

Writing the Results

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The culmination of all the efforts put in conducting a study is in obtaining the results of the study; hence, while publishing the study one should be very attentive in writing the Results section. In this series on reporting of research, the Journal has previously published articles on writing the 'Introduction' and the 'Methods' sections [1,2]. We herein provide pointers to writing the Results section, which is the cornerstone of a research paper where one can highlight the achievements of the study – it is here that one actually presents the painstakingly collected and analyzed data.

The skill of presenting the findings of one's study clearly and logically, so that it is easily understandable by the reader (who has never been as involved with the study details as the researcher) improves with practice. Many good studies are marred by results that are described in a haphazard, directionless and over-elaborative manner.

In this section, in addition to the text, tables and figures are also used to communicate the content. When well-written, this section can give a lucid picture of what the study is trying to say. Data obtained from the study, when presented coherently, inspires the readers' confidence in the authenticity and robustness of the study. It should be a step-by-step approach, taking the readers along the plan of analysis that was described in the methods section. At the end of this section, the readers should be able to draw their own conclusions about the study findings.

WHAT SHOULD BE INCLUDED IN THE RESULTS SECTION?

Results section is a platform to narrate the observations; no attempt should be made to explain the findings – interpretations should be left for the discussion section. Similarly, details of statistical tests, definitions, and plan of study should be included in the methods section rather than the results section. The guidelines for authors as per the targeted journal should be thoroughly read and instructions followed. Results section is for reporting the findings of your own study and not for any comparison

with other studies; however, in systematic reviews and meta-analysis, various included studies' pertinent results are presented. Do not give any data which is not your own and for which a reference has to be cited.

A large amount of data may be generated in a study; however, it is not wise to include all the data together. One has to be careful as to how much of the data are presented. Too much of information might obscure the pertinent findings, whereas too little might render the study incomprehensible and unreliable.

GENERAL STYLE OF WRITING

The style of writing should be fluent and uncluttered, without unnecessary use of adjectives and adverbs. Use past tense when describing the results as all events being reported while publishing the study has happened historically [3]. Write with clarity and brevity, as shown in the following example:

- (A) It is clearly seen that average weight of children in group A is markedly higher than that of group B.
- (B) The mean (SD) weight of children in group A [16.5 (2.1) kg] was higher as compared to that in group B [10.3 (1.2) kg], $P=0.04$.

Sentence B is the more appropriate way of expressing the result.

ORGANIZING THE RESULTS TO MAKE THEM MORE MEANINGFUL

The pattern of describing the results may differ in its minutiae according to the study type and the journal. However, the broad outlines are essentially the same. Qualitative studies have a slightly different approach than quantitative studies; we will concentrate on the latter in this paper.

Where to Start - Details of Study Subjects/Outline of Study?

One should start with data regarding number of patients/ subjects enrolled. Numbers of potential subjects

screened, numbers excluded for not meeting study criteria, numbers randomized, and numbers finally being analyzed along with numbers of trial deviates and lost to follow up should be clearly mentioned; use of a flow diagram may be useful. Following is an example to highlight these aspects:

“A total of 300 [175 (58.3%) girls] children with tuberculosis, aged 6 months to 15 years of age, were enrolled after screening 800 children attending the pediatric outpatient department of our hospital.”

Thereafter, a description of study subjects, the demographic and clinical characteristics can be presented in the text or in a table. Most editors/reviewers do not want the *P* value to be written when presenting the baseline demographic characteristics of the intervention and control arms of randomized controlled trials. Number of participants with missing data for each variable of interest should be indicated. Data regarding exposures and potential confounding factors should be mentioned here.

Which Reporting Guideline to Follow?

The various guidelines for reporting studies as well as the instructions to the authors by the journals should be closely followed. Details of these guidelines can be obtained from the link: <http://www.equator-network.org/>

The STROBE guidelines should be referred to in cases of observational studies – both case control and cohort studies [4]. It is advisable to include a flow diagram indicating the study outline. In case of cohort studies and cross-sectional studies, number or the summary measure of outcome events should be mentioned. In case control studies, the numbers in each exposure category or summary measure thereof should be reported.

In case of a randomized control trial, CONSORT statement for reporting should be followed and a study flow diagram is essential [5]. Dates defining the periods of study recruitment and follow-up should be mentioned. If the trial is stopped prematurely, reasons for doing so should be clearly specified. All adverse events, even if unrelated to the study intervention should be mentioned in each group.

While reporting diagnostic studies, the STARD guidelines are to be followed [6]. A flow diagram can be included to depict the enrollment of participants. The distribution of severity of disease in participants with the target condition and alternate diagnosis in those without the target condition has to be mentioned. A 2×2 table should be provided for the test result under study and the

reference or gold standard test. Diagnostic accuracy should be stated along with the 95% confidence interval. Any adverse events encountered while performing the test being studied and the reference standard should be reported.

Presenting the Outcomes: The Sequence?

It is important to have a proper sequence for the presentation of the observations of the study. Often, the authors present the observations where the *p* value is the lowest/ significant. At times, the presentation includes all the data collected with the main outcomes coming somewhere in between. It becomes difficult for the reader to follow such a haphazard arrangement.

Addressing the objectives

The primary objective of the study should be dealt with in the beginning. The data should be so stated that the primary question asked is answered clearly, using the statistical tests as described in the methodology section. Refrain from presenting raw data. Thereafter, the secondary outcomes, if any, should be presented.

Remaining data should follow the order as described in the methodology section. It is advisable to go from the simpler to more complicated results. Subgroup analysis should come in the last. Do not describe any finding in the result section for which the methodology and statistical analysis plan has not been stated in the methods section. On the other hand, present all relevant results as mentioned in the methodology section; do not exclude the observations from any test or investigation which has been mentioned in the methodology section. In case some *post hoc* analyses are performed, the same should be stated explicitly.

Results section can be divided into subheadings according to the objectives studied and analysis done, in order to increase the clarity; however, the same should be done as per the journal's format.

IMPORTANT ISSUES WHILE WRITING RESULTS SECTION

Although you would like to write a comprehensive results section and include all your study findings; frequently we miss some essential attributes of this section. Some of these are (**Box 1**):

1. Decimal points

Usually the computer programs that we use for statistical analysis will return results with a lot of digits after the decimal point like 3.4562789. Do not report as such; round off to the decimal point which reflects the sensitivity of your measuring instrument or assay. For example, if the birth-weight is measured in grams, then

the mean value for the weight should have only one decimal place rather than 2 or more decimal places. Usually one or two places after decimal point are sufficient. However, one should be consistent with the format which should be as per the journal's requirement.

2. Importance of *P* value

The significance of the statistical tests applied is usually presented as *P* values; the actual *P* value should be written instead of just stating <0.05 . Never state a *P* value as 0.000 – this does not make sense even if the statistical program does return such values; such values should be stated as <0.0001 . Many reviewers and journals nowadays prefer the 95% confidence interval over the *P* values [5].

3. Choose your words carefully

One should be cautious while using the word 'significant' – in the results section, it denotes that the difference is statistically significant and not by chance i.e. $P < 0.05$. Do not use the word if you find any difference which is not statistically significant. However, do present the statistically non-significant data as well. Defer from using words like 'about' or 'approximately' while describing the results.

4. Confounders

In scenarios where confounders are expected to alter the results, first give the unadjusted estimates and then the confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders

were adjusted for and why they were included; the process for the same should be described in the methods section.

5. Negative results

The researcher is usually biased towards the positive findings of his or her study. However, the negative results obtained from the studies are equally important; they may help to prove or disprove many proposed hypothesis. Remember to always report the negative findings as well. Not reporting the negative results is unethical and reduces the authenticity of the data.

6. Text – table dichotomy

Text and tables should be complimentary to each other, not repetitive. Some salient features informing the reader as to what is described in the tables can go in the text; rest can be depicted in the table, for example:

“A total of 300 [175 (58.3%) girls] children with tuberculosis, aged 6 months to 15 years of age, were enrolled. Mean (SD) age of the children was 110 (15.3) months. Table ... shows the baseline characteristics of the enrolled children.”

TABLES

Tables are a good way of presenting large amount of complicated data in a structured fashion. A lot can be communicated through tables, but care should be taken so that the tables are simple and comprehensible. The tables and text should not contain the same detailed information, this is considered redundant. Only the key message of the table can be concisely described in the text. The text should always be linked with the table by referencing the table sequentially. Depending on the journal, tables may be presented sequentially at the end of the manuscript after the 'References', or located within the text of your results section [7].

In a study with the objective to document the weight gain at the end of 6 months of anti-tubercular therapy, the result can be written as:

“At 6 months, median (IQR) weight gain was 3.5 (3.1, 4.7) kg and WAZ was 0.65 (0.59, 0.79). Change in WAZ was assessed at 2 and 6 months and are described in Table XYZ.”

Number of tables

Number of tables to be included is primarily decided by the requirement of the publishing journal. Usually a maximum of 3-4 tables should be sent. Remaining data may be submitted as supplementary material in case of online publications.

BOX 1. CHECK THESE BEFORE FINALIZING THE RESULTS SECTION

Decimal points

- Usually one or two places after decimal point are sufficient.
- Be consistent with the format.

Importance of *P* value

- Write the actual *P* value.
- Never state a *P* value as 0.000.

Choose your words carefully

- Be cautious while using the word 'significant'.

Confounders

- Make clear which confounders were adjusted for.

Negative results

- Always report the negative findings as well.

Text – table dichotomy

- Avoid repetition between text and tables.

Requisites of a good table

Each table should be complete in itself; one should be able to read the table without taking help from the text. The essential components of the table include a heading or legend, row and column headers and footnotes. Heading should be short, specific, descriptive, stating the key message to be enumerated in the table. Do not use abbreviations in the heading. Each row and column header should be able to explain what the row/column contains. The footnote should contain the abbreviations mentioned in the table and any other explanatory notes required. Always mention what summary statistic is being presented like N (%), mean (SD) or median (IQR) and also the unit of measurement. This can be mentioned in the appropriate column/row header or in the footnote (**Table I**). Indicate number of participants with missing data for each variable of interest. Do not just give percentages if the denominator is less than 100, rather give the actual observed values.

When comparisons are being made, the data should preferably be presented side by side.

Do not combine disparate variables in the same table. If a table becomes too long, it is better to split into two for better understandability.

FIGURES

Figure give a visual key which is usually appealing to the reader. Decide which data can be best presented in the

form of figure; it is usually the important information which is presented in this format – something which you want the readers to easily understand and retain. Figures can be in color or grey tone. Almost all journals charge extra for colored figures. Again the number of figures to be included is to be decided as per the requirement of the publishing journal.

Figures may range from simple line diagrams to scatter plots to radiographs/images. Figure should also be complete in itself with an informative heading with no abbreviations. Legends, data labels, axis titles etc. should all be complete [7].

The text, table and figure should be complimentary to each other and not mere duplication of data. Figures should be cited in the text and should be numbered in the order of reference in the text.

All figures and pictures should be submitted as separate files in the form of image file (.jpg, .ppt, .gif, .tif or .bmp) with minimum resolution of 300 dpi to ensure good print quality; the authors should refer to the target journal’s instructions to choose the correct file type and the resolution.

Types of Figures/Illustrations

1. *Photographic images:* These images are used to document observations such as clinical photographs of patients; data of imaging investigations such as

TABLE I: FACTORS ASSOCIATED WITH TREATMENT OUTCOME IN ENROLLED CHILDREN

Row header	Characteristics	Treatment success n=80	Poor outcome n=45	P value
	Age (mo), mean (SD)	99.1 (43.1)	113.7 (42.3)	0.2
	Gender, n (%)			
	Male	43 (53.7)	20 (50)	0.9
	TST positivity, n (%)	58 (79.4)	27 (75.0)	0.6
	Contact with TB, n (%)	21 (38.6)	18 (28.2)	0.2
	BCG vaccinated, n (%)	45 (58.9)	20 (44.2)	0.1
	Diagnosis, n (%)			
	Pulmonary	51 (63.7)	29 (64.4)	0.5
	Extra-pulmonary	29 (36.3)	16 (35.6)	
	Weight for age	-1.7	-1.8	0.4
	Z score at the start of therapy, median (IQR)	(-2.3,-0.9)	(-2.4, -1.2)	

AFB: acid fast bacillus; TB: tuberculosis; TST: tuberculin skin test; BCG: Bacillus Calmette Guerin; ATT: anti-tubercular therapy; IQR: interquartile range

radiographs, ultrasonography images, CT scan/ MRI scan images, radionuclide studies; intra-operative findings; surgical specimen; pathology images- cytopathology, histopathology, special stains, immunohistochemistry, etc.; laboratory investigations such as PCR results, gel/ blot images; tracing of investigations such as ECG, EEG, EMG, etc.

Images should be of good quality, maintaining the original proportions (not unnaturally distorted), cropped to delete unnecessary details and labeled properly. If you plan to include photographs of your patient, proper written consent should be obtained beforehand. Patient confidentiality is of paramount importance and all attempts should be made to protect the identity of the person like covering the eyes. The pictures should also have a legend describing what is being portrayed. At times, it is useful to combine many images in a single figure, e.g. CT scan/ MRI scan images; each of the images should be identified separately. Use of arrows or other markers may be helpful to highlight important findings.

2. *Graphs/data chart:* Data charts can effectively summarize numerical data for better presentation.

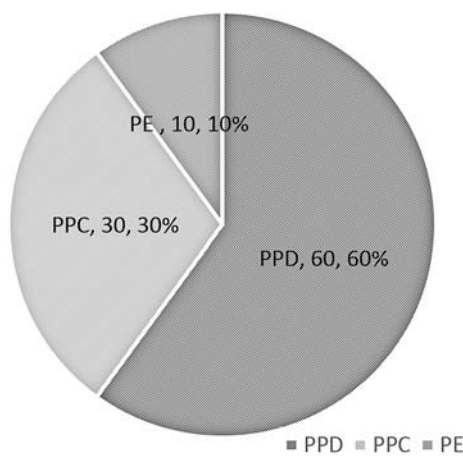
Choosing the right type of graph for your data is critical. The right graph depends on a number of factors like the type of data (continuous or categorical), the number of groups or variables involved and the intent of creating the graph. When one wants to demonstrate the composition or break up of a data set or groups within the data set, one can use pie charts or stacked bar charts. In order to show comparison between data, you can use bar charts or line plots. Line plots can be used to depict time trends. Distribution of data can be demonstrated by histograms, scatter plots. Overlapping of data can be picturized by Venn diagrams. The relationship or correlation between two variables can be demonstrated by scatter plots. Commonly used data charts are:

(a) *Pie chart:* Pie chart shows classes or groups of data in proportion to the whole data set. They are usually beneficial to depict large data sets, e.g. epidemiological surveys (**Fig. 1**). These are best used when the number of classes/ groups are 3-10. One should avoid using the pie chart where there are only 2 groups, e.g. gender.

(b) *Bar charts:* Bar charts may be horizontal or vertical. The height or length of the bars represents the measurement. By this method the same variable can be compared across groups or time points (**Fig. 2**). Stacked bars can also be made to make intra-group comparisons like in males and females or to show the composition of each group. It is better not to compare two variables in the

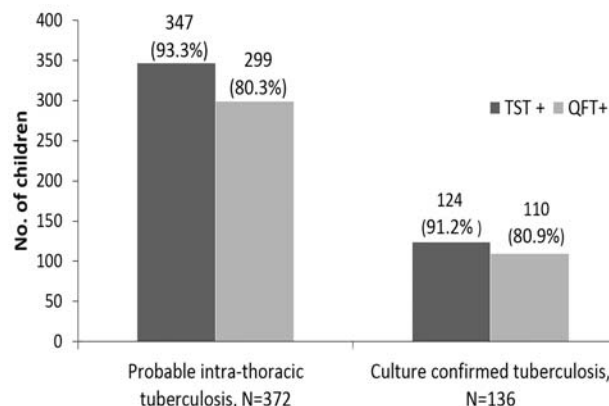
same chart if values of one variable overshadows or dwarfs the other. Also it is prudent to avoid clubbing too many variables or categories in the same chart- this makes the chart unreadable. If there are more than 5 groups to be compared, better to use horizontal bar charts.

(c) *Histogram:* In a histogram, the entire range of a continuous variable is divided consecutively into non-overlapping groups known as class intervals. The height of the vertical rectangles for each class interval represents the frequency or density of the variable, depending upon whether the class intervals are of equal or unequal width.



PPD: progressive pulmonary disease; PPC: primary pulmonary complex; PE: pleural effusion.

FIG.1 Pie chart depicting the diagnosis of enrolled children with tuberculosis.



TST: Tuberculin skin test; QFT: QuantiFERON gold in tube test.

FIG.2 Comparison of tuberculin skin test and QuantiFeron Gold In-tube test in children with probable and culture confirmed intra-thoracic tuberculosis.

(d) Scatter plots: Scatter plots can be used to present measurements on two or more variables that are related; the values of the variables on the y-axis are dependent on the values of the variable plotted along the x-axis (Fig. 3).

(e) Line plots: Line plots are similar in some ways to the scatter plots, with the condition that the values of the x variable have their own sequence (Fig. 4). Line plots can be used to depict time trends.

(f) Box plots: Box plots are used to depict the numerical data in the form of median and interquartile range (which forms the box); sometimes whiskers are added which may denote the maximum and minimum value. Outliers can also be depicted in the box plot (Fig. 5).

(g) Venn diagram: A Venn diagram is a type of chart that shows how different data sets relate to or overlap each other through intersecting portions of circles.

(h) ROC curves: Receiver Operating Characteristic curve is a plot of the true positive rate (sensitivity) against the false positive rate (1-specificity) for the different possible cut-offs of a diagnostic test. The area under the curve is a measure of accuracy of the test under question.

BOX 2. COMMON ERRORS ENCOUNTERED IN RESULTS SECTION

In text

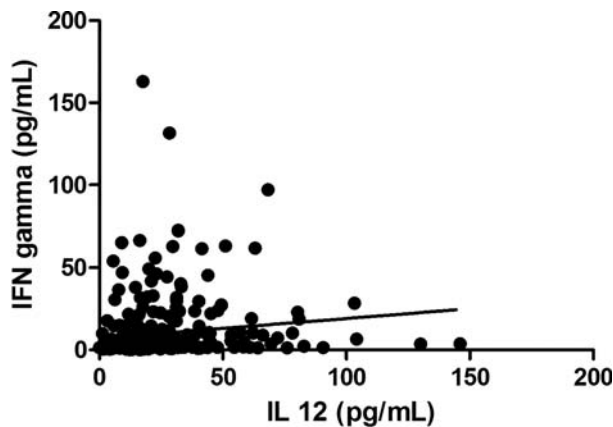
- Presenting the data haphazardly, not following the order mentioned in the methodology section.
- Trying to explain the results, giving one's own interpretation instead of stating the facts.
- Providing too little or too much information.
- Not reporting the negative findings.

In tables

- Duplication of information in text and tables.
- Table not complete in itself.
- Disparate characteristics and comparisons clubbed together in one table.
- Not linking the table with the text with proper reference and in the right chronological order.
- Inaccurate arithmetic – numbers do not add up.

In figures

- Graph not plotted to scale.
- Data not properly labeled.
- Omission of proper legends.
- Data not consistent with text.
- Not linking the table with the text with proper reference and in the right chronological order.



IFN-gamma: interferon gamma; IL 12: interleukin-12

FIG. 3 Scatter plot showing the relation between serum interferon-gamma and interleukin-12 level in 150 neonates at baseline.

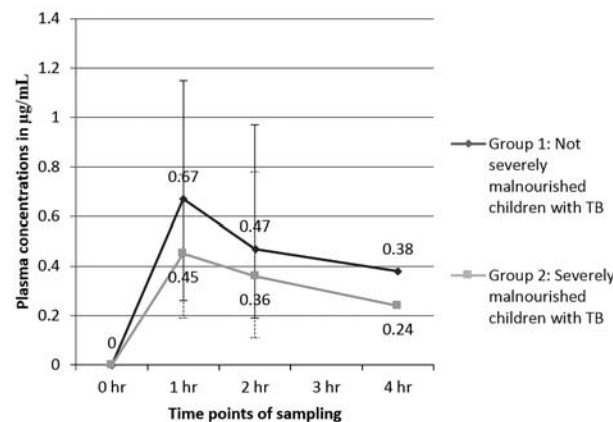


FIG. 4 Comparison of plasma concentrations of isoniazid in children with tuberculosis, with or without severe malnutrition.

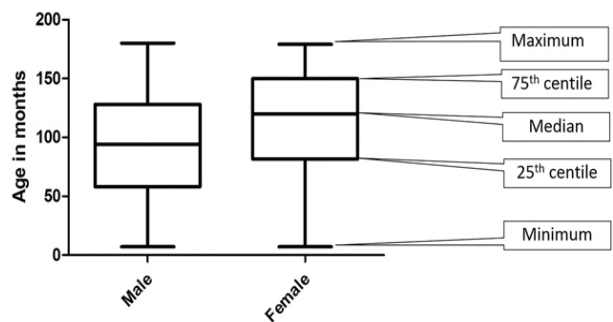


FIG. 5 Summary of age of 402 enrolled children with pulmonary tuberculosis.

(i) Forest plot: Forest plot is a graphical presentation of the results of meta-analysis, where the individual estimated effect of the included studies with the same objective is portrayed along with the cumulative effect.

VALUE OF REVISION

Finally, check and recheck your data. There should not be any discrepancy or inaccurate reporting. Discrepancies within the result section leave a bad impression on the reviewer, and question the reliability of the data.

You may want to get your result (or the whole paper) reviewed by a colleague before submission to any journal – a neutral perspective often brings out many flaws which are not visible to the author himself.

COMMON ERRORS

Box 2 lists some of the commonly encountered errors in the Results section. Enough attention should be paid to avoid these errors.

SUMMARY

The results section is the platform where the researchers present their data in an informative and lucid manner for the understanding of the readers. No explanation or interpretations are to be presented in this section.

Properly labelled tables and figures, chosen according to the data types, add to the value of this section. The sequence of the presentation of results should always follow the order mentioned in the methodology section. The primary objective of the study should be addressed up-front and with utmost clarity. Maintaining the accuracy and authenticity of the data presented is sacrosanct.

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