9559	3.7959

Tukey HSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN20b	1.3640	.67788	.754	-1.0119	3.7399
	DN24	.7080	.67788	.999	-1.6679	3.0839
	DN36	1.4700	.67788	.652	-.9059	3.8459
	DN5b	1.0400	.67788	.955	-1.3359	3.4159
	DN06	1.2080	.67788	.875	-1.1679	3.5839
	DN09	.2200	.67788	1.000	-2.1559	2.5959
	DN10	.4820	.67788	1.000	-1.8939	2.8579
	DN11	.3640	.67788	1.000	-2.0119	2.7399
	DN17	.8760	.67788	.989	-1.4999	3.2519
	DN17b	1.4520	.67788	.670	-.9239	3.8279
	DN01	-.4720	.67788	1.000	-2.8479	1.9039
	DN18b	.4280	.67788	1.000	-1.9479	2.8039
	DN19b	.3800	.67788	1.000	-1.9959	2.7559
	DN20b	.3240	.67788	1.000	-2.0519	2.6999
	DN24	-.3320	.67788	1.000	-2.7079	2.0439
	DN36	.4300	.67788	1.000	-1.9459	2.8059
DN5b	DN05	-1.0400	.67788	.955	-3.4159	1.3359
	DN06	.1680	.67788	1.000	-2.2079	2.5439
	DN09	-.8200	.67788	.994	-3.1959	1.5559
	DN10	-.5580	.67788	1.000	-2.9339	1.8179
	DN11	-.6760	.67788	.999	-3.0519	1.6999
	DN17	-.1640	.67788	1.000	-2.5399	2.2119
	DN17b	.4120	.67788	1.000	-1.9639	2.7879
	DN01	-.6400	.67788	.999	-3.0159	1.7359
	DN18b	.2600	.67788	1.000	-2.1159	2.6359
	DN19b	.2120	.67788	1.000	-2.1639	2.5879
	DN20b	.1560	.67788	1.000	-2.2199	2.5319
	DN24	-.5000	.67788	1.000	-2.8759	1.8759
	DN36	.2620	.67788	1.000	-2.1139	2.6379
DN06	DN05	-1.2080	.67788	.875	-3.5839	1.1679
	DN5b	-.1680	.67788	1.000	-2.5439	2.2079
	DN09	-.9880	.67788	.970	-3.3639	1.3879
	DN10	-.7260	.67788	.998	-3.1019	1.6499
	DN11	-.8440	.67788	.992	-3.2199	1.5319
	DN17	-.3320	.67788	1.000	-2.7079	2.0439
	DN17b	.2440	.67788	1.000	-2.1319	2.6199

Tukey HSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN01	.3480	.67788	1.000	-2.0279	2.7239
	DN18b	1.2480	.67788	.848	-1.1279	3.6239
	DN19b	1.2000	.67788	.880	-1.1759	3.5759
	DN20b	1.1440	.67788	.912	-1.2319	3.5199
	DN24	.4880	.67788	1.000	-1.8879	2.8639
	DN36	1.2500	.67788	.846	-1.1259	3.6259
DN09	DN05	-.2200	.67788	1.000	-2.5959	2.1559
	DN5b	.8200	.67788	.994	-1.5559	3.1959
	DN06	.9880	.67788	.970	-1.3879	3.3639
	DN10	.2620	.67788	1.000	-2.1139	2.6379
	DN11	.1440	.67788	1.000	-2.2319	2.5199
	DN17	.6560	.67788	.999	-1.7199	3.0319
	DN17b	1.2320	.67788	.859	-1.1439	3.6079
	DN01	.0860	.67788	1.000	-2.2899	2.4619
	DN18b	.9860	.67788	.970	-1.3899	3.3619
	DN19b	.9380	.67788	.980	-1.4379	3.3139
	DN20b	.8820	.67788	.988	-1.4939	3.2579
	DN24	.2260	.67788	1.000	-2.1499	2.6019
	DN36	.9880	.67788	.970	-1.3879	3.3639
DN10	DN05	-.4820	.67788	1.000	-2.8579	1.8939
	DN5b	.5580	.67788	1.000	-1.8179	2.9339
	DN06	.7260	.67788	.998	-1.6499	3.1019
	DN09	-.2620	.67788	1.000	-2.6379	2.1139
	DN11	-.1180	.67788	1.000	-2.4939	2.2579
	DN17	.3940	.67788	1.000	-1.9819	2.7699
	DN17b	.9700	.67788	.974	-1.4059	3.3459
	DN01	.2040	.67788	1.000	-2.1719	2.5799
	DN18b	1.1040	.67788	.931	-1.2719	3.4799
	DN19b	1.0560	.67788	.950	-1.3199	3.4319
	DN20b	1.0000	.67788	.967	-1.3759	3.3759
	DN24	.3440	.67788	1.000	-2.0319	2.7199
DN11	DN36	1.1060	.67788	.930	-1.2699	3.4819
	DN05	-.3640	.67788	1.000	-2.7399	2.0119
	DN5b	.6760	.67788	.999	-1.6999	3.0519
	DN06	.8440	.67788	.992	-1.5319	3.2199
	DN09	-.1440	.67788	1.000	-2.5199	2.2319

Tukey HSD						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN10	.1180	.67788	1.000	-2.2579	2.4939
	DN17	.5120	.67788	1.000	-1.8639	2.8879
	DN17b	1.0880	.67788	.937	-1.2879	3.4639
	DN01	-.3080	.67788	1.000	-2.6839	2.0679
	DN18b	.5920	.67788	1.000	-1.7839	2.9679
	DN19b	.5440	.67788	1.000	-1.8319	2.9199
	DN20b	.4880	.67788	1.000	-1.8879	2.8639
	DN24	-.1680	.67788	1.000	-2.5439	2.2079
	DN36	.5940	.67788	1.000	-1.7819	2.9699
DN17	DN05	-.8760	.67788	.989	-3.2519	1.4999
	DN5b	.1640	.67788	1.000	-2.2119	2.5399
	DN06	.3320	.67788	1.000	-2.0439	2.7079
	DN09	-.6560	.67788	.999	-3.0319	1.7199
	DN10	-.3940	.67788	1.000	-2.7699	1.9819
	DN11	-.5120	.67788	1.000	-2.8879	1.8639
	DN17b	.5760	.67788	1.000	-1.7999	2.9519
	DN01	-.8840	.67788	.988	-3.2599	1.4919
	DN18b	.0160	.67788	1.000	-2.3599	2.3919
	DN19b	-.0320	.67788	1.000	-2.4079	2.3439
	DN20b	-.0880	.67788	1.000	-2.4639	2.2879
	DN24	-.7440	.67788	.998	-3.1199	1.6319
	DN36	.0180	.67788	1.000	-2.3579	2.3939
DN17b	DN05	-1.4520	.67788	.670	-3.8279	.9239
	DN5b	-.4120	.67788	1.000	-2.7879	1.9639
	DN06	-.2440	.67788	1.000	-2.6199	2.1319
	DN09	-1.2320	.67788	.859	-3.6079	1.1439
	DN10	-.9700	.67788	.974	-3.3459	1.4059
	DN11	-1.0880	.67788	.937	-3.4639	1.2879
	DN17	-.5760	.67788	1.000	-2.9519	1.7999

Based on observed means.

The error term is Mean Square (Error) = 1.149.

Table above showed that none of the comparisons was significant because the P- values for the comparisons were greater than 0.05, the values obtained for the pair wise comparisons where less than HSD critical value of 1.304, this implied that the comparisons among the Dental workers was not statistically significant, this implied that all the Dentists interact equally with radiation.

Table 4. *Sheffee Post hoc test for Dental medical Radiation workers.*

Scheffe						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
DN01	DN18b	.9000	.67788	1.000	-2.4683	4.2683
	DN19b	.8520	.67788	1.000	-2.5163	4.2203
	DN20b	.7960	.67788	1.000	-2.5723	4.1643
	DN24	.1400	.67788	1.000	-3.2283	3.5083
	DN36	.9020	.67788	1.000	-2.4663	4.2703
	DN05	-.5680	.67788	1.000	-3.9363	2.8003
	DN5b	.4720	.67788	1.000	-2.8963	3.8403
	DN06	.6400	.67788	1.000	-2.7283	4.0083
	DN09	-.3480	.67788	1.000	-3.7163	3.0203
	DN10	-.0860	.67788	1.000	-3.4543	3.2823
	DN11	-.2040	.67788	1.000	-3.5723	3.1643
	DN17	.3080	.67788	1.000	-3.0603	3.6763
	DN17b	.8840	.67788	1.000	-2.4843	4.2523
DN18b	DN01	-.9000	.67788	1.000	-4.2683	2.4683
	DN19b	-.0480	.67788	1.000	-3.4163	3.3203
	DN20b	-.1040	.67788	1.000	-3.4723	3.2643
	DN24	-.7600	.67788	1.000	-4.1283	2.6083
	DN36	.0020	.67788	1.000	-3.3663	3.3703
	DN05	-1.4680	.67788	.977	-4.8363	1.9003
	DN5b	-.4280	.67788	1.000	-3.7963	2.9403
	DN06	-.2600	.67788	1.000	-3.6283	3.1083
	DN09	-1.2480	.67788	.995	-4.6163	2.1203
	DN10	-.9860	.67788	1.000	-4.3543	2.3823
	DN11	-1.1040	.67788	.998	-4.4723	2.2643
	DN17	-.5920	.67788	1.000	-3.9603	2.7763
	DN17b	-.0160	.67788	1.000	-3.3843	3.3523
DN19b	DN01	-.8520	.67788	1.000	-4.2203	2.5163
	DN18b	.0480	.67788	1.000	-3.3203	3.4163
	DN20b	-.0560	.67788	1.000	-3.4243	3.3123
	DN24	-.7120	.67788	1.000	-4.0803	2.6563
	DN36	.0500	.67788	1.000	-3.3183	3.4183
	DN05	-1.4200	.67788	.982	-4.7883	1.9483
	DN5b	-.3800	.67788	1.000	-3.7483	2.9883
	DN06	-.2120	.67788	1.000	-3.5803	3.1563
	DN09	-1.2000	.67788	.996	-4.5683	2.1683

Scheffe						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN10	-.9380	.67788	1.000	-4.3063	2.4303
	DN11	-1.0560	.67788	.999	-4.4243	2.3123
	DN17	-.5440	.67788	1.000	-3.9123	2.8243
	DN17b	.0320	.67788	1.000	-3.3363	3.4003
	DN01	-.7960	.67788	1.000	-4.1643	2.5723
	DN18b	.1040	.67788	1.000	-3.2643	3.4723
	DN19b	.0560	.67788	1.000	-3.3123	3.4243
	DN24	-.6560	.67788	1.000	-4.0243	2.7123
	DN36	.1060	.67788	1.000	-3.2623	3.4743
	DN05	-1.3640	.67788	.988	-4.7323	2.0043
DN20b	DN5b	-.3240	.67788	1.000	-3.6923	3.0443
	DN06	-.1560	.67788	1.000	-3.5243	3.2123
	DN09	-1.1440	.67788	.998	-4.5123	2.2243
	DN10	-.8820	.67788	1.000	-4.2503	2.4863
	DN11	-1.0000	.67788	.999	-4.3683	2.3683
	DN17	-.4880	.67788	1.000	-3.8563	2.8803
	DN17b	.0880	.67788	1.000	-3.2803	3.4563
	DN01	-.1400	.67788	1.000	-3.5083	3.2283
	DN18b	.7600	.67788	1.000	-2.6083	4.1283
	DN19b	.7120	.67788	1.000	-2.6563	4.0803
	DN20b	.6560	.67788	1.000	-2.7123	4.0243
	DN36	.7620	.67788	1.000	-2.6063	4.1303
	DN05	-.7080	.67788	1.000	-4.0763	2.6603
DN24	DN5b	.3320	.67788	1.000	-3.0363	3.7003
	DN06	.5000	.67788	1.000	-2.8683	3.8683
	DN09	-.4880	.67788	1.000	-3.8563	2.8803
	DN10	-.2260	.67788	1.000	-3.5943	3.1423
	DN11	-.3440	.67788	1.000	-3.7123	3.0243
	DN17	.1680	.67788	1.000	-3.2003	3.5363
	DN17b	.7440	.67788	1.000	-2.6243	4.1123
	DN01	-.9020	.67788	1.000	-4.2703	2.4663
	DN18b	-.0020	.67788	1.000	-3.3703	3.3663
	DN19b	-.0500	.67788	1.000	-3.4183	3.3183
DN36	DN20b	-.1060	.67788	1.000	-3.4743	3.2623
	DN24	-.7620	.67788	1.000	-4.1303	2.6063
	DN05	-1.4700	.67788	.976	-4.8383	1.8983

Scheffe						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN5b	-.4300	.67788	1.000	-3.7983	2.9383
	DN06	-.2620	.67788	1.000	-3.6303	3.1063
	DN09	-1.2500	.67788	.995	-4.6183	2.1183
	DN10	-.9880	.67788	1.000	-4.3563	2.3803
	DN11	-1.1060	.67788	.998	-4.4743	2.2623
	DN17	-.5940	.67788	1.000	-3.9623	2.7743
	DN17b	-.0180	.67788	1.000	-3.3863	3.3503
	DN01	.5680	.67788	1.000	-2.8003	3.9363
	DN18b	1.4680	.67788	.977	-1.9003	4.8363
	DN19b	1.4200	.67788	.982	-1.9483	4.7883
	DN20b	1.3640	.67788	.988	-2.0043	4.7323
	DN24	.7080	.67788	1.000	-2.6603	4.0763
	DN36	1.4700	.67788	.976	-1.8983	4.8383
DN05	DN5b	1.0400	.67788	.999	-2.3283	4.4083
	DN06	1.2080	.67788	.996	-2.1603	4.5763
	DN09	.2200	.67788	1.000	-3.1483	3.5883
	DN10	.4820	.67788	1.000	-2.8863	3.8503
	DN11	.3640	.67788	1.000	-3.0043	3.7323
	DN17	.8760	.67788	1.000	-2.4923	4.2443
	DN17b	1.4520	.67788	.979	-1.9163	4.8203
	DN01	-.4720	.67788	1.000	-3.8403	2.8963
	DN18b	.4280	.67788	1.000	-2.9403	3.7963
	DN19b	.3800	.67788	1.000	-2.9883	3.7483
	DN20b	.3240	.67788	1.000	-3.0443	3.6923
	DN24	-.3320	.67788	1.000	-3.7003	3.0363
	DN36	.4300	.67788	1.000	-2.9383	3.7983
DN5b	DN05	-1.0400	.67788	.999	-4.4083	2.3283
	DN06	.1680	.67788	1.000	-3.2003	3.5363
	DN09	-.8200	.67788	1.000	-4.1883	2.5483
	DN10	-.5580	.67788	1.000	-3.9263	2.8103
	DN11	-.6760	.67788	1.000	-4.0443	2.6923
	DN17	-.1640	.67788	1.000	-3.5323	3.2043
	DN17b	.4120	.67788	1.000	-2.9563	3.7803
	DN01	-.6400	.67788	1.000	-4.0083	2.7283
DN06	DN18b	.2600	.67788	1.000	-3.1083	3.6283
	DN19b	.2120	.67788	1.000	-3.1563	3.5803

Scheffe						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN20b	.1560	.67788	1.000	-3.2123	3.5243
	DN24	-.5000	.67788	1.000	-3.8683	2.8683
	DN36	.2620	.67788	1.000	-3.1063	3.6303
	DN05	-1.2080	.67788	.996	-4.5763	2.1603
	DN5b	-.1680	.67788	1.000	-3.5363	3.2003
	DN09	-.9880	.67788	1.000	-4.3563	2.3803
	DN10	-.7260	.67788	1.000	-4.0943	2.6423
	DN11	-.8440	.67788	1.000	-4.2123	2.5243
	DN17	-.3320	.67788	1.000	-3.7003	3.0363
	DN17b	.2440	.67788	1.000	-3.1243	3.6123
	DN01	.3480	.67788	1.000	-3.0203	3.7163
	DN18b	1.2480	.67788	.995	-2.1203	4.6163
	DN19b	1.2000	.67788	.996	-2.1683	4.5683
	DN20b	1.1440	.67788	.998	-2.2243	4.5123
	DN24	.4880	.67788	1.000	-2.8803	3.8563
	DN36	1.2500	.67788	.995	-2.1183	4.6183
DN09	DN05	-.2200	.67788	1.000	-3.5883	3.1483
	DN5b	.8200	.67788	1.000	-2.5483	4.1883
	DN06	.9880	.67788	1.000	-2.3803	4.3563
	DN10	.2620	.67788	1.000	-3.1063	3.6303
	DN11	.1440	.67788	1.000	-3.2243	3.5123
	DN17	.6560	.67788	1.000	-2.7123	4.0243
	DN17b	1.2320	.67788	.995	-2.1363	4.6003
	DN01	.0860	.67788	1.000	-3.2823	3.4543
	DN18b	.9860	.67788	1.000	-2.3823	4.3543
	DN19b	.9380	.67788	1.000	-2.4303	4.3063
	DN20b	.8820	.67788	1.000	-2.4863	4.2503
	DN24	.2260	.67788	1.000	-3.1423	3.5943
	DN36	.9880	.67788	1.000	-2.3803	4.3563
DN10	DN05	-.4820	.67788	1.000	-3.8503	2.8863
	DN5b	.5580	.67788	1.000	-2.8103	3.9263
	DN06	.7260	.67788	1.000	-2.6423	4.0943
	DN09	-.2620	.67788	1.000	-3.6303	3.1063
	DN11	-.1180	.67788	1.000	-3.4863	3.2503
	DN17	.3940	.67788	1.000	-2.9743	3.7623
	DN17b	.9700	.67788	1.000	-2.3983	4.3383

Scheffe						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN01	.2040	.67788	1.000	-3.1643	3.5723
	DN18b	1.1040	.67788	.998	-2.2643	4.4723
	DN19b	1.0560	.67788	.999	-2.3123	4.4243
	DN20b	1.0000	.67788	.999	-2.3683	4.3683
	DN24	.3440	.67788	1.000	-3.0243	3.7123
	DN36	1.1060	.67788	.998	-2.2623	4.4743
DN11	DN05	-.3640	.67788	1.000	-3.7323	3.0043
	DN5b	.6760	.67788	1.000	-2.6923	4.0443
	DN06	.8440	.67788	1.000	-2.5243	4.2123
	DN09	-.1440	.67788	1.000	-3.5123	3.2243
	DN10	.1180	.67788	1.000	-3.2503	3.4863
	DN17	.5120	.67788	1.000	-2.8563	3.8803
	DN17b	1.0880	.67788	.999	-2.2803	4.4563
	DN01	-.3080	.67788	1.000	-3.6763	3.0603
	DN18b	.5920	.67788	1.000	-2.7763	3.9603
	DN19b	.5440	.67788	1.000	-2.8243	3.9123
	DN20b	.4880	.67788	1.000	-2.8803	3.8563
	DN24	-.1680	.67788	1.000	-3.5363	3.2003
	DN36	.5940	.67788	1.000	-2.7743	3.9623
DN17	DN05	-.8760	.67788	1.000	-4.2443	2.4923
	DN5b	.1640	.67788	1.000	-3.2043	3.5323
	DN06	.3320	.67788	1.000	-3.0363	3.7003
	DN09	-.6560	.67788	1.000	-4.0243	2.7123
	DN10	-.3940	.67788	1.000	-3.7623	2.9743
	DN11	-.5120	.67788	1.000	-3.8803	2.8563
	DN17b	.5760	.67788	1.000	-2.7923	3.9443
	DN01	-.8840	.67788	1.000	-4.2523	2.4843
	DN18b	.0160	.67788	1.000	-3.3523	3.3843
	DN19b	-.0320	.67788	1.000	-3.4003	3.3363
	DN20b	-.0880	.67788	1.000	-3.4563	3.2803
	DN24	-.7440	.67788	1.000	-4.1123	2.6243
DN17b	DN36	.0180	.67788	1.000	-3.3503	3.3863
	DN05	-1.4520	.67788	.979	-4.8203	1.9163
	DN5b	-.4120	.67788	1.000	-3.7803	2.9563
	DN06	-.2440	.67788	1.000	-3.6123	3.1243
	DN09	-1.2320	.67788	.995	-4.6003	2.1363

Scheffe						
(I) Dental ID	(J) Dental ID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	DN10	-.9700	.67788	1.000	-4.3383	2.3983
	DN11	-1.0880	.67788	.999	-4.4563	2.2803
	DN17	-.5760	.67788	1.000	-3.9443	2.7923

Based on observed means.

The error term is Mean Square (Error) = 1.149.

The table above also showed that none of the comparisons significant values was less than 0.05, this implied that the comparisons was not significant, due to their same rate of interaction with radiation [3]. On comparing the mean with the scheffee critical value of 1.566, it was observed than none of the pair wise comparisons were greater than the critical value, this meant that the comparisons among Dental medical workers was not statistically significant because of their same rate of interaction with radiation [3].

Comparison of three post hoc tests.

As should be apparent from the foregoing discussion, there are substantial differences among post hoc procedures. The procedures differ in the amount and kind of adjustment to alpha provided [11]. The critical values for the three post hoc test was shown below:

Critical Difference

LSD: 0.674

Tukey (HSD): 1.304

Scheffe: 1.566

The most important issue is to choose a procedure which properly and reliably adjusts for the types of problems encountered in your particular research application [8]. Although Scheffe's procedure is the most popular due to its conservatism, it is actually wasteful of statistical power and likely to lead to Type II errors unless complex comparisons are being made [11]. When all pairs of means are being compared, Tukey's is the procedure of choice. In special design situations, other post hoc procedures may also be preferable and should be explored as alternatives [11]. The LSD gave the least mean for the comparison, therefore is the best post hoc analysis for this research [11].

10. Conclusion and Recommendation

10.1. Conclusion

The conclusion that can be drawn from this comparisons was LSD recorded the least critical value for the significant different, while Scheffee recorded the highest value, this implied that for the comparisons to be statistically significant LSD post hoc test must be carried [1].

10.2. Recommendation

Comparisons between Tukey, LSD and Scheffee for Dental Medical workers of Usman Danfodiyo University Teaching hospital is very important, considering the wide application of ionizing radiation,

From the result obtained it is recommended that;

1. Harshaw 4500 manual TLD reader used in the study should always be calibrated with 137Cs beam exposure before use.
2. Workload on radiation workers that result in human error should be reducing through affordable time-schedule.
3. Model that will detect cancer at any radiosensitive organs should be constructed.
4. The TLD should be read after one month due to the temperature of Sokoto to avoid fading of the chips.
5. More staff should be employ to reduce the workload in the departments.

Abbreviations

DN	Dental Medical Workers
LSD	Least Significant Difference
TLD	Thermoluminicent Dosimeter
ANOVA	Analysis of Variance
Q	Critical Value

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Author Contributions

Ahmadu Ibrahim is the sole author. The author read and

approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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