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Power Analyse Review of Research Articles in Life Science Journals

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ABSTRACT In experimental studies, defining the suitable sample size is one of the important steps for statistical design. Power analysis is used for identifying reliability of the statistical analysis results in scientific researches. Power analysis is implemented in two different ways; in the process prior to the research by defining the suitable sample size and based on the sample size, impact size and type 1 error level for defining the statistical power level. In this study, 716 articles of last year's issues published in journals on life sciences and scanned in the Science Citation Index (SCI) and Science Citation Index Expanded (SCI-EXP.), has been reviewed under the concept of statistical methods, statistical software, sample numbers, error levels and statistical power calculation situation. As a result of the analysis, it was determined that awareness of power analysis is quite low and the number of articles which use power analysis has been found to be only one. However, it was found that statistical power is higher in the parametric tests than non-parametric tests.

INTRODUCTION

Power analysis is used to determine the reliability of the statistical analysis of the results achieved in scientific research. Statistical power analysis consists of four basic components. These are sample size, type 1 error, effect size and power of the test.

Power and sample size estimations are used by researchers to determine the required number of subjects to answer research questions (or null hypothesis). The case of thrombolysis treatment in acute myocardial infarction (AMI) is an example for this. For many years, clinicians felt that this treatment would be of benefit given the proposed etiology of AMI; however, successive studies failed to prove the case until the completion of adequately powered "mega-trials" that proved the small but important benefit of thrombolysis (Jones et al. 2003).

Determining the appropriate sample size of the experimental studies is one of the most important steps in the statistical design. Researchers aim to achieve optimal results with the adequate number of samples for scientific work. One of the most important benefits offered by the researchers of statistical power analysis is to provide the ideal power level facilities with the smallest sample analysis possible. Keeping the number of samples at the optimum level provides huge gains to researchers in terms of time and economy. Type 1 error, the number of samples used in the experiments and effect size has a crucial role in determining the statistical power level.

Sample size calculations indicate how the statistical tests used in the study are likely to perform. Therefore, it is no surprise that the type of test used in a study affects how the sample size is calculated. For example, parametric tests are better at finding the differences between groups than non-parametric tests (this is why we often try to convert basic data to normal distributions). Consequently, an analysis reliant upon a non-parametric test (for example, Mann-Whitney U) will need more patients than the one based on a parametric test (for example, Student's t test) (Jones et al. 2003). Descriptive studies need hundreds of subjects to give acceptable confidence interval for slight effects. Experimental studies generally need less number of samples while in the cross-over designs, one-quarter of the number is required compared to a control group because every subject gets the experimental treatment in a cross-over study. Evaluation studies in a single group with pre-post type of design need half the number for a similar study with a control group. A study design with one-tailed hypothesis requires twenty percent lesser subjects compared to twotailed studies. Non-randomized studies needs twenty percent more subjects compared to randomized studies in order to accommodate confounding factors. Furthermore, additional ten – twenty percent subjects are required to allow adjustment of other factors such as withdrawals, missing data, lost to follow-up etc. (Suresh and Chandrashekara 2012).

Power analysis is the important subject of successful work in different disciplines, especially in the field of health sciences. There are some studies to determine the sample size (Zodpey 2004; Wilson et al. 2007; Lan and Lian 2010; Sathian et al. 2010; Suresh and Chandrashekara 2015) and the power level (Rossi 1990; Aguinis et al. 2005; Woods et al. 2006; Bezeau and Graves 2010; Fitzner and Heckinger 2010; Gaskin and Happell 2013; Çapik 2013; Overland et al. 2014; Kocadal et al. 2015; Bakker et al. 2016). In addition, work-related power analysis in the life sciences is also available (Thomas and Juanes 1996; Dell et al. 2002; Festing and Altman 2002; Hall et al. 2003; Jennions and Moller 2003; Roush and Tozer 2004; Hawkins et al. 2013).

The aim of this study is to understand power analysis and why it is important. In this study, 716 articles have been analysed in terms of statistical methods that have been used, statistical software, sample size, the error level and statistical power calculation condition. Under this purpose, primarily to promote the research material review, the frequency table is presented on research papers, research notes, letters to the editor, short scientific study, case report and other papers. Articles are grouped on the basis of the study field and under the headings containing statistical analysis, only descriptive statistics, only frequency tables and other research papers have been examined. In addition, articles were also examined according to the basic fields of study in terms of type 1 error level specified by the author. Low, medium and high level effect size of statistical power was calculated separately based on basic fields of study for all journals for each of the statistical analysis used in the articles.

METHODOLOGY

In this study, 716 articles of last year's issues published in journals on life sciences and scanned in the Science Citation Index (SCI) and Science Citation Index Expanded (SCI-EXP.), has been reviewed under the concept of statistical methods, statistical software, sample numbers, error levels and statistical power calculation situation. The distributions of the types of articles published in journals are given in Table 1.

Table 1: The distribution of the article type

Article type	*Number of observations (n)*	*%*
Research article	634	88.5
Review	29	4.1
Research note	1	0.1
Letter to editor	1	0.1
Short communication	40	5.6
Case report	9	1.3
Other	2	0.3
Total	716	100

Statistical power analysis for the realization of G * Power 3.1 is used. Statistical processes such as frequency tables, calculation of descriptive statistics and the creation of cross tabulations were performed with SPSS 22.0 statistical software package.

Power analysis is applied in two different ways namely determination of the appropriate number of samples in the pre-process research (Priori) and determination of statistical power level according to sample size, effect size and type I error (post hoc) in the performed study. If the power analysis is done to determine the number of sampling, the researcher needs to know the parameter values for the studied population such as mean, standard deviation etc. In addition, calculation of effect size to determine the direction of the study hypothesis with type 1 and type 2 error values is important. If power analysis is carried out after the completion of the research, type 1 error level and the number of samples must be known. The number of groups involved in the research should be noted (In some cases sample size of groups) depending on the type of statistical test.

In scientific work that includes statistical inferences, hypothesis is established and tested to investigate problems in the decision-making process. Type 1 error (α) and type 2 error (β) is likely to make two types of errors in hypothesis testing. Type 1 error (α) 0.10, 0.05 and 0.01; type 2 error (β) 0.20 can take values. These values may vary according to the characteristics and sensitivity of the research. The power of test is expressed by ($1-\beta$). This value is expected to be above 0.80. Power test indicates that the possibility of rejection of the null hypothesis is not actually correct. Type 1 and Type 2 errors are in inverse relationship with each other. Reduction of the two-error type's value is possible by increasing the number of samples at the same time. Thus, increase in the power of the test is ensured. If Type 1 error value increases, the power of the test increases too. Type 1 error is an error type which emerges with the actually correct to decide that the null hypothesis is wrong (Kocabas et al. 2013; Karagöz 2014). Type 2 error arises although no significant difference can be determined between the means or effect with this condition. The statistical power represents the applied statistical methods' ability to determine the truth of the effect that actually exists (Cohen 1988, 1992; Murphy et al. 2009; Gaskin and Happell 2012).

Articles, which are examined in this study, are subjected to power analysis in the appropriate low-medium-high effect sizes to different statistical tests indicated by Cohen (1988). For this purpose, post hoc type power analysis was performed. Standard effect size values stated by Cohen (1988), type 1 error level specified by the authors in the articles, sample size, number of groups depending on the type of performed test statistics and sample size of groups are used for power analysis. It is assumed that the hypothesis is established in the two-way statistical tests.

The variables analysed in the generated data sets are determined as the journal article is printed, the number / volume number, the journal number / serial number, year of publication, title of work, types of publications, the main field of study, the paper used methods / types of tests, the number to use statistical tests, whether they reported statistical research results, the hypothesis research indicated status, discussed the status of the relationship between results and hypotheses, examination of the assumptions of the statistical test, the subject of research case when keeping assumptions transformation implementation status, error level, statistical power calculation status, the effect size of the reported condition, the effect size calculated quantity, on the state of calculated number of samples, the sample size calculated in the test, used sample size in the research, used statistical software package, the number of authors and the state of being a writer working in the field of statistics in the article written.

Effect size calculation formulas for a variety of statistical tests designed by Cohen (1988) is illustrated in Table 2.

Table 2: Effect size formula of statistical tests and class intervals

Test type	*Size effect formula*	*Effect size class intervals*		
		Low effect size	*Medium effect size*	*High effect size*
t-test[1]	$d = \dfrac{X_1 - X_2}{\sqrt{\dfrac{(n_1 - 1)\, S^2_1 + (n_2 - 1)\, s^2_2}{n_1 + n_2 - 2}}}$ $d = \dfrac{m_1 - m_2}{\sigma}$	0.20	0.50	0.80
Correlation analysis	r	0.10	0.30	0.50
Chi-square test[2]	$w = \sqrt{\sum_{i=1}^{m} \dfrac{(P_{1i} - P_{0i})^2}{P_{0i}}}$	0.10	0.30	0.50
Anova[3]	$\sigma_m = \sqrt{\dfrac{\sum_{i=1}^{k} (m_i - m)^2}{k}}$ $f = \dfrac{\sigma_m}{\sigma}$	0.10	0.25	0.40
Multiple linear regression[4]	$f^2 = \dfrac{R^2_{Y\text{-}B}}{1 - R^2_{Y\text{-}B}}$	0.02	15	0.35

[1] *m_1 and m_2: Mean of population when the variances are equal accepted; ó common standard deviation. When the variances are not equal accepted and unknown, x_1 and x_2 sample statistics used.* [2] *P_{0i}: The proportion in cell i posited by the null hypothesis. P_{1i} = the proportion in cell i posited by the alternative hypothesis, reflecting the effect for that cell. m = the number of cells.* [3] *ó = the standard deviation of the population, "$m_i - m$": The departure of the population means from the mean of the combined population k = the number of groups.* [4] *Multiple correlations of a set B, made up of n variables (the independent variables), on Y (the dependent variable)* (Cohen 1988, Brock 2003).

RESULTS

In this study, 634 research articles from 716 have been investigated for the suitability of the power analysis and 450 articles were identified with statistical inferences. There was sufficient power analysis with regard to the implementation of the remaining 184 articles. The distribution of basic field of research articles is located in Table 3. Research papers are grouped under four headings in this study as articles containing statistical analysis, only frequency table, only descriptive statistics and other research articles. According to the subjects and designated title distributions depending on the number of articles located here. When the total value are examined, it is seen that the density of the article, which includes only descriptive statistics and frequency tables. Descriptive statistics and frequency tables summarize the data contained in the study. The parametric and non-parametric statistical analysis methods reflect a much more detailed way depending on the purpose of the study. The distribution of the basic fields of study of error level is located in Table 4. Six basic fields have been identified which include fisheries and aquatic science, crop production, biology, ecology, agriculture, and veterinary in the examined articles. Also six different error levels were determined in the article that contains the statistical analysis such as 0.00, 0.0001, 0.001, 0.005, 0.01 and 0.05. Error level plays an important role in issues such as acceptance or rejection of the hypotheses contained in studies and determining the power of the statistical analysis. When the distribution of the error level in Table 4 are analysed, it is seen that the error level of value 0.05 is used quite a lot. At the same time, another remarkable point is that although statistical analysis is used, the error level is not included in the studies text. This situation is expressed by 0.00 error level.

Error level, the sample size of the study and type of statistical analysis methods which are not clearly specified in articles including statistical analysis, have been subjected to power analysis. Some artificial intelligence methods, multivariate

Table 3: The distribution of the basic fields of study of research articles

The basic fields of study	*Contains statistical analysis articles*		*Contains descriptive statistics articles*		*Contains frequency table articles*		*Other research papers*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Fisheries and aquatic science	65	14.40	0	0.00	0	0.00	0	0.00	65	100
Crop production	36	8.00	4	13.80	8	11.00	2	2.40	50	100
Biology	49	10.90	5	17.20	13	17.80	26	31.70	93	100
Ecology	15	3.30	2	6.90	3	4.10	2	2.40	22	100
Agriculture	103	22.8	3	10.3	14	19.2	21	25.6	141	100
Veterinary	182	40.40	15	51.70	35	47.90	31	37.80	263	100
Total	450	100	29	100	73	100	82	100	634	100

Table 4: The distribution of the basic fields of study of error level

The basic fields of study	*α= 0.00*		*α= 0.0001*		*α= 0.001*		*α= 0.005*		*α= 0.01*		*α= 0.05*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*N*	*%*
Fisheries and aquatic science	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	65	15.8	65	100
Crop production	14	7.6	0	0.0	0	0.0	0	0.0	0	0.0	36	8.8	50	100
Biology	44	23.9	0	0.0	0	0.0	0	0.0	2	6.7	47	11.4	93	100
Ecology	7	3.8	0	0.0	1	20.0	1	50.0	1	3.3	12	2.9	22	100
Agriculture	38	20.7	0	0	0	0	0	0	14	46.7	89	21.7	141	100
Veterinary	81	44.0	2	100	4	80.0	1	50.0	13	43.3	162	39.4	263	100
Total	184	100	2	100	5	100	2	100	30	100	411	100	634	100

statistical methods applied to the articles of non-linear regression analysis in the study were also excluded.

Statistical analyses used in 450 articles were determined as analysis of variance, multiple linear regression analysis, the Friedman test, chi-square analysis, correlation analysis, Kruskal Wallis test, Mann-Whitney U test, MANOVA, paired t-test, simple linear regression analysis, t-test and Wilcoxon test. Power analysis was performed for each test according to the statistical analysis methods used in the article. Power analysis was performed according to mentioned type 1 error level of article for low, medium and high effect size. The distributions of the effect size of different statistical analysis methods are shown in Table 5.

Table 5 shows that ANOVA is the most common type of statistical test used by researchers. Almost none of the methods for determining the number of samples were detected in the surveyed publication. The results of analysis show that simple linear regression analysis, one of the parametric statistical analysis methods, has the highest power at low and medium effect size. The paired t-test is determined as the highest power with statistical tests at high effect size. While Wilcoxon test-one of the methods of non-parametric statistical analysis has the highest power on low and medium level, Mann Whitney U test has maximum statistical power on the high effect level.

There is only one article that applied the power analysis before conducting the study. Researchers have found the ideal sample size for their work at the end of power analysis and used this sample size. The statistical distributions of calculated power according to the basic fields of studies are given in Table 6. Table 6 shows that the basic fields of studies have fewer than eighty percent power level at total value on low and medium effect size. The power of the statistical tests used in the articles published in fisheries and aquatic science, crop production, ecology was reported to be above eighty percent. Dots in the table represent that standard error cannot be calculated. The cause of this condition, the number of observations is only one. The distribution of calculated power according to low, medium and high effect size at defined intervals is shown in Table 7.

When Table 7 is examined, an increase in the number of statistical tests that have high statistical power along with the effect size is seen. Similarly, the decrease in the effect level of eighty percent statistical power causes decrease in the number of statistical test. Obtained results are of similar character with power analysis studies in the literature.

Statistical analysis in scope of the study of articles was examined for several variables. As shown in Table 8, quite a large portion of the article reflects the reporting of statistical tests to the text. However, to reveal the research hypothesis, the relationship between hypothesis and results have been rather poor. In particular, the control of the t-test and analysis of variance assumptions in the study are of great importance. Quite a large portion of the examined articles did not include information about assumptions control and transformation that has been made in the absence of current assumptions.

The software used to perform statistical analysis in research articles are shown in Table 9. It is observed that the majority of the authors used SPSS and SAS programmes. The number of authors in articles is located in Table 10. These results indicate that two, three, four and five au-

Table 5: Power distribution of statistical analysis methods according to different effect size

Statistical analysis	*n*	*Low effect size*	*Medium effect size*	*High effect size*
Anova	271	0.17±0.01	0.46±0.01	0.69±0.01
Multiple linear regression	2	0.11±0.02	0.50±0.16	0.80±0.14
Friedman	2	0.47±0.44	0.62±0.37	0.86±0.13
The chi square	41	0.22±0.03	0.69±0.05	0.85±0.04
Correlation	26	0.26±0.04	0.69±0.06	0.90±0.03
Kruskal Wallis	23	0.22±0.05	0.48±0.08	0.64±0.06
Mann Whitney U	26	0.11±0.01	0.35±0.04	0.60±0.04
Manova	2	0.11±0.01	0.49±0.11	0.87±0.09
Paired t-test	6	0.37±0.13	0.83±0.07	0.98±0.01
Simple linear regression	29	0.46±0.06	0.84±0.04	0.93±0.03
t-test	48	0.22±0.03	0.55±0.04	0.76±0.03
Wilcoxon	2	0.09±0.02	0.32±0.15	0.62±0.24
Total	478	0.20±0.01	0.53±0.01	0.73±0.01

Table 6: The statistical distributions of calculated power according to the basic fields of studies

The basicfields of study	*Statistical analysis*	*n*	*Low effect size*	*Medium effec t size*	*High effect size*
Fisheries and Aquatic Science	Anova	33	0.26± 0.04	0.61± 0.05	0.80± 0.04
	Friedman	1	0.92± .	1.00± .	1.00± .
	Chi Square	1	0.07± .	0.35± .	0.82± .
	Correlation	5	0.52± 0.13	0.91± 0.08	0.99± 0.00
	Kruskal Wallis	5	0.54± 0.18	0.83± 0.16	0.88± 0.11
	Mann Whitney U	2	0.09± 0.01	0.35± 0.10	0.69± 0.15
	Paired t-test	4	0.46± 0.19	0.87± 0.07	0.99± 0.00
	Simple linear regression	6	0.70± 0.13	0.99± 0.00	1.00 ± 0.00
	t-test	6	0.40± 0.13	0.77± 0.12	0.92± 0.04
	Total	63	0.38± 0.04	0.71± 0.04	0.86± 0.02
Crop Production	Anova	28	0.13± 0.01	0.51± 0.05	0.78± 0.04
	Correlation	2	0.28± 0.19	0.71± 0.28	0.95± 0.04
	Simple linear regression	3	0.19± 0.03	0.80± 0.10	0.97± 0.02
	t-test	1	0.12± .	0.50± .	0.88± .
	Total	33	0.15± 0.01	0.55± 0.04	0.81± 0.04
Biology	Anova	21	0.14± 0.02	0.47± 0.06	0.72± 0.06
	Chi Square	4	0.09± 0.03	0.52± 0.20	0.75± 0.19
	Kruskal Wallis	1	0.07± .	0.21± .	0.49± .
	Mann Whitney U	3	0.12± 0.03	0.47± 0.14	0.77± 0.12
	Simple linear regression	1	0.19± .	0.84± .	0.99± .
	t-test	6	0.16± 0.03	0.59± 0.10	0.87± 0.05
	Total	36	0.13± 0.01	0.50± 0.04	0.75± 0.04
Ecology	Anova	8	0.13± 0.02	0.53± 0.10	0.79± 0.09
	Correlation	1	0.01± .	0.26± .	0.88± .
	Simple linear regression	1	0.72± .	0.99± .	1.00± .
	t-test	1	0.44± .	0.99± .	0.99± .
	Total	11	0.20± 0.06	0.59± 0.09	0.84± 0.07
Agriculture	Anova	79	0.14± 0.02	0.40± 0.03	0.66± 0.03
	Chi Square	3	0.12± 0.02	0.75± 0.10	0.98± 0.01
	Correlation	9	0.20± 0.07	0.68± 0.11	0.88± 0.07
	Kruskal Wallis	2	0.07± 0.01	0.22± 0.08	0.47± 0.18
	Mann Whitney U	3	0.07± 0.01	0.23± 0.07	0.46± 0.14
	Manova	2	0.11± 0.01	0.49± 0.11	0.87± 0.09
	Paired t-test	1	0.27± .	0.92± .	0.99± .
	Simple linear regression	8	0.29± 0.09	0.79± 0.10	0.90± 0.07
	t-test	5	0.39± 0.17	0.70± 0.12	0.92± 0.04
	Total	112	0.16± 0.01	0.47± 0.02	0.71± 0.02
Veterinary	Anova	103	0.18± 0.02	0.44± 0.03	0.63± 0.03
	Multiple linear regression	2	0.11± 0.02	0.50± 0.16	0.80± 0.14
	Friedman	1	0.02± .	0.24± .	0.73± .
	Chi Square	33	0.25± 0.04	0.71± 0.06	0.85± 0.04
	Correlation	9	0.20± 0.06	0.63± 0.11	0.85± 0.07
	Kruskal Wallis	15	0.14± 0.03	0.42± 0.09	0.58± 0.08
	Mann Whitney U	18	0.11± 0.01	0.36± 0.06	0.58± 0.05
	Paired t-test	1	0.13± .	0.56± .	0.92± .
	Simple linear regression	10	0.54± 0.12	0.80± 0.10	0.88± 0.08
	t-test	29	0.16± 0.02	0.45± 0.06	0.66± 0.05
	Wilcoxon	2	0.09± 0.02	0.32± 0.15	0.62± 0.24
	Total	223	0.19± 0.01	0.50± 0.02	0.68± 0.02

thored articles are more than the others. The level of single-author work is rather low.

DISCUSSION

In this study, last one year's issues consisting 716 articles of the journals publishing articles on life sciences, which are scanned in Science Citation Index (SCI) and Science Citation Index Expanded (SCI-EXP.), have been reviewed under the concept of statistical methods, statistical software, sample size, error levels and statistical power calculation situation. According to other studies in the literature, this study is quite a comprehensive quality research and power levels are calculated by grouping in terms of the basic fields of studies,

Table 7: Low, medium and high power distribution according to effect sizes at defined intervals

Statistical power	*Low effect size*		*Medium effect size*		*High effect size*	
	n	*%*	*N*	*%*	*n*	*%*
≤25	368	77	152	31.8	33	6.9
0.26-0.49	54	11.3	92	19.2	87	18.2
0.50-0.79	27	5.6	80	16.7	100	20.9
0.80-0.95	11	2.3	49	10.3	51	10.7
≥95	18	3.8	105	22	207	43.3
Total	478	100	478	100	478	100

Table 8: Variables related to the review of statistical tests

	Yes		*No*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*
Reported on the status of statistical tests	421	93.6	29	6.4	450	100
Hypothesis established status	16	3.6	434	96.4	450	100
Discussion of the relationship between hypothesis and results	16	3.6	434	96.4	450	100
Assumptions examination and testing status	51	11.3	399	88.7	450	100
Assumptions are not valid, the status of changing transform and methods	23	5.1	427	94.9	450	100

Table 9: The software used in the article

Programmes	*n*	*%*
Unspecified	327	43.8
SPSS	175	23.5
Other	100	13.4
SAS	58	7.8
Statistica	29	3.9
MSTAT-C	22	2.9
MINITAB	20	2.7
JMP	9	1.2
R	6	0.8
Total	746	100.0

Table 10: Number of authors of the article

Number of authors	*n*	*%*
Articles excluded from consideration	39	5.44
1	36	5.02
2	114	15.92
3	111	15.50
4	116	16.20
5	120	16.76
6	84	11.73
7	49	6.84
8	21	2.93
9	8	1.11
10	11	1.53
10>	7	0.97
Total	716	100.0

used type 1 error by authors, error and statistical analysis methods.

In the literature, to identify published articles in scientific journals of the power levels and to interpret general conditions of article in terms of statistical analysis, some of the studies conducted are as follows: Brock (2003) in his study studied power levels of broadcast published in journals on 374 articles with different effect sizes in the field of international business research as in this study. Different from the researchers' study, articles were not only examined in terms of power level but also in terms of the application of statistical analysis and reporting as in this study. Brock (2003)'s results show that examined articles has sufficient statistical power with the high effect size. Power level has been found to take place at lower levels than the ideal value with high effect size in this study. It stated that the type 2 error is quite high with low effect size. Also researcher indicates that power analysis awareness is relatively low. Obtained results of Brock (2003) are similar to the results of the researchers' work.

Gaskin and Happell (2013) have examined the methods of statistical analysis with power analysis separately, like in the researchers' study. The results of the researchers' study are similar to the results of another study in which power analysis was reported in only four of the examined 23 studies. Research results show that statistical power level is much higher than the ideal level of eighty percent with high effect size. In the medium effect size, it was reported to be in the ideal level of statistical power level. Reported power levels in the researchers' study is lower than that indicated by Gaskin and Happell (2013) because of the higher number of examined articles in the researchers' study and basic fields of study variation.

Overland et al. (2014) have examined experimental surveys and both of these combine studies which are published in the Journal of Research in Music Education between the years 2000-2010 to detect average statistical power at various effect size. In a similar manner to researchers' study, descriptive statistics were used for the statistical analysis and power levels were evaluated together. In addition, power levels are grouped separately according to small, medium and large effect sizes. Mentioned study reflects the results of a study performed in a single area. This study approach is much more detailed in the way the research is carried out in many different areas. When results of this study are analyzed, effect size increases, and it also appears that the statistical power level increases. This result is consistent with the researchers' study. The effect sizes have increased, which also appers to increase the statistical power level.

Kocadal et al. (2015) evaluate scientific research papers held in the field of orthopedics and traumatology scanned under SCIE published in Turkey in terms of power analysis and sample size. Similar to researchers' study, the number of articles with power analysis is reported to be very low. Bakker et al. (2016) examined 291 study published in the field of psychology with power analysis. For his purpose, they take advantage of studies' type 1 error level and effect size. Power level of studies are determined by the different effect sizes, which have been demonstrated to be true and have predicted sample sizes. The reaserchers' study, compared with examined studies, offers a quite detailed perspective of either sample size or methodological examination.

Researchers need to increase sample size in order to increase the statistical power. The samples should be chosen so to provide at least eighty percent statistical power. The use of measured variables provides more statistical power than ordinal or nominal variables. In addition, the type of statistical tests to be selected before the research is very important. Power level is higher in the parametric tests to non-parametric tests under the assumption of normality. In case of working with different groups, the sample size in group affect positive statistical power level of the test to be used.

CONCLUSION

Results show that eighty percent and above statistical power of the number of tests have normal levels high effect size. However, the number of tests that have statistical power lesser than eighty percent is considerably a lot. Benefit of power analysis to determine the sample size used in the work of researchers increases the possibility of accurate decisions in statistical test that include the hypothesis-testing phase. Carrying out at the ideal level of statistical power of the analysis increases the reliability of analysis results. Doing power analysis at the planning stage of a work of researchers and to determine the sample size according to this results increases the reliability results of the study besides providing benefits either in labour or economic sense. Studies in life sciences analysis is usually done with live materials hence, power analysis is of great importance at the beginning of the work in this field. In addition, a study including live subjects (for example, Human or Animal), sample size is an important ethical matter. The importance of power analysis is not understood sufficiently according to either literature or the researchers' results found in life science.

This study is intended to be a source of information and raising awareness to scientists who work in the field of life sciences.

NOTE

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