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# Growth Analysis of Research Literature on Malnutrition in Children, 1999 to 2014: A Scientometric Study

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**Abstract**

The paper analyse the articles as reflected through PubMed database for the year 1999 to 2014 to investigate the trend in the growth of literature on Malnutrition in children. The results of the study reveals that , the value of an average RGR of articles $R_t$(P) increased gradually from 0.63to 2.47 (1999 to 2013) and there is miniature decrease in the year 2012 (2.33). The mean relative growth $R_t$(P) for the first 8 years (1999 - 2006) indicates a growth rate of 2.53 years, whereas for the next 8 years (2007 - 2014) it was increased 4.48 yearsThe $R^2$ value for the linear trend (0.9187) is more than that of exponential trend (0.9262), which indicates that the exponential trend is more suitably fit to as compared to linear trend.

**Keywords:** Malnutrition; Nutrition Food; Children; Scientometric Study; Growth of Literature; RGR (Relative Growth Rate); Doubling Time($D_t$).

## Introduction

Scientometrics is a branch of 'Science'. It is one of the most significant measures for assessment of scientific productivity. It is also interrelated to and overlapping benefits with bibliometrics and informetrics.

In 1969, Nalimov and Mulchenkocoined the Russian equivalent of the term "Scientometrics" *(Nalimov, and Mulchenko, 1969).* The term 'Scientometric' is a field which consists of the quantitative methods applied to the study of the science as an information process. This techniquecontains statistical and thesaurus methods, and indicators as to the number of citations, terms so on and it is a scientific discipline, which performs reproducible measurements of scientific activity, and exposes its objective quantitative regularities. *(Keshava, 2014)*

'Scientrometrics is an application of *quantitative techniques* (i. e. system analysis, mathematical and statistical techniques etc)*to scientific communication* (science output, science policy, science administration etc.) with the objectives of:

(a) Developing science indicators; (b) Measuring the impact of science on society; and (c) Comparing the output as well as the impact of science at national and international levels.(Pouris, 1989).

The world's most dangerous issue in children's health is that Malnutrition. It is one of the serious healthiness problems and high contributor to child mortality. Nearly 1/3 (one- third) of children in under developed and developingcountries are either skin-and-bone or stunted. In addition to that more than 30% of people living in developing countries suffer from micronutrient deficiencies.*(ICN2, 2014)*

Entire physical development of Children depends on their Nutrition food,if the body does not have the energy it wants in the form of food, otherwise they may suffer weight loss (generally due to lack of muscle mass). Malnutrition affectedtoinsufficient fat stores and very pint-sized muscle in children.They often have prominentbonesand excessive large abdomens.it reduces brain development, and these children have a high incidence of problem because their bodies lost power to fight with infection. Malnutrition causes to the high death rate among children in developing countries.*(JAMA,2004)*

The world has failed to control malnutrition over the past decades until now, even though well-tested methodologies for doing so exist. More than 1/8 (One in Eight) of the population still suffer from malnutrition in world. The scale of the problem will

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prevent many countries from placing the foundation for sustainable development that is central to *the post-2015 development agenda* and unless policies and priorities are changed. Where as in Sub-Saharan Africa, there is malnutritionwillgoing to increase and malnutrition remains widespread and improving slowly in South-East Asia. *(JAMA, 2004)*

Home-based treatment is been developing by WHO for severe acute malnutrition for cultivating the lives of thousands of children per year. Ready-to-use Therapeutic Food (RUTF) has revolutionized the treatment of severe malnutrition. WHO is providingfoodsfor malnourished children for safe to use at home and certify rapid weight gain to severe cases.(WHO, 2015)

*Department of Nutrition for Health and Development stated about Malnutrition as, "We are guilty of many errors and many faults, but our worst crime is abandoning the children, neglecting the foundation of life. Many of the things we need can wait. The child cannot. Right now is the time his bones are being formed, his blood is being made and his senses are being developed. To him we cannot answer "Tomorrow". His name is "Today" (WHO, 2015).*

*Growth of Literature*

The variations in the mass of literature over a specific period termed as growth literature. Gilbert (1978) has studied the existing literature on the indicators of growth of knowledge in scientific specialties, and has listed many ways of measuring it, noting their strength and limitations and commenting, at same time, on their use. Gupta, B.M (1977) suggests two approaches that have normally been considered in understanding knowledge growth: (i) Qualitative and (ii) Quantitative. Qualitative methodsrecommendedthe structural or descriptive models of knowledge growth, while descriptive model use social phenomenon to explain diffusion and formation of knowledge. Quantitative approach is trusted on summarization of statistics to elaborate the observed behavior, whereas others apply growth and technology diffusion models and bibliometric / Scientometric techniques.

More number of studies has been made on the growth of literature in the field of Medicine literature but a lesser amount ofstudies has been reported on growth of research literature on*Malnutrition in Children*. Therefore an attempt has been made to study the growth and dynamics of Malnutrition research literature.

## Objectives

- To define the growth of 'Malnutrition in Children' literature by calculating relative growth rate and doubling time for publications;
- To fit both modified exponential curve and linear curve for the original publications data studying actual growth pattern.

## Scope And Methodology

The Scientometric study is a statistical method of counting to evaluate and quantify the growth of a subject. The research trend during the said time span would be clearly understood from this study and a predictive projection may be made for an anticipatable future. There are several areas in science, social science and arts for which scientometric studies have been carried out.

The present study is confinedtoonly'Malnutrition in Children' literature as reflected in the PubMed database which were published during year from 1999 to 2014.

The data for this study was downloaded from the*PubMed database*, it is a free resource developed and maintained by the National Center for Biotechnology Information (NCBI) at the National Library of Medicine (NLM). Here we used Pubmed for downloading the data; the search term applied was "Malnutrition in Children". This may considered as central keyword of the topic discussed. A total of 8112 records spanning over the years 1999 to 2014 were downloaded from Pubmed on 15.02.2015. The downloaded data was analysed for source items to find the research trend. The articles were categorized chronologically and transported to spread sheet application (MS Excel) and evaluated the data as per objectives of the study.

## Data Analysis

The articles were downloaded and classified chronologically. To investigate the nature and growth of articles, exponential, linear and logistic were tested. The exponential growth is define as:

$$F(t) = a\, e^{bt}$$

Where

a = the initial size of literature i.e. at time t=o and b, the continuous growth rate is related to the

percentage by which the size increases each year.

The logistic has a lower limit and an upper limit or a celling beyond which the size cannot grow and can be represented mathematically as $U_t = \frac{K}{1+\mu}$

Where,

U = expected size of literature

K and μ = constants and t = time.

Similarly, the linear growth is represented as $U_e = a + b_t$

*Relative Growth Rate (RGR)*

Relative Growth Rate (RGR) and Doubling Time (Dt) had been applied. RGR means the increase in the number of articles per unit of time. The mean RGR of articles over the exact period of interval is represented as:

Rt = Relative Growth Rate of articles over the specific period of time.

$\log_e p(0)$ = Logarithm of initial number of articles

$\log_e p(t)$ = Logarithm of final number of articles

Similarly, RGR of subject's articles has increased in number of articles per unit of time. The mean RGR of subject articles Rt(SA) over the period the specific period of time is determined as:

$$Rt(SA) = \frac{1}{t}\left[\log_e p(t) - \log_e p(0)\right]$$

Rt (SA) = Relative Growth Rate of articles over the specific period of time.

= Logarithm of initial number of articles

= Logarithm of final number of articles

*Doubling Time ($D_t$)*

Dt (Doubling Time) has been calculated using the following formula:

*Doubling Time or $D_t$ = 0.693/R*

Dt (Doubling Time) is directly related to RGR and is defined as the time required for the articles to become double of the existing amount. In case the number of articles in subject doubles during a given period, then the difference between logarithms of number at the beginning and at the end of this period must be the logarithm of the number 2. We used Napier logarithm and the taken value of is 0.693. Therefore, as per this (0.693) and an average growth rate we calculated by what time interval does the Napier logarithm of numbers increase by 0.693. So the Doubling time is calculated as

$$Dt(SA) = \frac{\log_e 2}{Rt(SA)} = \frac{0.693}{Rt(SA)}$$

Here, Dt (SA) = average doubling time of the articles(Keshava, 2014).

Here Doubling time can give more intuitive sense of the long term impact of growth than simply viewing the percentage growth rate.

$$T_d = \frac{\log 2}{\log(1+\frac{r}{100})}$$

Where:

**$T_d$**= Doubling Time

**r**= Constant Growth rate.

**Table 1:** Relative Growth-rate (RGR) and doubling time ($D_t$) of articles in Malnutrition in Children from 1999 to 2014.

| Year | No. of Articles | Cumulative | $Log_e 1^p$ | $Log_e 2^p$ | $R_t$ (P) | Mean $R_t$ (P) | $D_t$ (P) | Mean $D_t$ (P) |
|---|---|---|---|---|---|---|---|---|
| 1999 | 344 | 344 | 5.84 | 5.84 | 0.00 | | 0.00 | |
| 2000 | 394 | 738 | 5.98 | 6.60 | 0.63 | | 1.26 | |
| 2001 | 353 | 1091 | 5.87 | 6.99 | 1.13 | | 2.26 | |
| 2002 | 439 | 1530 | 6.08 | 7.33 | 1.25 | | 2.50 | |
| 2003 | 421 | 1951 | 6.04 | 7.58 | 1.53 | | 3.07 | |
| 2004 | 381 | 2332 | 5.94 | 7.75 | 1.81 | | 3.62 | |
| 2005 | 460 | 2792 | 6.13 | 7.93 | 1.80 | | 3.61 | |
| 2006 | 461 | 3253 | 6.13 | 8.09 | 1.95 | 1.26 | 3.91 | 2.53 |
| 2007 | 530 | 3783 | 6.27 | 8.24 | 1.97 | | 3.93 | |
| 2008 | 546 | 4329 | 6.30 | 8.37 | 2.07 | | 4.14 | |
| 2009 | 555 | 4884 | 6.32 | 8.49 | 2.17 | | 4.35 | |
| 2010 | 598 | 5482 | 6.39 | 8.61 | 2.22 | | 4.43 | |
| 2011 | 566 | 6048 | 6.34 | 8.71 | 2.37 | | 4.74 | |
| 2012 | 649 | 6697 | 6.48 | 8.81 | 2.33 | | 4.67 | |
| 2013 | 731 | 7428 | 6.59 | 8.91 | 2.32 | | 4.64 | |
| 2014 | 684 | 8112 | 6.53 | 9.00 | 2.47 | 2.24 | 4.95 | 4.48 |
| | 8112 | | | | | | | |

$R^2$ (Linear trend for no. of articles)= 0.9187

$R^2$ (Exponential trend for no. of articles ) =0.9262

$R^2$ (Exponential trend for cumulative no. of articles ) = 0.9076

**Fig. 1:** Linear trend for no. of articles from 1999 -14

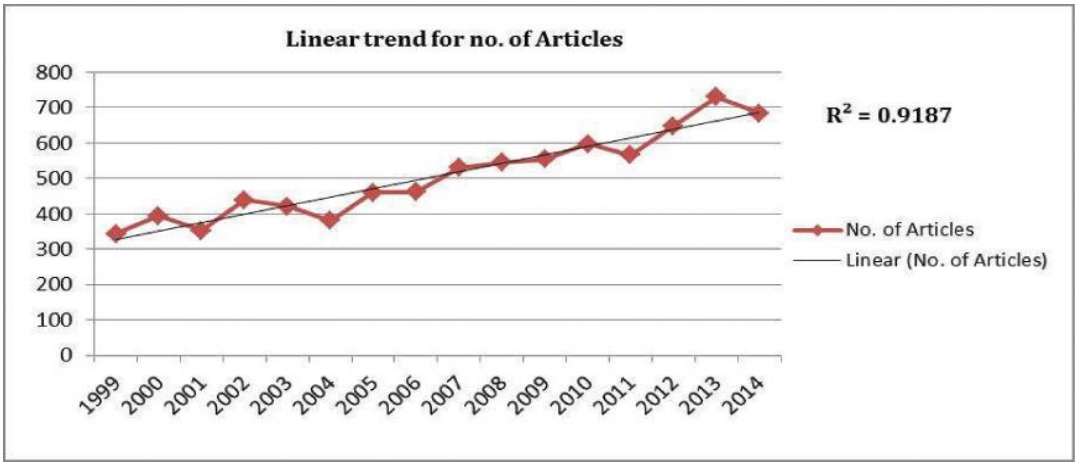



**Fig. 2:** Exponential trend for no. of articles from 1999-14

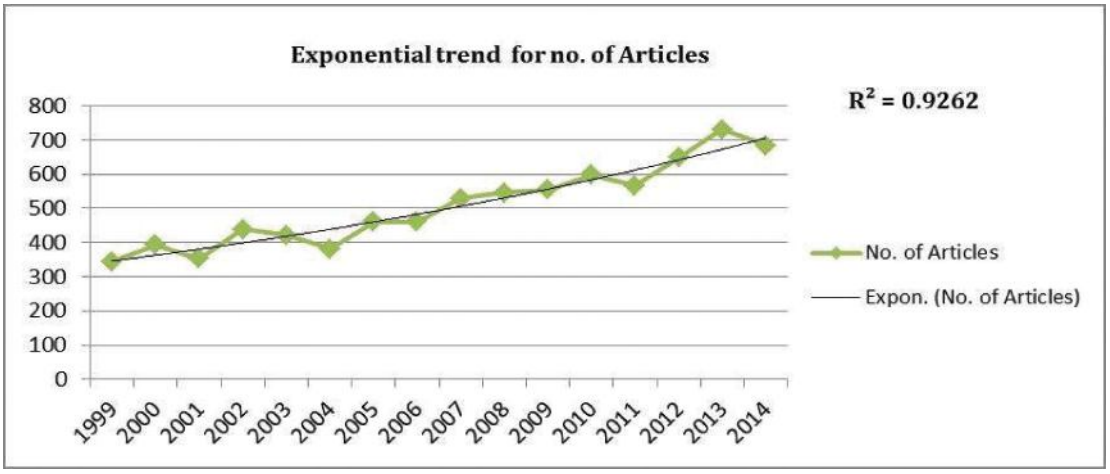
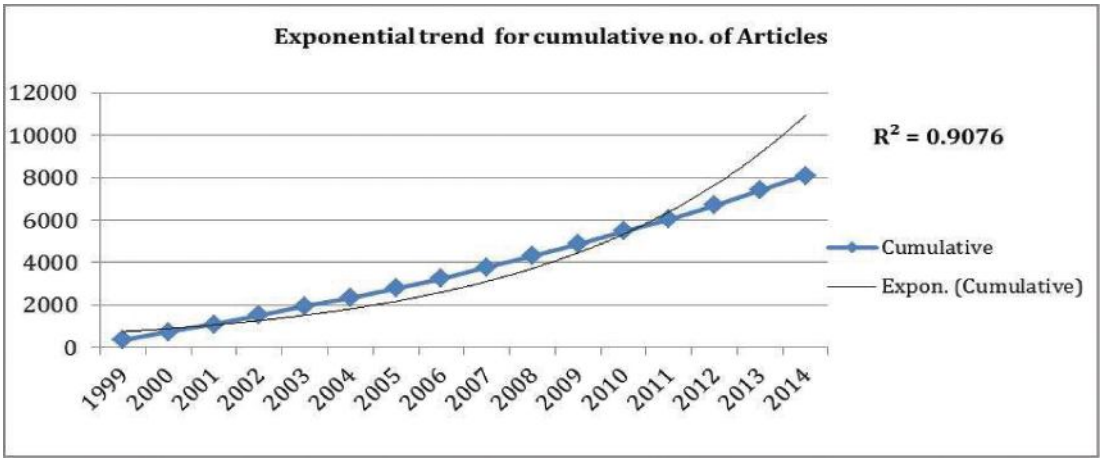



**Fig. 3:** Exponential trend for cumulative no. of articles from 1999-14




*Relative Growth Rate (RGR)*

As the table1 clearly indicates, the value of an average RGR of articles $R_t(P)$ increased gradually from 0.63to 2.47 (1999 to 2013) and there is miniature decrease in the year 2012 (2.33). Therefore during year 2000 to 2013 there were much research has been done to eradicate this deadly disease. Majority of the countries of the world has given much importance to research to control and combat the disease , hence the RGR has been increased. It is due to most of the countries successfully eradicated the disease of malnutrition. Therefore, not much studies have not

been reported. For the first eight years i.e. 1999 to 2006 the RGR was 1.26 and in the next eight years i.e. from 2007 to 2014, it was increased to 2.24.interestingly it noted that, during the year 2013 (2.32) the $R_t(P)$ has been decreased slightly. whereas in the Year 2014their has been $R_t(P)$ growth was risedupto (2.47).Because of variations in Cumulative articles.Cumulativevalues of Doubling time of the publication of articles $D_t(P)$ increased gradually from 2000 (1.26 years) to 2013 (4.95).

The mean relative growth $R_t(P)$ for the first 8 years (1999 - 2006) indicates a growth rate of 2.53 years, whereas for the next 8 years (2007 - 2014) it was increased 4.48 years. It shows that the mean relative growth of malnutrition literature has shown an increasing trend. It may be due to interdisciplinary and multidisciplinary nature of research and the communication patterns of medical researchers. Therefore, it is inferred that majority of the countries have shown keen interest in research to eradicate Malnutrition. The linear growth trend is fit to number of articles and exponential growth trend fit to number of articles and number of cumulative articles for the years 1999 to 2014. The table 1 and Fig. 1, 2 & 3 reveals that the $R^2$ value for the linear trend (0.9187) is more than that of exponential trend (0.9262), which indicates that the exponential trend is more suitably fit to as compared to linear trend. Further, the exponential trend is fit to the cumulative number of articles from 1999 to 2014. The $R^2$ value for this trend is 0.9076, shows 91.38 % variation observed from the cumulative number of articles.

*Major Findings*

The year-wise analysis of the growth of literature output shows that the growth was asymmetrical from the year 1999 to 2009, and it was high during 2006 to 2007. Again decreased in the year 2008.Between the years 2009 to 2013 there was a exponential growth of research literature on malnutrition worldwide. The high productivity during these years may be due to their significance of the studies on Malnutrition, which may have got prominence in Research and subsequent literature as well. Therefore, it is evident from the study that there was an asymmetrical growth of literature on 'Malnutrition in Children'during a span of 16 year (1999 to 2014)

## Conclusion

Many of the disciplinesaround the world, would be aimed at informed decision making, critical assessments of the amount of new knowledge contributed by the research output and so on. Therefore valid measures of knowledge growth may be obtained. It helps to provide exact, useful descriptions and estimatedgrowthof knowledge in the field of 'malnutrition amongthechildren.

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