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Non-Communicable Diseases of Humans versus Palliative Care: An Insightful Data Centric Approach

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Abstract

Rational: Estimates on palliative care and mortality due to Non-Communicable Disease (NCD) for most nations are seemingly absent in the literature. An insightful data centric approach is a requisite need to fill in the void as a contribution to the existing body of knowledge.

Objectives: Quantitatively validate a revelation in literature and a general perception that palliative care in terms of NCD's is not considered a key therapy for end stage patients in emerging nations as opposed to the thinking in developed countries. Establish statistically at global level a significant relationship does exist between NCD and palliative care parameters due to skewing of overall categorical data through added advanced country-based measurements. Corroborate the overall finding at global level with similar country specific assessments from a developed nation and an emerging economy.

Method: Chose Australia as the developed nation and Sri Lanka as the emerging economy for analysis since they had approximately equal populations. Based on available categorical data two-way contingency tables were constructed to perform Chi-square goodness of fit tests to assess statistical significance between linked variables. Similar analysis was done at a global level to provide additional information.

Data Sources: Secondary data from Australia, Sri Lanka and World Health Organization (WHO).

Results: At global level and for Australia a statistically significant relationship was established between palliative care and NCD deaths. For Sri Lanka it did not yield statistical significance.

Significance of Results: Chi-square tests based on data linked with palliative care and NCD's yielded significant outcomes for Australia and at the global level. For Sri Lanka result was non-significant.

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Introduction

An author of an interesting study reported some findings from an interpretative phenomenological study involving ten doctors and their experiences of learning to care for people who were dying [1]. It was an article that queried whether the medical education of doctors had adequately prepared them for this key element of their work and recommended ways in which they may be better prepared to care for people, who were at the doorstep of death.

Thereafter in the current millennium a group of scientists explored the relationship between palliative medicine and the wider medical world [2]. It was drawn on data from a focus group study in which doctors from a range of specialties talked about developing palliative care for patients with heart failure. Another article went a step further in exploring the continuities and discontinuities in policy present during that time on the extension of palliative care to people with heart failure in the UK [3]. It focused on how professionals in cardiology and specialist palliative care negotiated their disciplinary boundaries within the context of those policy moves. Another recent study provides an insight into the experience of health professionals in terms of their desire to get involved in die-conversations (discussions on the verge of death) emphasizing the utmost importance of addressing the topic openly, respectfully and with curiosity towards the patient's individuality, thereby potentially preventing suicide [4]. In such a context, distinct disciplinary boundaries were established and presented in this paper in terms of palliative care vis-à-vis non-communicable diseases.

A Non-communicable Disease (hereinafter referred to as NCD) can be defined as a medical condition or disease that is non-infectious and non-transmissible among humans. Globally, they are the leading causes of death and disease burden. The four main categories of NCD's are Cardiovascular Disease, Diabetes Mellitus, Cancer and Chronic Lung disease that cause over 30 million deaths across the globe every year. Most NCD's are not classified as "Terminal diseases", since in certain instances a therapeutic or other medication could provide a long-lasting cure at some stage of the illness. If not cured during the final stage of a NCD, the affected patient will undergo severe discomfort and pain. It will affect the quality of life of the individual and to minimize the agony palliative care becomes a feasible and a viable solution.

"Palliative care" is defined as an interdisciplinary medical caregiving approach aimed at optimizing quality of life and mitigating suffering among people with serious, complex illness. WHO defines palliative care as "an approach that improves the quality of life of patients and their families facing problems associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial, and spiritual" [5]. Palliative care also becomes an essential component of the response to NCD's and an ethical responsibility of health systems and health care professionals [6,7].

Lack of access to palliative care exists despite a growing need, driven by a rise in the global aging population and an epidemiological shift. Many NCD's for which palliative care is commonly needed are increasing in prevalence, especially in low and middle-income countries [8,9,10,11]. It is a fact that has been corroborated by a global assessment survey found in the current literature [12]. Furthermore, it has been stated in the current literature that the number of palliative care services as well as clinical and educational programmes are increasing rapidly in western industrialised nations, and at a drastically low level in the developing world [13]. WHA67.19 resolution requested WHO to monitor the global status of palliative care and evaluate its progress. In such a context, WHO carried out periodic global surveys of Member States (In years 2001, 2005, 2010, 2013) to assess capacities for NCD prevention and control. It was repeated in 2015 and included a broad set of questions on palliative care [14].

As an extension to the knowledge contribution of such assessments a complete quantitative research endeavour in a macro global sense is presented in this paper coupled with an enhancement of the available secondary data in the subject domains and a micro-level statistical analysis involving two countries to assess contributory relationships. The country level analysis is executed to ascertain in a statistical sense if palliative care is considered important in the developing world as opposed to it being considered as a not so important therapy in emerging nations. A quantitative approach of such nature was conducted, since such a study is seemingly absent in the current literature. For it to be a meaningful exercise Australia and Sri Lanka were chosen as the two nations. It is because both countries have similar populations in terms of size and because one is a developed nation as opposed to the other possessing a middle-income emerging economy. Another reason that factored into the selection of the two countries happens to be the huge disparity in terms of health care spending and resource logistics. In this article approximate country-specific results for a certain period (between years 2012 - 2014) for the two countries are presented. Thereafter the results are compared and assessed with the global position in discussing implications and proposing suitable remedies in addressing the missing voids within the current body of knowledge.

Data and analysis

Global Level: Data

Globally, NCD's contribute to 70% of all deaths and generate 93% of adult palliative care need [15]. It is also reported that an estimated 37.4% of all deaths need palliative care based on data captured in 2013 [16].

Therefore, at a global level NCD deaths in which palliative care was present = 70 x 0.93 = 65.1%.

Similarly, at a global level non-NCD deaths in which palliative care was present = (100-70) x (1-0.93) = 30 x 0.07 = 2.1%.

Following the same logic, at global level NCD deaths in which palliative care was absent = 70 x 0.07 = 4.9%.

Similarly, at a global level non-NCD deaths in which palliative care was absent = 30 x 0.93 = 27.9%.

Based on the secondary data provided above the following contingency grid table on observed frequencies is presented at global level.

Table 1: Global observed percentages of NCD deaths versus palliative care, 2013.

Palliative Care	Deaths		Totals
	NCD Deaths	Non-NCD Deaths	
Present	65.1	2.1	67.2
Absent	4.9	27.9	32.8
Totals	70	30	100

Global Level: Analysis

Based on the categorical data in terms of observed frequencies provided in **Table 1**, corresponding expected frequencies can be computed for each cell excluding the totals using the following formula:

Expected Frequency = (Row Total x Column Total) / Grand Total (1)

Therefore, at a global level NCD deaths in which palliative care was present = (70 x 67.2) / 100 = 47.04%.

Similarly, at a global level non-NCD deaths in which palliative care was present = (30 x 67.2) / 100 = 20.16%.

Following the same logic, at global level NCD deaths in which palliative care was absent = (70 x 32.8) / 100 = 22.96%.

Similarly, at a global level non-NCD deaths in which palliative care was absent = (30 x 32.8) / 100 = 9.84%.

Based on the secondary data provided above the following contingency grid table on *expected frequencies* is presented at *global level*.

Table 2: Global expected percentages of NCD deaths versus palliative care, 2013.

Palliative Care	Deaths		Totals
	NCD Deaths	Non-NCD Deaths	
Present	47.04	20.16	67.2
Absent	22.96	9.84	32.8
Totals	70	30	100

An appropriate Chi-Square (χ^2) hypothesis test (the most suitable goodness-of-fit test for categorical data) at global level shall comprise of the following hypothesis.

Null hypothesis H_0: There's no established link between presence of Palliative care and NCD deaths.

Alternative hypothesis H_a: There's a link between presence of Palliative care and NCD deaths.

Chi-square test statistic will be governed by the equation:

$\chi^2 = \sum (\text{Observed Frequency} - \text{Expected Frequency})^2/\text{Expected Frequency}$ (2)

By using the data in Tables 1, 2 and equation 2 the following results are obtained.

$\chi^2 = [(65.1-47.04)^2/47.04] + [(2.1-20.16)^2/20.16] + [(4.9-22.96)^2/22.96] + [(27.9-9.84)^2/9.84] = 6.93375 + 16.17875 + 14.2057317 + 33.1467073 = 70.464939$.

Australia Country Level Data

Of deaths in high-income countries 75% are supposedly caused by progressive advanced chronic conditions [17]. End stage NCD related deaths of such nations form a significant proportion of such a mortality segment with Australia not being an exception. Furthermore, it substantiates a finding in the literature stating that palliative care is practiced only by 75% of Australia's general physicians [18]. In such a context, an Australian fieldwork study enabled to trace the changing notions of a "good death" to a "good enough death" due to palliative care [19]. Within such an environment, NCD's in Australia contributed to 36.5% of all deaths and generated 39.5% of adult palliative need in the year 2012 as reported in 2014 [20].

Therefore, for Australia NCD deaths in which palliative care was present = 36.5 x 0.395 =14.4175%.

Similarly, for Australia Non-NCD deaths in which palliative care was present = (100-36.5) x (1-0.395) = 38.4175%.

Following the same logic, for Australia NCD deaths in which palliative care was absent = 36.5 x (1- 0.395) = 22.0825%.

Similarly, for Australia Non-NCD deaths in which palliative care was absent = (100-36.5) x 0.395 = 25.0825%.

Based on the secondary data provided above the following contingency grid table on observed frequencies is presented at Australia country level.

Table 3: Australian observed percentages of NCD deaths versus palliative care, 2012.

Palliative Care	Deaths		Totals
	NCD Deaths	Non-NCD Deaths	
Present	14.4175	38.4175	52.835
Absent	22.0825	25.0825	47.165
Totals	36.5	63.5	100

Australia Country Level: Analysis

Using formula (1) we get the following results.

Therefore at a Australia level NCD deaths in which palliative care was present = (52.835 x 36.5) / 100 = 19.2847%.

Similarly, at a Australia level Non-NCD deaths in which palliative care was present = (63.5 x 52.835) / 100 = 33.5502%.

Following the same logic, at Australia level NCD deaths in which palliative care was absent = (47.165 x 36.5) / 100 = 17.2152%.

Similarly, at Australia level Non-NCD deaths in which palliative care was absent = (47.165 x 63.5) / 100 = 29.9497%.

Based on the secondary data provided above the following contingency grid table on *expected frequencies* is presented at *Australia level*.

Table 4: Australian expected percentages of NCD deaths versus palliative care, 2012.

Palliative Care	Deaths		Totals
	NCD Deaths	Non-NCD Deaths	
Present	19.2847	33.5502	52.835
Absent	17.2152	29.9497	47.165
Totals	36.5	63.5	100

An appropriate Chi-Square (χ^2) hypothesis test at Australia country level shall comprise of the following hypothesis.

Null hypothesis H_0: There's no established link between presence of Palliative care and NCD deaths.

Alternative hypothesis H_a: There's a link between presence of Palliative care and NCD deaths.

By using the data in Tables 3, 4 and equation 2 the following results are obtained.

χ^2 = [(14.4175-19.2847) ^{2}/19.2847] + [(33.5502-38.4175) ^{2}/38.4175] + [(17.2152-22.0825) ^{2}/22.0825] +[(29.9497-25.0825) ^{2}/25.0825] = 1.22841609 + 0.61666192 + 1.07282279+ 0.94446869 = 3.86236949.

Sri Lanka Country Level Data

Around 80% of the global palliative care need is in low- to middle-income countries [21,22,16,7]. Assessing a middle-income nation such as Sri Lanka therefore becomes a feasible option. In Sri Lanka NCD's contributed to 75% of all deaths in the year 2014 as reported in 2014 [23]. Based on global statistics, it is estimated that palliative care is needed in 40%-60% of all deaths [23]. Since a direct figure cannot be found for Sri Lanka pertaining to the palliative care need for NCD's as per the available secondary data, a reasonable approximation will be to take the 3rd quartile of the 40% - 60% global palliative care needs for all deaths for NCD related mortalities of an emerging economy due to the dearth of advanced surgical and therapeutic remedies. In such a context NCD related deaths in Sri Lanka would generate 55% of adult palliative need in the year 2014.

Therefore, in Sri Lanka NCD's contribute to 75% of all deaths and generate 55% of adult palliative need in the year 2014 as per reported data of 2014.

Therefore for Sri Lanka NCD deaths in which palliative care was present = 75 x 0.55 =41.25%.

Similarly, for Sri Lanka Non-NCD deaths in which palliative care was present = (100-75) x (1-0.55) = 11.25%.

Following the same logic, for Sri Lanka NCD deaths in which palliative care was absent = 75 x (1-0.55) = 33.75%.

Similarly, for Sri Lanka Non-NCD deaths in which palliative care was absent = (100-75) x 0.55 = 13.75%.

Based on the secondary data provided above the following contingency grid table in terms of *observed frequencies* is presented at *Sri Lanka country level*.

Table 5: Sri Lankan observed percentages of NCD deaths versus palliative care, 2014.

Palliative Care	Deaths		Totals
	NCD Deaths	Non-NCD Deaths	
Present	41.25	11.25	52.5
Absent	33.75	13.75	47.5
Totals	75	25	100

Sri Lanka Country Level: Analysis

Using formula (1) we get the following results.

Therefore, at a Sri Lanka level NCD deaths in which palliative care was present = (52.5 x 75) / 100 = 39.375%.

Similarly, at a Sri Lanka level Non-NCD deaths in which palliative care was present = (52.5 x 25) / 100 = 13.125%.

Following the same logic, at Sri Lanka level NCD deaths in which palliative care was absent = (47.5 x 75) / 100 = 35.625%.

Similarly, at Sri Lanka level non-NCD deaths in which palliative care was absent = (47.5 x 25) / 100 = 11.875%.

Based on the secondary data provided above the following contingency grid table on expected frequencies is presented at Sri Lanka level.

Table 6: Sri Lankan expected percentages of NCD deaths versus palliative care, 2014.

Palliative Care	Deaths		Totals
	NCD Deaths	Non-NCD Deaths	
Present	39.375	13.125	52.5
Absent	35.625	11.875	47.5
Totals	75	25	100

An appropriate Chi-Square (χ^2) hypothesis test at Sri Lanka country level shall comprise of the following hypothesis.

Null hypothesis H_0: There's no established link between presence of Palliative care and NCD deaths.

Alternative hypothesis H_a: There's a link between presence of Palliative care and NCD deaths.

By using the data in Tables 5, 6 and equation 2 the following results are obtained.

χ^2 = [(41.25-39.375) ^{2}/39.375] + [(11.25-13.125) ^{2}/13.125] +[(33.75-35.625) ^{2}/35.625] +[(13.75-11.875) ^{2}/11.875] = 0.08928571 + 0.26785714 + 0.09868421 + 0.29605263 = 0.75187969.

Results

At global level the test statistic χ^2 = 70.464939 > 3.841 (χ^2 Critical value at 5% significance level and degrees of freedom = 1 from Chi-square table). Therefore, it implies that the null hypothesis should be rejected, and a significant link exists between NCD deaths and palliative care at a global level.

At Australia country level the test statistic χ^2 = 3.8623 > 3.841 (χ^2 Critical value at 5% significance level and degrees of freedom = 1 from Chi-square table). Therefore, it implies that the null hypothesis should be rejected, and a significant link exists between NCD deaths and palliative care at the Australian national level.

At Sri Lanka country level the test statistic χ^2 = 0.7518 < 3.841 (χ^2 Critical value at 5% significance level and degrees of freedom = 1 from Chi-square table). Therefore, it implies that the null hypothesis should not be rejected, and a significant link does not exist between NCD deaths and palliative care at the Sri Lankan national level.

Remark: Degrees of freedom (df) for the given χ^2 hypothesis test contingency table is given by the formula: (Number of rows of table – 1) x (Number of columns of table – 1) (3)

Discussion and Conclusion

At a global level an opinion exists that an important association does exist between end stage NCD deaths and palliative care. Due to the availability of secondary data related to the subject areas and also due to the fact that most of the data is from developed nations it does skew the theories towards cred-

ibility without factual information. It is due to the overwhelming emphasis placed on palliative care for patients suffering from NCD's, its promotion and the availability of large-scale funding in wealthy countries towards its implementation to reduce pain and enrich quality of life of their critical NCD patients. On the contrary, in emerging economies such as Sri Lanka the importance of palliative care has not been assessed to a great degree mainly due to a lack of funding. Furthermore, in such emerging nations the general perception is that palliative care is not an important component in treating patients as opposed to therapeutic medications. Therefore, it is not practiced as a common therapy in the nation's health sector on a broad scale. Sri Lanka in such an environment becomes an ideal case study representing most low- and middle-income nations that pays little attention towards the promotion and implementation of palliative care in addressing NCD's.

Therefore, in this paper at a global level and for a developed nation like Australia with a vibrant healthcare sector a statistically significant link has been established between deaths due to NCD's and the presence of palliative care. It corroborates and validates the presumption in developed nations that of palliative care been considered as a feasible therapy in treating end stage NCD patients. On the contrary for an emerging economy such as Sri Lanka the same statistical analysis procedure applied globally and to Australia in this paper proves that a statistically significant relationship does not exist between deaths due to NCD's and the contribution of palliative care. Therefore, the general opinion of health sector professionals in low- and middle-income nations classifying palliative care as a nonessential therapy have been justified and corroborated quantitatively in the study presented in this paper. Furthermore, due to such a perception operational palliative care policy, funding for palliative care, and access to palliative care services are seriously lacking in a majority of low and middle-income countries. It is a fact that has been validated and corroborated by the statistical analysis done and the subsequent results that have been revealed in this paper. Much work is needed in addressing such issues worldwide if governments are to uphold their commitments to ensuring access to palliative care. This analytical study provides a deeper data centric quantitative insight as to how global progress should be monitored towards this goal. Extending the proposed analysis of this paper to entail other nations would be a worthwhile future research endeavour.

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