"Science Stays True Here"
Journal of Mathematics and Statistical Science (ISSN 2411-2518), Vol.5, 69-80 | Science Signpost Publishing

Comprehensive Meta Analysis
Meta Analysis and A Special Technics

İrem Yanık[1], Prof.Dr.Hüseyin Tatlıdil[2]

1. Department of Statistics, Hacettepe University, Beytepe, 06800, Ankara, Turkey

2. Department of Statistics, Hacettepe University, Beytepe, 06800, Ankara, Turkey

Abstract

Comprehensive Meta Analysis (CMA) is a package program developed to perform meta analysis. Meta analysis provides is a general judgment on the subject by combining work done independtly on the same subject.A general judgment on these studies is reached by analyzing independent studies on similar topics statistically.It is easier and more reliable to make a new study by taking advantage of the previous studies because the number of analyses performed on the same subject increases every day and every analysis is forced by the researcher in terms of material and time. In addition, the researcher may not have sufficient sample for the subject to be studied; since we combine independent studies in meta analysis, the sample of the subject to be studied has also been expanded, so the study will have more consistent results. Because multiple studies are combined in metadata analysis, the measure that is needed to combine these studies is the size of the impact. The concept of impact size is very important for meta analysis. To do meta analysis, the researcher must first select the work that he / she will include in the analysis. Then, each study should calculate the impact sizes and perform statistical analysis for impact sizes and interpret the results.

In this study, the package program developed to perform meta analysis was introduced and the use of the program was explained. An original application was resolved with the help of Comprehensive Meta Analysis V3.

Keywords: Comprehensive meta analysis, meta analysis, effect size

Introduction

Meta-Analysis; it allows us to combine independent studies and research on similar topics and analyze the analysis [1]. Independent studies on the same subject are analyzed statistically and a general judgment is reached on these studies [1].Since the analysis is an analyze, the word meta is used.Since multiple independent research studies are combined in the meta-analysis; it is the size of the measure impact that is needed to combine research. The effect size concept is very important for meta-analysis.

Corresponding Author: İrem Yanık E-Mail : irem.yanik@hacettepe.edu.tr

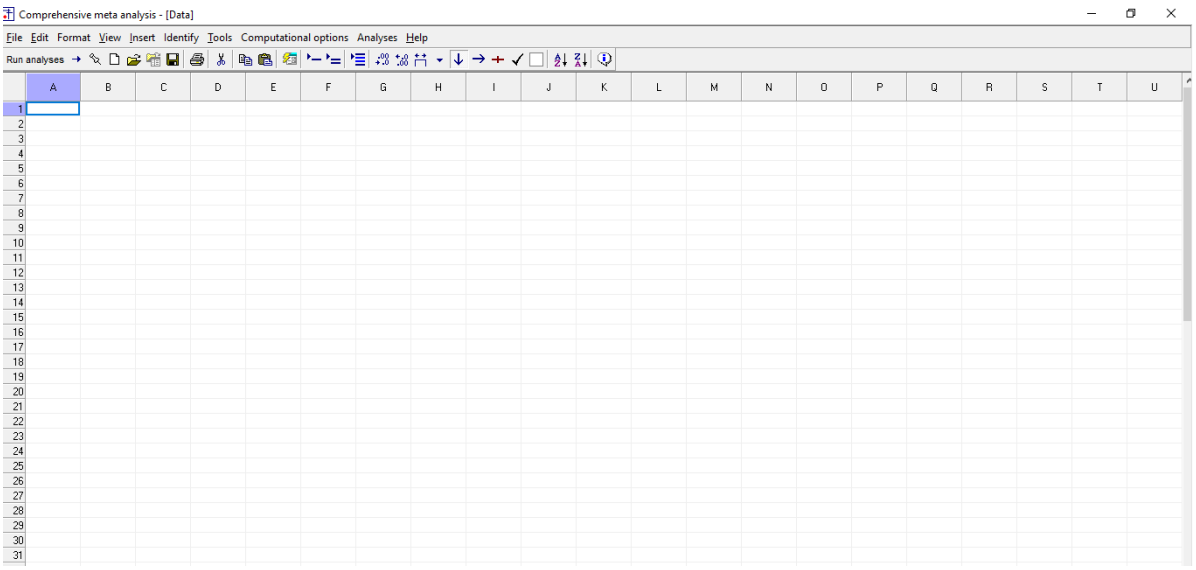
This concept is considered as a dependent variable in meta-analysis [2]. When the researcher decides to conduct a meta-analysis on a subject, he or she must first reach independent studies on the same subject [3]. Then the meta-analysis should include the sample of the study should be included in the study [3]. Secondly, the working data is coded to determine the effect size [3]. Finally, the analysis of the effect sizes and the interpretation of the study data are carried out [3].

In the meta-analysis studies, the standardized effect size should be reached. For the determination of the studies to be included in the analysis; the study and control group must have [3].Studies that do not report the statistical data required to calculate the effect size cannot be included in the meta-analysis [3].

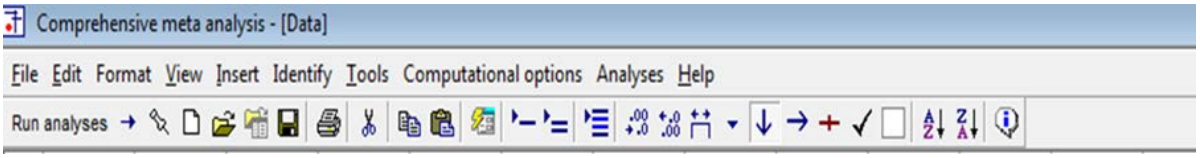
CMA program; It is a package program developed for meta-analysis. After you install the CMA program on your computer, the program will create a shortcut on your desktop and on the Windows Start menu labeled CMA V3.exe. The program can be run by clicking on any of these short paths [4].

When we run the program, we can see that the interface of the CMA is very clear and intuitive.

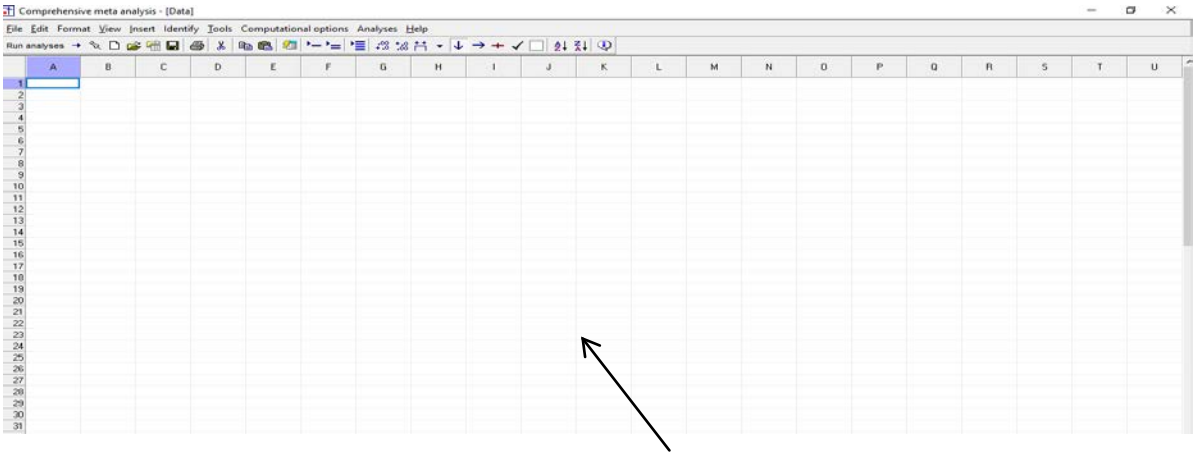
Screenshot.1 : CMA program interface



Screenshot.2 : Quick Access Toolbar



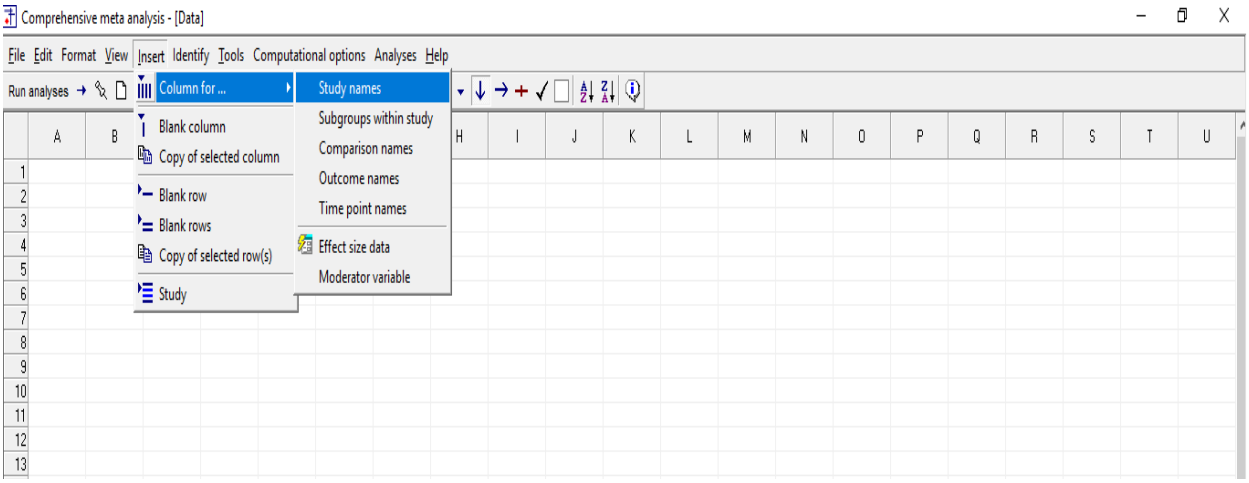
Screenshot.3 : Spreadsheet used for data entry



Spreadsheet used for data entry

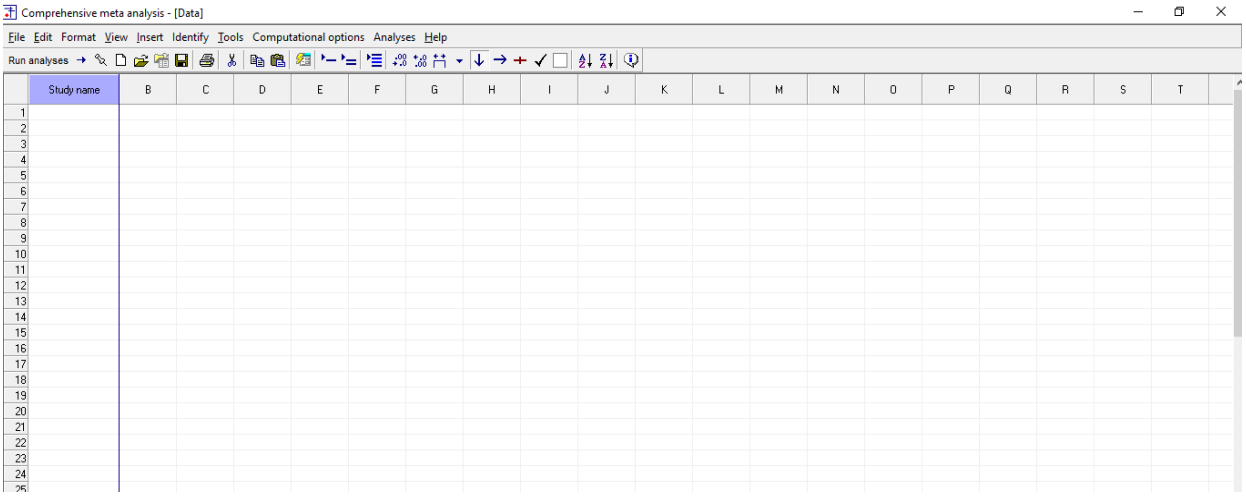
Program; It uses a spreadsheet for the input of data, but requires the definition of specific columns to keep the working names and the impact size data. To create a column of names in the study, click the Insert tab, then click Column For Study Names [4].

Screenshot .4 : Add column for working names-1



Source: Meta-Analysis Manual V3.pdf

Screenshot.5 : Add column for working names-2

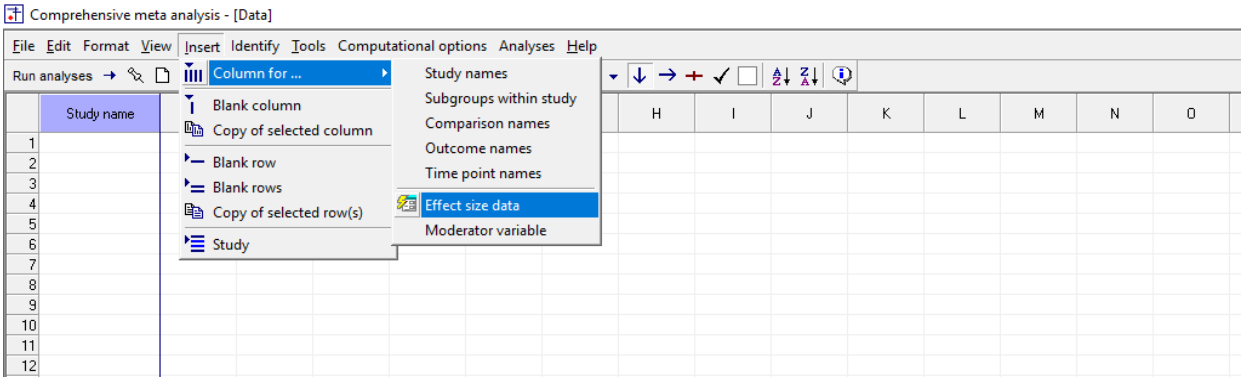


Source: Meta-Analysis Manual V3.pdf

Adds columns to program run names.

To create a column for Effect Size data; From the Insert tab, click Column for Effect Size Data [4].

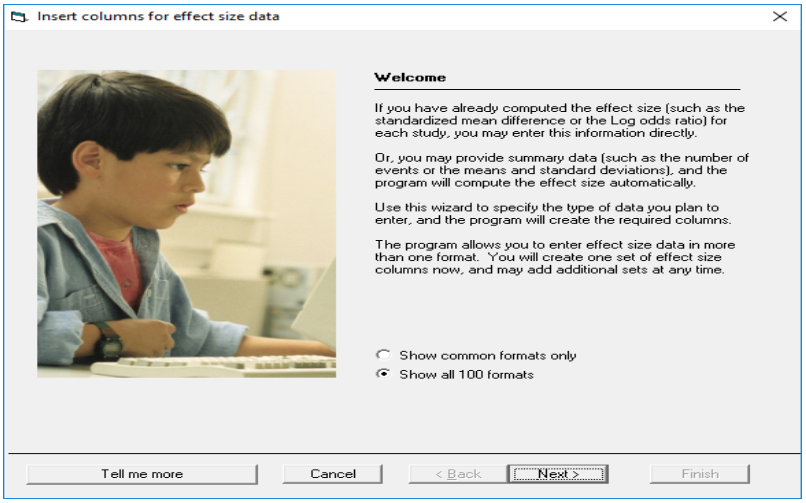
Screenshot.6 : Add column for effect size data



Source: Meta-Analysis Manual V3.pdf

After clicking Insert Column for Effect Size data, we see that the Effect Size Wizard wizard opens in the window. Effect Size Wizard; allows the user to select the desired format for their effect size. With the wizard, we can enter the effect size data in multiple formats [4]. If we click the first option, if we click on all the formats (formats) the second option, we see only 100 formats.

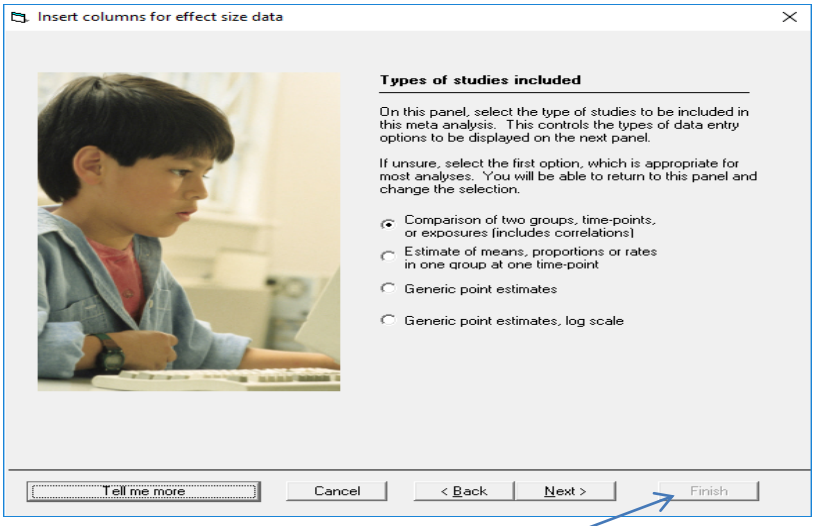
Screenshot.7 : Effect size wizard



Source: Meta-Analysis Manual V3.pdf

To select data entry types (types of work) for this meta-analysis on the 2nd screen of the wizard. For the first option; Comparison of 2 groups, time points; For the second option; Estimation of means, rates and ratios in a group at one time; For the third option; Point Estimates; For the fourth option; General Point Estimates and mass scale formats can be seen in the next window.

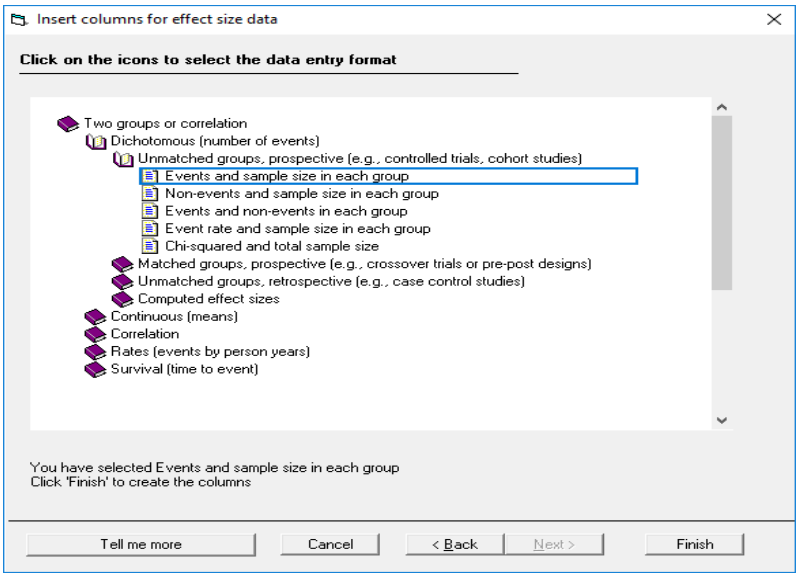
Screenshot.8 : Effect size wizard- Data entry types



Source: Meta-Analysis Manual V3.pdf

To select the related data input type and click Next, we can see the list of formats (formats) that are hierarchically arranged in the 3rd screen of the wizard. At the end selecting the format and clicking Finish.

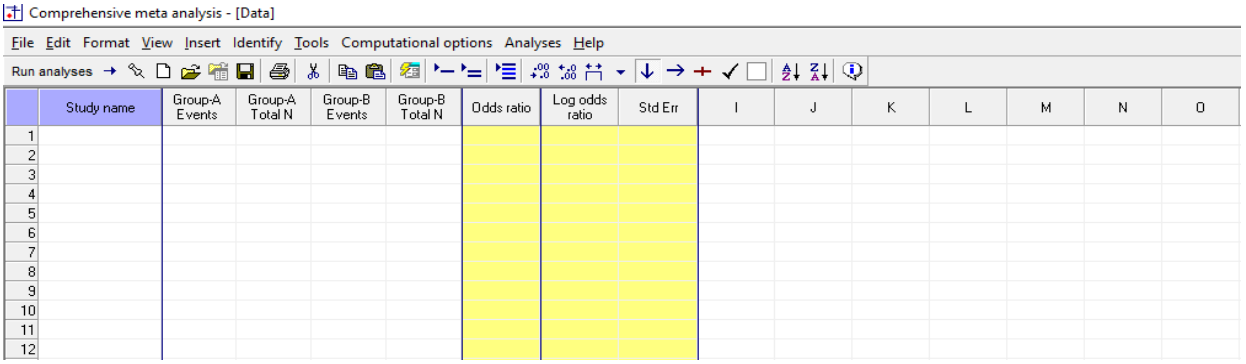
Screenshot.9 : Effect size wizard- Format List



Source: Meta-Analysis Manual V3.pdf

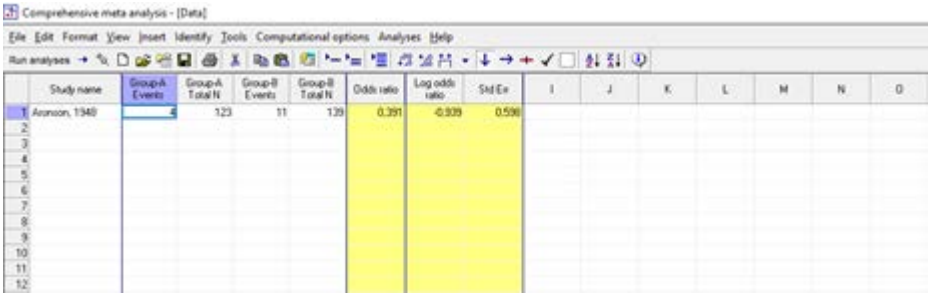
After clicking Finish, That columns which are created for data entry can be seen.

Screenshot.10 : Effect size data input columns - Effect size columns



Source: Meta-Analysis Manual V3.pdf

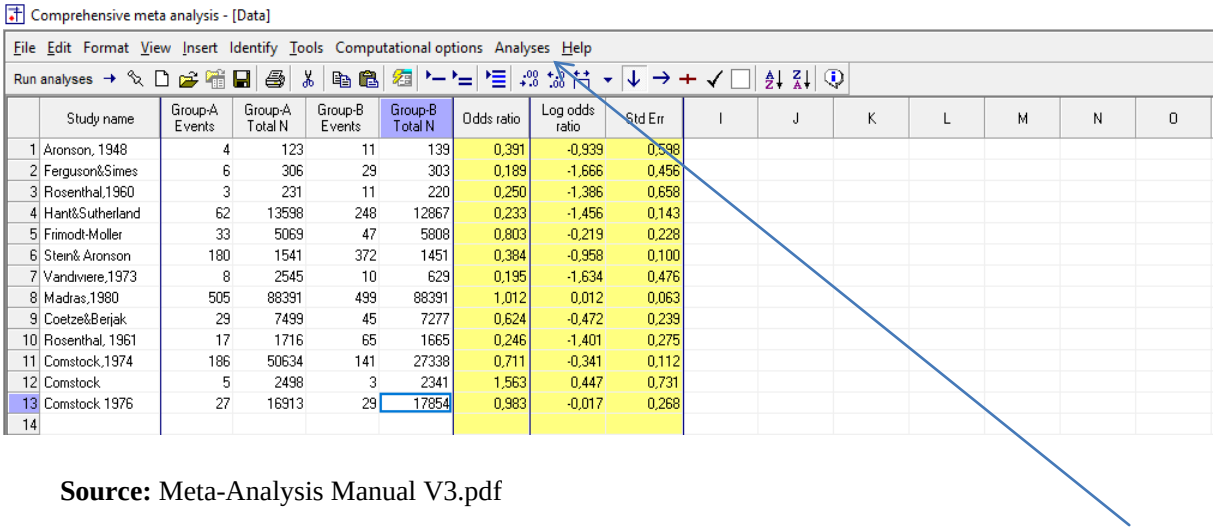
Screenshot.11 : Effect size data input columns - Effect size columns-2



Source: Meta-Analysis Manual V3.pdf

Before starting the analysis, open the data set by clicking File,Open and clicking on the .CMA data file from the tabs. Below is the BCG data set in the program [4].

Screenshot.12: Open a data set

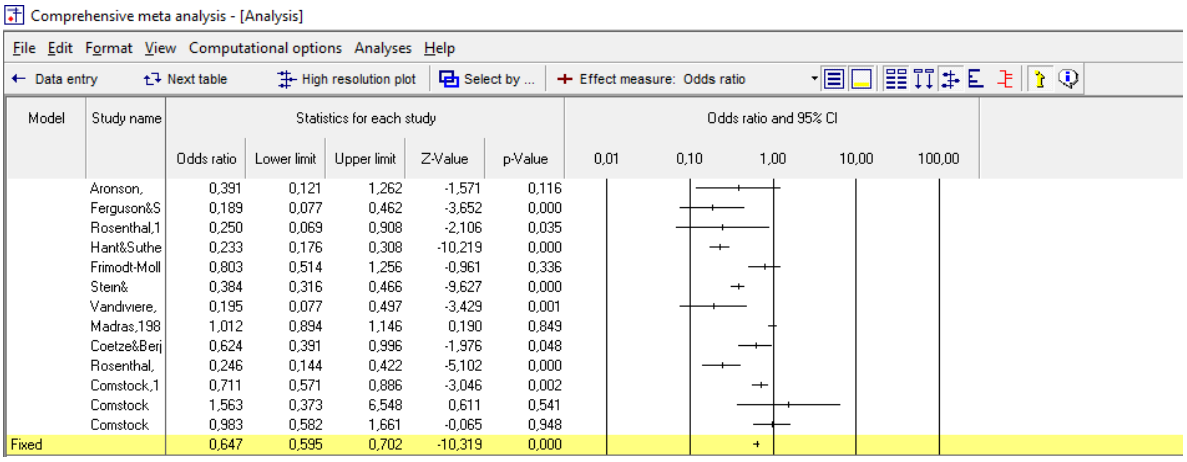


	Study name	Group-A Events	Group-A Total N	Group-B Events	Group-B Total N	Odds ratio	Log odds ratio	Std Err
1	Aronson, 1948	4	123	11	139	0,391	-0,939	0,598
2	Ferguson&Simes	6	306	29	303	0,189	-1,666	0,456
3	Rosenthal,1960	3	231	11	220	0,250	-1,386	0,658
4	Hant&Sutherland	62	13598	248	12867	0,233	-1,456	0,143
5	Frimodt-Moller	33	5069	47	5808	0,803	-0,219	0,228
6	Stein& Aronson	180	1541	372	1451	0,384	-0,958	0,100
7	Vandviere,1973	8	2545	10	629	0,195	-1,634	0,476
8	Madras,1980	505	88391	499	88391	1,012	0,012	0,063
9	Coetze&Berjak	29	7499	45	7277	0,624	-0,472	0,239
10	Rosenthal, 1961	17	1716	65	1665	0,246	-1,401	0,275
11	Comstock,1974	186	50634	141	27338	0,711	-0,341	0,112
12	Comstock	5	2498	3	2341	1,563	0,447	0,731
13	Comstock 1976	27	16913	29	17854	0,983	-0,017	0,268
14								

Source: Meta-Analysis Manual V3.pdf

To start the analysis, from the Quick Access Toolbar, click Run Analysis or Tabs; Click on Anaylses Run Analyses [4].

Screnshot.13 : Analysis Screen-1



Model	Study name	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value
	Aronson,	0,391	0,121	1,262	-1,571	0,116
	Ferguson&S	0,189	0,077	0,462	-3,652	0,000
	Rosenthal,1	0,250	0,069	0,908	-2,106	0,035
	Hant&Suthe	0,233	0,176	0,308	-10,219	0,000
	Frimodt-Moll	0,803	0,514	1,256	-0,961	0,336
	Stein&	0,384	0,316	0,466	-9,627	0,000
	Vandviere,	0,195	0,077	0,497	-3,429	0,001
	Madras,198	1,012	0,894	1,146	0,190	0,849
	Coetze&Berj	0,624	0,391	0,996	-1,976	0,048
	Rosenthal,	0,246	0,144	0,422	-5,102	0,000
	Comstock,1	0,711	0,571	0,886	-3,046	0,002
	Comstock	1,563	0,373	6,548	0,611	0,541
	Comstock	0,983	0,582	1,661	-0,065	0,948
Fixed		0,647	0,595	0,702	-10,319	0,000

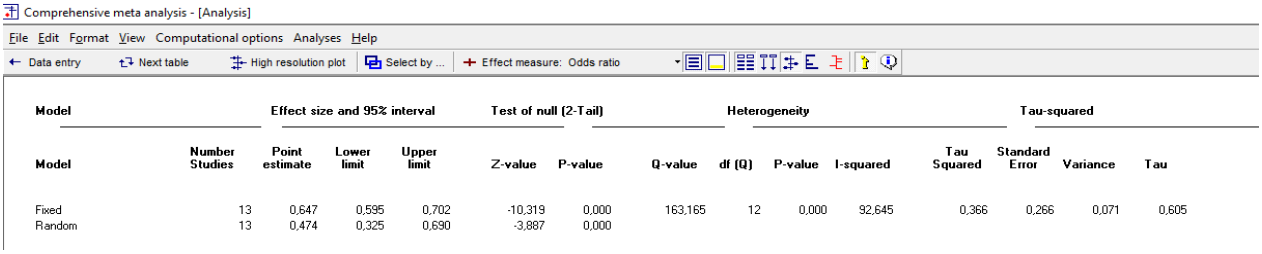
Source: Meta-Analysis Manual V3.pdf

Meta analysis can be started by clicking Run Anaylses. The primary effect size in the program data entry screen; In this case, Odds performs the first analysis for Ratio.

In the pop-up window, select Working names; For studies, the statistics titled Statistics and Odds Ratio, in the probability ratio and confidence intervals for each study can be seen [4]. The last row of the spreadsheet shows summary data [4].

Data entry; data return page.The Next Table; allows you to switch between views. Thus; The next schedule button allows you to switch between the windows and the spreadsheet. This provides more detail on point estimation and heterogeneity [4].

Screenshot.14 : Analysis Screen-2

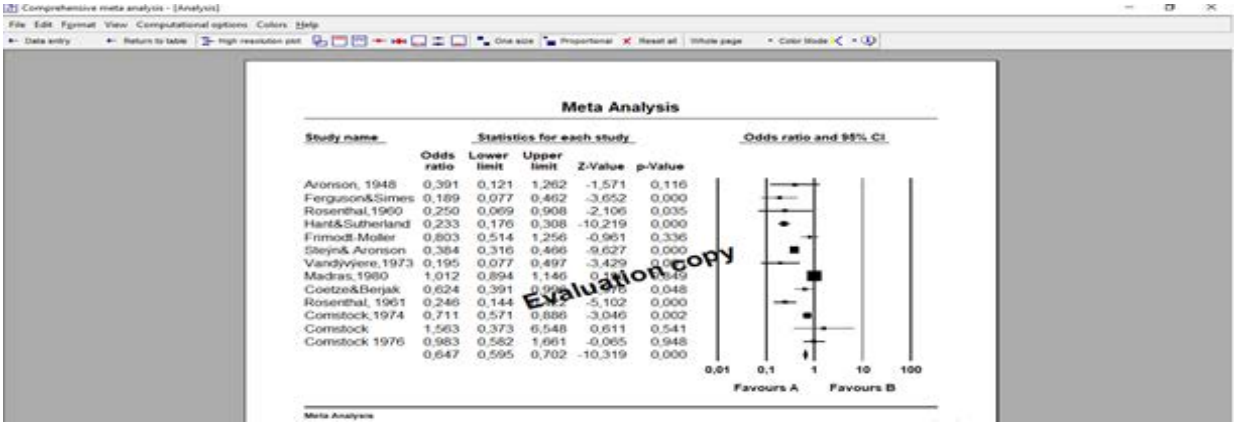


Model		Effect size and 95% interval			Test of null (2-Tail)		Heterogeneity				Tau-squared			
Model	Number Studies	Point estimate	Lower limit	Upper limit	Z-value	P-value	Q-value	df (Q)	P-value	I-squared	Tau Squared	Standard Error	Variance	Tau
Fixed	13	0,647	0,595	0,702	-10,319	0,000	163,165	12	0,000	92,645	0,366	0,266	0,071	0,605
Random	13	0,474	0,325	0,690	-3,887	0,000								

Source: Meta-Analysis Manual V3.pdf

High resolution plot; allows us to display the graphic at a higher resolution.

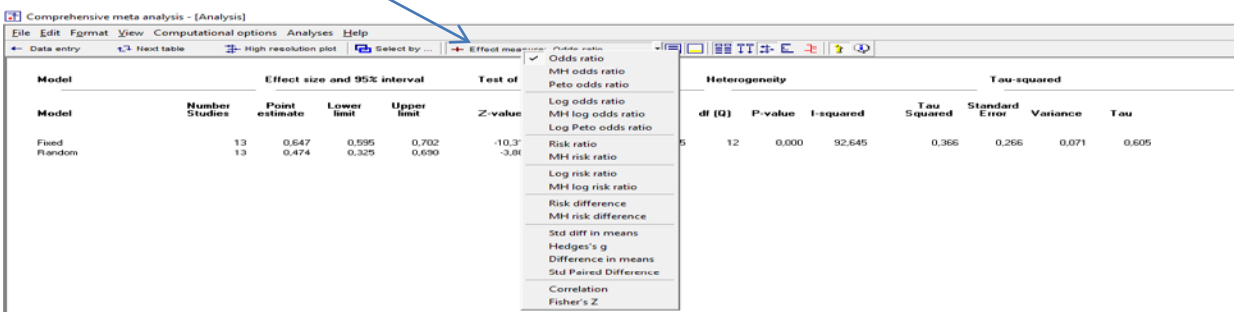
Screenshot.15 : Analysis Screen-3



Source: Meta-Analysis Manual V3.pdf

Effect Measure; The effect measure toolbar option shows a selection of available impact metrics.

Screenshot.15 : Analysis Screen-3



Source: Meta-Analysis Manual V3.pdf

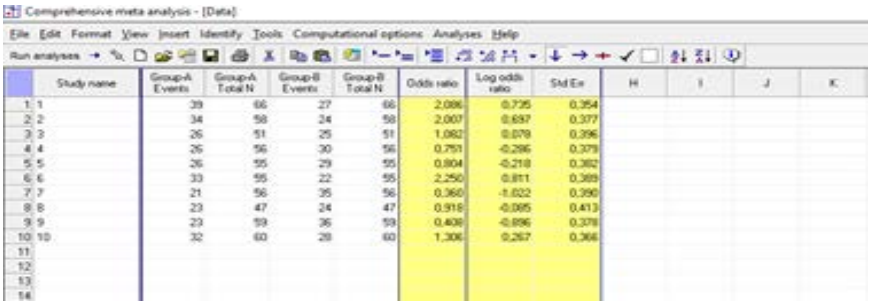
Analyze

In order to show how two concatenated data can be combined in randomly controlled trials, 10 studies produced with Microsoft Excel program were transferred to Comprehensive Meta Analysis program and analysis was done for odds ratio. In this application, it will be assumed that the data obtained from the observations that the tires belonging to 2 different brands have been eroded during the specified warranty period are used.

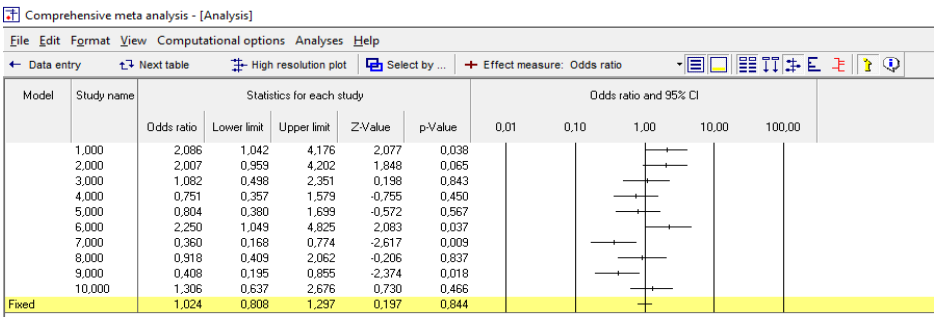
Table 1: Worn and non-worn tire numbers of 2 different brands

	A BRAND CAR TIRE		B BRAND CAR TIRE	
STUDIES	*WORN*	*NOT WORN*	*WORN*	*NOT WORN*
1	39	27	139	117
2	34	24	117	98
3	26	25	103	104
4	26	30	125	122
5	26	29	138	128
6	33	22	108	104
7	21	35	101	125
8	23	24	136	132
9	23	36	103	123
10	32	28	114	132

Screenshot16 : Odds ratio for brand A tires

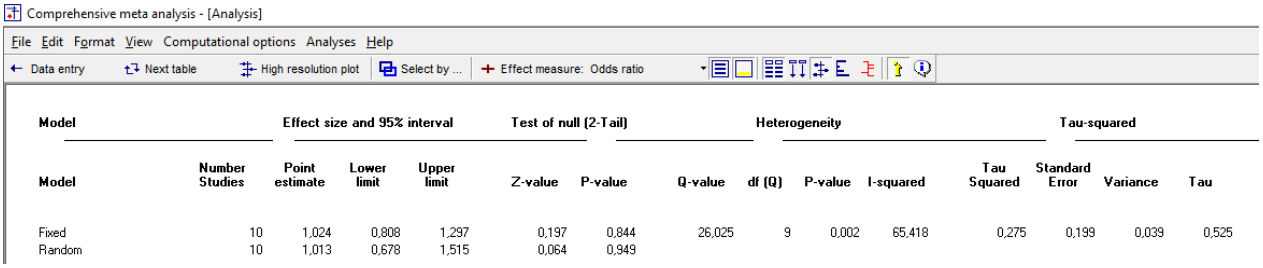


Screenshot.17 : Odds ratio for brand A tires and statistics and confidence intervals for odds ratio for each study



When we interpret this table, we say that the odds ratio of 7th and 8th studies is statistically significant since the confidence interval of the 7th and 8th studies does not include 1.

Screenshot.18 : Detailed additional statistics for brand A tires



Comprehensive meta analysis - [Analysis]

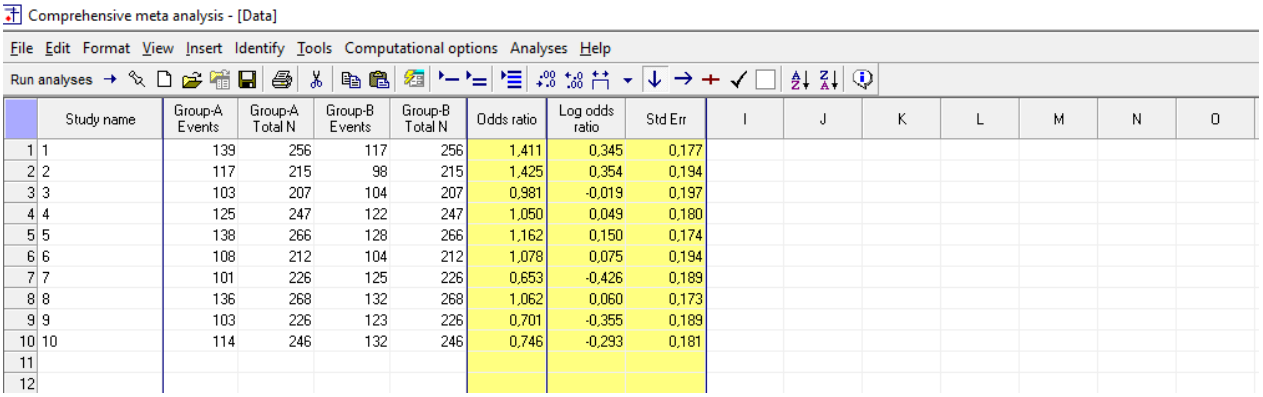
File Edit Format View Computational options Analyses Help

Data entry | Next table | High resolution plot | Select by ... | Effect measure: Odds ratio

Model		Effect size and 95% interval			Test of null (2-Tail)		Heterogeneity				Tau-squared			
Model	Number Studies	Point estimate	Lower limit	Upper limit	Z-value	P-value	Q-value	df (Q)	P-value	I-squared	Tau Squared	Standard Error	Variance	Tau
Fixed	10	1,024	0,808	1,297	0,197	0,844	26,025	9	0,002	65,418	0,275	0,199	0,039	0,525
Random	10	1,013	0,678	1,515	0,064	0,949								

For A brand tires, confidence intervals, z-values and p-values of 10 studies are shown according to fixed-acting and random-acting model. When we interpret this table, the effect of brand A alone is meaningless because it has p values (p> 0.05) according to fixed and random effect model for brand A.

Screenshot.19 : Odds ratio for brand B tires



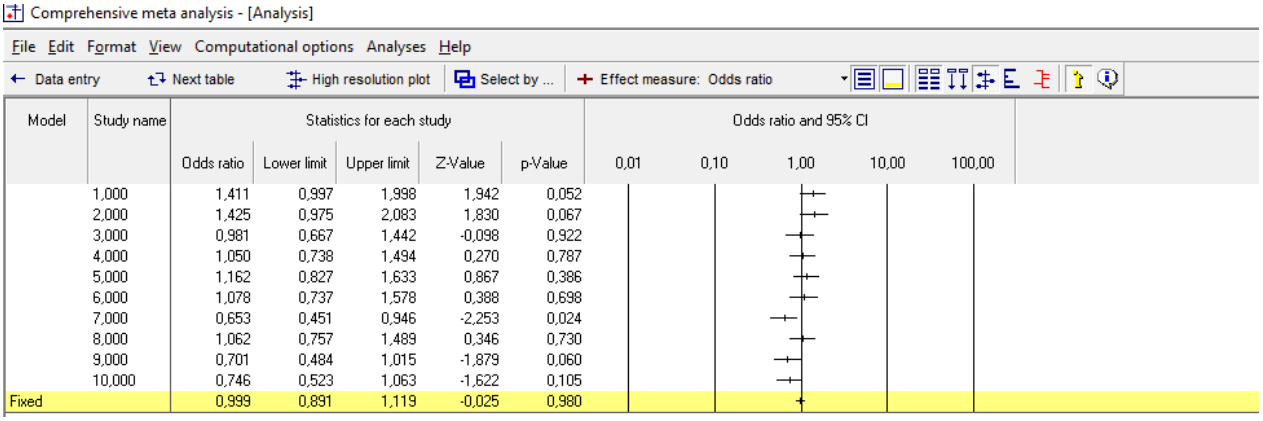
Comprehensive meta analysis - [Data]

File Edit Format View Insert Identify Tools Computational options Analyses Help

Run analyses

	Study name	Group-A Events	Group-A Total N	Group-B Events	Group-B Total N	Odds ratio	Log odds ratio	Std Err	I	J	K	L	M	N	O
1	1	139	256	117	256	1,411	0,345	0,177							
2	2	117	215	98	215	1,425	0,354	0,194							
3	3	103	207	104	207	0,981	-0,019	0,197							
4	4	125	247	122	247	1,050	0,049	0,180							
5	5	138	266	128	266	1,162	0,150	0,174							
6	6	108	212	104	212	1,078	0,075	0,194							
7	7	101	226	125	226	0,653	-0,426	0,189							
8	8	136	268	132	268	1,062	0,060	0,173							
9	9	103	226	123	226	0,701	-0,355	0,189							
10	10	114	246	132	246	0,746	-0,293	0,181							
11															
12															

Screenshot.20 : Odds ratio for brand B tires and statistics and confidence intervals for odds ratio for each study



Comprehensive meta analysis - [Analysis]

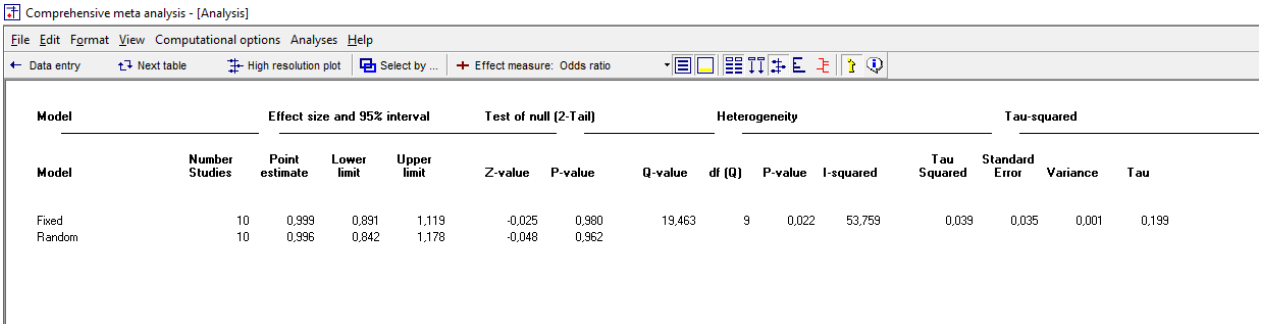
File Edit Format View Computational options Analyses Help

Data entry | Next table | High resolution plot | Select by ... | Effect measure: Odds ratio

Model	Study name	Statistics for each study					Odds ratio and 95% CI
		Odds ratio	Lower limit	Upper limit	Z-Value	p-Value	0,01 0,10 1,00 10,00 100,00
	1,000	1,411	0,997	1,998	1,942	0,052	
	2,000	1,425	0,975	2,083	1,830	0,067	
	3,000	0,981	0,667	1,442	-0,098	0,922	
	4,000	1,050	0,738	1,494	0,270	0,787	
	5,000	1,162	0,827	1,633	0,867	0,386	
	6,000	1,078	0,737	1,578	0,388	0,698	
	7,000	0,653	0,451	0,946	-2,253	0,024	
	8,000	1,062	0,757	1,489	0,346	0,730	
	9,000	0,701	0,484	1,015	-1,879	0,060	
	10,000	0,746	0,523	1,063	-1,622	0,105	
Fixed		0,999	0,891	1,119	-0,025	0,980	

In the statistics related to the B brand, we can say that the 7th study was the seventh study with the most significant effect among the studies when the confidence interval did not include 1.

Screenshot.21 : Detailed additional statistics for brand B tires



Model		Effect size and 95% interval			Test of null (2-Tail)		Heterogeneity				Tau-squared			
Model	Number Studies	Point estimate	Lower limit	Upper limit	Z-value	P-value	Q-value	df (Q)	P-value	I-squared	Tau Squared	Standard Error	Variance	Tau
Fixed	10	0,999	0,891	1,119	-0,025	0,980	19,463	9	0,022	53,759	0,039	0,035	0,001	0,199
Random	10	0,996	0,842	1,178	-0,048	0,962								

According to the random and fixed-effect model for B brand tires, confidence intervals z values and p values of 10 studies are seen. When we interpret this study, the effect of the B brand alone is meaningless because there are p values (p> 0.05) for the B brand according to the fixed and random effect model.As a result, when the tires belonging to 2 different brands are examined separately, it has been reached 95% confidence level.If we combine the relevant results, we can say that there is a significant relationship between tire brand and tire wear at 95% confidence level.Therefore, there is a significant difference between the different tire types and the wear of the tires during the specified warranty period.

Conclusions

In the meta-analysis application conducted with the CMA, different studies were carried out on 10 studies by assuming that the tires with different brand tires were worn during the specified warranty period.Detailed additional statistics have been obtained for the fixed-acting model and the random-acting model.According to these results, it has been concluded that the effects of A and B on their own are insignificant.Therefore, there is a significant relationship between the different tire types and the wear of the tires during the specified warranty period.

In this study, it is tried to explain the CMA program in general terms. The Comprehensive Meta Analysis program is a package program developed for meta-analysis. The study describes the steps that need to be taken to start a new project, how to enter data entry columns, and how to create columns of influence size. It was also shown how to perform the analysis after the data entry and how to reach the detail results (additional statistics). Then, in randomly controlled trials, the data obtained in the Microsoft Excel program was analyzed by taking the appropriate steps in the Comprehensive Meta Analyze program by assuming that the warranty period stated by different brand tires is used to show how the data with 2 results can be combined.The aim of the meta-analysis is to combine the studies on the same topic and to reach the general conclusion.

References

[1]. AKGÖZ, S., ERCAN, İ., & KAN, İ. (2004). Meta Analizi. Uludağ Üniversitesi Tip Fakültesi Dergisi, 30(2), 107-12.

[2]. ŞEN, S. (2017, 11). https://sedatsen.files.wordpress.com/2017/11/meta-analiz.pdf.

[3]. KABLAN, Z., TOPAN, B., & ERKAN, B. (2013). Sinif İçi Öğretimde Materyal Kullaniminin Etkililik Düzeyi: Bir Meta-Analiz Çalişmasi. Kuram ve Uygulamada Eğitim Bilimleri, 13(3), 629-644.

[4]. BORENSTEIN, M., HEDGES, L., HIGGINS, J., & ROTHSTEIN, H. (n.d.). Meta-Analysis Manual V3.pdf.

[5]. Comprehensive Meta Analysis V3.

Published: Volume 2019, Issue 4 / April 25, 2019