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Funnel plots and choropleth maps in cancer risk communication: a Delphi study

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Abstract

Background. *In the last decades, the issues related to health risk communication to stakeholders and citizens involving health care practitioners and local political authorities have been increasingly debated. The study evaluated an alternative strategy to communicate cancer risk to local communities, involving an expert panel of public health operators in comparing two different graphic tools, Funnel Plot and Choropleth map.*
Study design. *A Delphi method process was implemented to achieve a unified consensus on an expert panel of public health operators with regard to weaknesses and strengths of the Funnel Plot and the Choropleth map as tools for cancer risk communication to local communities and other stakeholders.*
Methods. *Participants were asked to score the efficacy of the two tools using a scale. Six properties were explored through two consecutive consensus rounds. Scales were used to calculate frequencies and the content validity ratio for each domain within the consensus rounds.*
Results. *After the two consecutive rounds, participants expressed their preference in favour of the Choropleth map for its ability to define the spatial location of the risk and to locate any potential cluster, while reaching a consensus with regard to the Funnel Plot properties to identify hot spots, displaying the scope of the phenomenon under investigation, and to show the precision of estimates and communicating the significance of estimates.*
Conclusion. *The Delphi process allowed us to conclude that Funnel Plot could be used as a complement to the current and commonly used graphical and visual formats to effectively communicate cancer epidemiological data to communities and local authorities, representing a useful tool for empowering the general population.*

Introduction

In the last decades, issues related to health risk communication to stakeholders and citizens involving health care practitioners and local political authorities have been increasingly debated (1). In detail, the need to involve citizens in the decision-making process on health risks associated with the environment through a capacity building

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process, starting with adequate information, was pointed out. To provide correct communication and to spread appropriate and effective information of risks related to healthcare to stakeholders are the first steps to achieve shared decisions, particularly for health risks related to cancer (2). Atlases have been widely considered the simplest and most effective, available graphical tools to communicate epidemiological data on cancer by reporting geographic comparisons (3), particularly on a local scale (4). They include thematic maps, such as the Choropleth map (CM), using a color scale to represent epidemiological data. However, CM was considered to be misleading for stakeholders since the colour scale approach used does not properly display the potential inaccuracy in the estimation (5). Moreover, these limitations may have led to inefficient decision-making and implementation of inappropriate health policies (5). Recent evidences have speculated on the use of the Funnel plot (FP) as a complement to the current and commonly used graphical and visual formats (choropleth maps, caterpillar plots, etc.) to effectively communicate cancer registry statistics to communities and local authorities, visually conveying an efficient and simple way to represent cancer incidence rates (1, 6).

In Italy, the need to improve risk communication to populations residing in areas considered at high environmental risk without basis of evidence has arisen according to cancer risk perceptions (7).

The study evaluated an alternative strategy to communicate cancer risk to local communities and health authorities, involving an expert panel of public health operators representatives of the Sicilian Regional Health System (RHS) in order to compare different graphic tools (FP and CM) through the Delphi technique (8, 9) with the aim to validate the additional use of the FP in the graphical representation of the oncological risk.

Methods

An expert panel of 37 public health representatives assigned to the 9 health agencies and of differing areas of expertise within the Sicilian RHS, who were attending a two-year Master course in science for "Health Promotion and Epidemiology Applied to Preventive Medicine (PROSPECT)" at the University of Palermo (10), were recruited in the study.

A Delphi method process was adapted to our aim and implemented to achieve a unified consensus on weaknesses and strengths of FP and CM as a useful tool for cancer risk communication to local communities and other stakeholders (patients' associations, physicians, pharmacists, local administration, etc.).

A set of 6 domains exploring the properties of FP (**Figure 1.a**) and CM (**Figure 1.b**) in cancer risk communication was defined according to current literature (1) and presented to the recruited public health operators using graphical support. The explored properties were: 1) definition of the spatial location of the risk; 2) identification of hot spots; 3) locating clusters; 4) displaying the scope of the phenomenon under investigation; 5) showing the precision of estimates; 6) communicating the significance of estimates.

The survey was administered via e-mail linked to Google Form and it was introduced by a presentation of both visual formats, including a short glossary of the technical terms used. To this end, the SIRs of the 82 Palermo Province municipalities, calculated for the period 2003–2011 by Palermo Province Cancer Registry, were represented through CM and FP.

One month later (May 2016), an e-mail was sent to invite the participants to join the first round of the Delphi study. The instructions provided called on the public health operators to evaluate the communicative efficacy of each visual format separately, according to

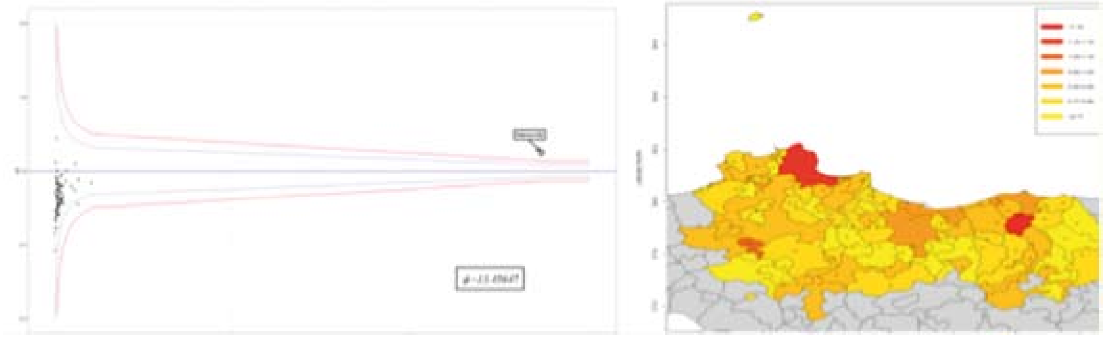

Figure 1 - Graphical supports (a. Funnel Plot; b. Choropleth map) used in the Delphi consensus process.

the 6 proposed domains, by using a 10-points ordinal scale, ranging from 0 (minimum score of efficacy) to 10 (maximum score of efficacy). Two months later (July 2016), another e-mail invitation was sent to all of the public health operators to join the second round. To this end, the questionnaire was reviewed according to results of the first round. Participants were asked to score, by direct comparisons, the efficacy of the two visual formats with regard to the same properties' domains by using a 3-point scale ranging from 1 (lowest score of efficacy) to 3 (highest score of efficacy). As a final consensus on strengths and weakness was reached, no round was implemented thereafter.

Answers given by the participants were collected using Microsoft Excel. Answers collected during the first round were categorized by defining scores between 1- 5 (≤5) as "low efficacy" and between 6 -10 (≥ 6) as "high efficacy", while for the second round, scores were categorized considering 1 as "low efficacy", 2 as "middle efficacy" and 3 as "high efficacy".

Scales were used to calculate frequencies (High efficacy score, HES) and a content validity ratio (CVR) (11) for each domain within the consensus rounds. CVR was defined as a linear transformation of a proportional level of agreement, representing the proportion of expert participants rating the efficiency of the visual formats according to the explored domains, and was calculated as follows:

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}}$$

where n_e is the number of participants rating the tools as high efficient and N is the total expert numbers. According to the number of public health operators attending the Delphi, the cut off for CVR value was set at 0.50, with a CVR ≥0.50 indicating a minimum level of agreement among the panel members exceeding 50%.

Results

Of the 37 invited public health operators, 16 (13 physicians, 1 statistician, 2 biologists) answered to the I Delphi round (response rate: 43.2%) (Table 1), while 17 (14 physicians, 1 statistician, 2 biologists) adhered to the II Delphi round (response rate: 45.9%) (Table 2).

During the first round, the efficacy of CM and FP, rated separately for each one of the explored domains, documented a high level of concordance for CM (CVR ≥0.50), with a high efficacy score (HES) (≥6 in a 10-points scale) for the following visual format properties (Table 1): identification of hot spots (HES = 75.0%; CVR= 0.5); locating clusters (HES = 81.2%; CVR= 0.62).

Table 1 - Delphi round I: consensus scores on high efficacy reported for the two visual formats (Choropleth Map and Funnel Plot).

Properties explored	Choropleth Map		Funnel Plot	
	HES^ n (%)	CVR*	HES^ n (%)	CVR*
1. Definition of the spatial location of the risk	16 (100.0)	**1.0**	11 (68.7)	0.37
2. Identification of hot spots	12 (75.0)	**0.5**	15 (93.7)	**0.87**
3. Locating clusters	13 (81.2)	**0.62**	11 (68.7)	0.37
4. Displaying the scope of the phenomenon under investigation	11 (68.7)	0.37	13 (81.2)	**0.62**
5. Showing the precision of estimates	8 (50.0)	0.0	14 (87.5)	**0.75**
6. Communicating the significance of estimates	11 (68.7)	0.37	14 (87.5)	**0.75**

*CVR: Content Validity Ratio [a cut off value of ≥0.50 has been calculated on the basis of the number of panel members responding to the first and the second round (n=16 and 17, respectively)]
^HES: High efficacy score

Furthermore, a full agreement (CVR= 1.0) of the respondents was reached on high efficacy in the "definition of the spatial location of the risk" (HES= 100.0%).

Otherwise, for FP a high level of concordance (CVR ≥0.50) in rating high efficacy (≥6 in a 10-points scale) was documented for the following explored properties: identification of hot spots (HES= 93.7%; CVR= 0.87); displaying the scope of the phenomenon under investigation (HES= 81.2%; CVR 0.62); showing the precision of the estimates (HES = 87.5%; CVR 0.75); communicating the significance of estimates (HES= 87.5.7%; CVR 0.75).

In the second round, participants were asked to assess the efficacy of CM and FP by direct comparison of the two visual tools (Table 2). Therefore, CM was rated with an HES and with a positive high

Table 2 - Delphi round II: consensus scores on high efficacy reported for the two visual formats by direct comparison (Choropleth Map versus Funnel Plot).

Properties explored	Choropleth Map		Funnel Plot	
	HES^ n (%)	CVR*	HES^ n (%)	CVR*
1. Definition of the spatial location of the risk	13 (76.5)	**0.52**	2 (11.8)	-
2. Identification of hot spots	3 (17.6)	**-**	12 (70.6)	0.41
3. Locating clusters	11 (64.7)	0.29	4 (23.5)	-
4. Displaying the scope of the phenomenon under investigation	3 (17.6)	-	11 (64.7)	0.29
5. Showing the precision of estimates	2 (11.8)	-	14 (82.3)	**0.65**
6. Communicating the significance of estimates	3 (17.6)	-	14 (82.3)	**0.65**

*CVR: Content Validity Ratio [CVR cut off value (≥0.50) has been calculated on the basis of the number of panel members responding to the first and the second round (n=16 and 17, respectively)]
^HES: High efficacy score

level of concordance only for the property of definition of spatial location (HES= 76.5%; CVR 0.52). Conversely, FP was rated with an HES and with a positive high level of concordance for the following property domains: showing the precision of estimates (HES= 82.3%; CVR 0.65) and communicating the significance of estimates (HES= 82.3%; CVR 0.65).

Discussion and conclusions

The properties of thematic maps, such as CMs, and FP within the context of disseminating on a local scale cancer epidemiological data to stakeholders were explored through a Delphi consensus process. To this end, an expert panel of public health representatives of the Sicilian RHS was involved. After two consecutive rounds, participants identified weaknesses and strengths of FP and CM in cancer risk communication to local communities and health authorities by rating the level of efficacy of the two tools concerning six specific property domains, first separately and then by direct comparison. To evaluate agreement among the different recruited panellists we preferred to use CVR method, instead of the common used statistical indexes, allowing to explore the qualitative dimension rather than the quantitative one.

Participants expressed their preference in favour of CM for its ability to define the spatial location of the risk and to locate any potential cluster, while they indicated a positive consensus on FP with regard to its properties to identify hot spots, to show the precision of estimates, to highlight the significance of the estimates and to display the scope of the phenomenon under investigation. Not by chance, it has been reported in literature that FPs allow one to visualize both information and precision levels without the need for processing several numeric values (12). These results supported the use of FP in the healthcare field to compare survival (6) and mortality in public health surveillance (12).

Furthermore, the direct comparison of the two visual formats documented a consensus of participants on the high efficacy of CM in defining the spatial location of the risk and of FP to show the precision of estimates and to communicate the significance of estimates.

Although CMs are still the commonly used visual formats for reporting geographic comparisons of cancer epidemiological data (3), the opinion reported by the public health operators who were interviewed addressed the use of FPs as a supplementary tool to overcome the limits of thematic maps in properly displaying the potential inaccuracy in the estimation and, consequently, to provide local authorities and communities with synthetic access to valid and understandable cancer incidence data. These findings can have practical applications for public health operators with regard to small-area studies as compared to large scale ones (13-15), since the differences in color scale can be misleading for the stakeholders while reading a CM, so amplifying the incorrect message to be overexposed to environmental risk factors among others (5). This is also true when disseminating epidemiological data on rare cancers (16) or on specific cancer sites (17), as well as when mapping the risk for rare and complex diseases using a Public Health Genomics approach (18-20), so raising the need to evolve knowledge and competencies of public health operators to face the new Public Health challenges (21-23).

However, according to the limitation of the Delphi process, it was not possible to study participants' opinion and viewpoint on aspects unexplored by the considered properties. Therefore, further qualitative investigations, such as focus groups and semi-structured interviews, should be performed to better understand the missing implications related to the joint use of CM and FP to communicate cancer risk to local communities.

Another limitation of the study was represented by the relatively low response rate, probably due to the on-line implementation of the Delphi process. Therefore, a face-to-face approach should be considered in further studies. Although the expert panel was composed of public health operators belonging to different areas of expertise and representatives of the 9 health agencies within the Sicilian RHS, a selection bias should be taken into account. Thus, studies on a larger sample should be performed to confirm the results of this study.

In conclusion, despite the above-mentioned limitations, the Delphi process allowed us to conclude that FPs could be used as a complement to the current and commonly used graphical and visual formats to effectively communicate cancer epidemiological data to communities and local authorities, so representing a useful tool for empowering both the general population and decision makers. This is particularly important in the perspective of an efficacy health communication and possible health literacy interventions in the cancer field (24) in order to implement population and person-centered cancer risk communication public health strategy.

Riassunto

Uso del funnel plot e della choropleth map nella comunicazione del rischio oncologico: un approccio Delphi

Introduzione. Negli ultimi decenni un crescente dibattito ha sollevato questioni relative alla comunicazione del rischio per la salute a portatori di interesse e cittadini, coinvolgendo operatori sanitari e autorità politiche locali. Lo studio ha valutato una strategia alternativa per comunicare il rischio oncologico alle comunità locali, coinvolgendo un panel di operatori di salute pubblica al fine di confrontare due diversi strumenti grafici, il Funnel Plot e la Choropleth Map.

Disegno di studio. Il metodo Delphi è stato utilizzato per raggiungere il consenso all'interno di un panel di esperti rappresentativi degli operatori di salute pubblica del Servizio Sanitario Regionale siciliano interpellati sui punti di forza e di debolezza del Funnel Plot e della Choropleth Map, utilizzati come strumenti per la comunicazione del rischio oncologico alle comunità locali.

Metodi. Ai partecipanti è stato chiesto di valutare i due strumenti grafici con riferimento a 6 specifiche proprietà, utilizzando una scala di efficacia, in due consecutivi round di consensus. I giudizi espressi sono stati utilizzati per calcolare le frequenze e il content validity ratio per ciascuna proprietà esplorata nel corso dei due round di consensus.

Risultati. Alla fine dei due rounds consecutivi, i partecipanti hanno espresso la loro preferenza a favore della Choropleth Map con riferimento alla proprietà di definire la localizzazione spaziale del rischio e nell'individuare eventuali cluster, mentre si è raggiunto un consenso a favore delle proprietà del Funnel Plot circa la capacità di identificare gli hot spots, di mostrare la portata del fenomeno in esame, di mostrare la precisione delle stime e di comunicare il significato delle stime.

Conclusioni. Il processo Delphi ci ha permesso di concludere che il Funnel Plot potrebbe essere utilizzato in maniera complementare agli strumenti grafici comunemente utilizzati per comunicare efficacemente i dati epidemiologici oncologici alle comunità e alle autorità locali.

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