

Tutorial: Simple Analytic Framework for Addressing a Problem in Public Health Practice or Epidemiological Research

Dr. Gregory Fant

Visiting Professor, Public Health (Epidemiology), Jodhpur School of Public Health Rajasthan, INDIA

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ABSTRACT

Various types of quantitative health data are used to understand the extent of a public health problem and guide public health decision-making. Statistical thinking, methods, and tests are used with this health data to help produce quantitative evidence. This statistical evidence can illustrate the main features of a public health problem by using statistical ideas to quantify associations or to help assess the success or failure of a public health intervention. In this tutorial, I want to describe an analytic framework that may be useful to address a public health situation containing quantitative data.

Key Words: Public Health Practice, Analytic Framework, Epidemiological Methods, Statistical Tests

INTRODUCTION

In public health practice, quality improvement is a systematic and continuous enhancement of health care service aimed towards patient treatment and satisfaction. In order to achieve this goal, various types of quantitative health data are used in order to help management leaders to incorporate and implement effective strategies for quality improvement focused on patients' satisfaction and well-being. A proper understanding and development of an effective analytic approach needs to be used in order to make positive improvements. Health care needs and health service quality improvement will be achieved when a proper analytic approach is utilized by the management in addressing successes and failures in public health. This tutorial seeks to describe an analytical framework that is useful in addressing a public health concern using quantitative data.

Analytic Framework

A proper statistical framework that effectively addresses public health needs and expectations should be used. The results

obtained from analysis of the data will assist the management in setting out effective public health strategies and policies that are consistent with quality improvement and patient satisfaction. ⁽¹⁾ Statistical analysis is part of an effective process that addresses research questions where uncertainty and variability are involved. There are basically five steps utilized in addressing and supporting epidemiological research and public health concerns:

1. Formulation of problem statement
2. Selection of an appropriate and efficient study design that effectively addresses the problem statement.
3. Collection of data
4. Organization and description of collected data in line with the problem statement.
5. Drawing inferences and conclusions from the data that aid in making statistical decisions and addressing the problem statement.

From an epidemiological point of view, there are various approaches that may be used to develop and carry out proposed

study for a particular public health problem. When skillfully applied these epidemiological methods yields relevant and scientific findings. The choice of epidemiological method to be used depends on the nature of problem statement whereas the protocol used in data collection will depend on the epidemiological method selected and the nature of the problem statement as well. (2) There are two categories of epidemiological methods to be selected; observational method uses a systematic and prolonged data collection and observation technique. Researchers use their senses to examine situations or people in their natural setting without assigning any treatment to the subjects. The observational method includes parameters such as ecological designs and case control. Unlike the observational method, the experimental method involves treatment and procedures for which an outcome is observed. It involves parameters such as random assignment, control, manipulation, and random selection. (3)

The choice of a statistical method to be used on a particular public health problem should be attached to certain specific considerations, for example, the target population or population of interest. From the target population of interest, a representative sample is selected and data collected from the sample. The data obtained is then described, evaluated and inferred using an appropriate inferential statistical method. (4)

Selecting a Statistical Test

Methodology is a procedure and approach used in collection and assembly of data that will assist in the formulation of research objectives such as appraisals, interviews, and other study practices both the past and the current. It is important to note that setting up of an appropriate sampling objective will assist in limiting the number of errors and attaining more accurate results on public health needs and expectations. An appropriate approach is significant in addressing the number of subjects required to accomplish the research and the selection process to be followed.

A good scientific practice involves the specification of initial statistical tests that will ultimately be used to address the problem statement. Descriptive statistics are means of describing the main characteristics of a chosen representative data sample set. Firstly, the focus is to understand characteristics of the sample set in terms of the central tendencies, for example, the mode, mean and median. Secondly, we are able to measure the variation or spread of the data set for example the standard deviation and variance. Thirdly, with the help of frequency distribution tables, we can measure the nature of frequency distribution of the sample data set. Lastly, we are able to obtain a graphical illustration of the data set, for instance, in form of scatter plots or histograms. (5)

Table 1. Framework for selecting a statistical test

	Data Type			
Statistical Goal	Measurement data (parametric assumptions)	Rank, Score, or Measurement data (nonparametric assumptions)	Binomial data	Survival time data
Describe One Group	Mean, Standard Deviation	Median, Interquartile range	Proportion	Kaplan Meier survival curve
Compare One Group	One-sample t-test	Wilcoxon test	Chi-square or binomial test	
Compare paired groups	Paired t-test	Wilcoxon-signed rank test	McNemar's test	
Compare unpaired groups	Independent sample t-test	Mann-Whitney test	Fisher's test	Log-rank test or Mantel Haenszel test
Compare three or more matched groups	Repeated-measures ANOVA	Friedman test	Cochrane Q test	Cox proportional hazard regression
Compare three or more unmatched groups	1-way ANOVA	Kruskal-Wallis test	RxC chi-square test (or a chi-square test for large samples)	Cox proportional hazard regression
Quantify association	Pearson correlation	Spearman correlation	Contingency coefficient	
Predict value from another variable	Simple linear regression	Nonparametric regression	Simple logistic regression	Cox proportional hazard regression

Adapted from (Motulsky 1995; Pett 2016)

On the other hand, inferential statistics utilizes the sample data set to make statistical conclusions or inferences. They are used in the evaluation of statistical hypothesis and in making generalizations from the sample to with respect to the target population. The process of formulation of the problem statement (statistical goal) is essential in selecting an appropriate inferential statistical test. (2) For example in the table below (table 1), the statistical goals, the data type, and the underlying assumptions help in determining the statistical test to be used in the inferential statistical analysis for a specific problem statement.

CONCLUSION

It is important for the public health practitioner and/or health statistician to realize that effective analysis of a selected sample data set is part of the answer to a particular public health problem. It is, however, important to discuss the statistical findings in relation to the problem statement that was initially formulated. In order to arrive at a reasonable decision for a public health problem, a proper analysis of the data

set should be done using the above framework or any other suitable framework in order to arrive at a reasonable solution for the public health problem. A simple analytic framework as proposed above will aid in better understanding of the problem and generation of information and knowledge for the solution of the problem and to aid in public health decision making.

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