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Mini-Review Article

Methodologies of Verbal autopsy and Social autopsy tools, adopted by VASA studies in exploring under-five mortality determinants

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Abstract

Background: Verbal Autopsy/Social Autopsy (VASA) tools should be based on a well-holistic conceptual framework, allowing them to record and organize a wide range of determinants and contributors of child mortality in developing countries. This paper aims to review how successfully VASA studies have been able to record and organize biological and social determinants of child mortality, in pursuit of World Health Organization's (WHO) guidelines for verbal autopsy (VA) and Kalter's recommendations for social autopsy (SA).

Methodology: A systematic search of literature from January 1995 to January 2018 was conducted on primary studies which attempted VA and SA on deceased cases of under-5 child mortalities using VA and SA questionnaires. A thorough search revealed 16 directly relevant papers.

Results: Sixteen relevant studies from 14 countries revealed the two most common conceptual frameworks which were utilized for VASA studies. VA component of three studies followed W.H.O.'s guidelines, while the SA component of the other three studies followed Kalter's recommendations. The most robust VA tools identified were INDEPTH Network VA tool, INCLEN VA tool, and WHO VA tool; while CHERG SA tool and BASICS SA tool were found as the most robust SA tools.

Conclusion: Due to the fact that only separate recommendations for VA, and conceptual frameworks for SA exists and no evidence on integrated conceptual framework exists, we suggest that there is a great need for developing a conceptual framework, based on which an integrated VASA tool can be developed and utilized in VASA based child mortality investigations in developing countries.

Keywords

Child Mortality, Verbal Autopsy, Social Autopsy, VASA, Conceptual Framework, Pathway to Survival Conceptual Framework

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Introduction

To improve the child health and survival of developing countries, where the child mortality estimates are clustered; availability of reliable, accurate and timely data on the estimates of child deaths and information as to why such deaths occurred is critically important[1]. In most of the developing countries of Sub Saharan African and South Asian regions, large number of the child deaths fails to get registered with the National Civil and Vital Registration System (NCVRS)[1]. This is mostly due to the weak NCVRS in such countries[2]. Here, a large number of children dies inside home, mostly in non-accessible areas[2&3]. Failure of getting in touch with the healthcare practitioners or facilities (in case of home-based mortalities or mortalities occurring in non-accessible areas) may result in non-registration of such deaths with health care facilities and with national database[2&3]. Such deaths also have their cause of death not being assigned[3]. Due to these and other limitations, a large number of child mortalities and their statistical data gets missed out from being recorded and are not registered in the NCVRS[2&3]. Such countries, therefore, fail to acquire a valid and reliable data on the child death statistics and their related causes.

Verbal Autopsy (VA) has been in practice for quite a long time in capturing the death events and assigning their cause of death (CoD) in geographies where the death events and their causes have not been captured and certified due to any reason[3]. Conducting VA interviews involve recording information on signs and symptoms preceding any death event. Such information assists researchers in assigning the biological cause of any child death[2]. Filling the gap of knowledge on the cause-specific mortality across the missed population is of greater public health importance. The VA specifically focuses on recording biological determinants, however, it does not focus on capturing (except few items) non-biological determinants (NBDs) related to child death events[4]. The NBDs linked with any death event comprises of a vast variety of determinants which are other than biological in nature and ranges from socio-economic, cultural; to the determinants linked with health-seeking behaviour, healthcare delivery, and case-management process[5-8]. The importance of NBDs in relation to child mortality and the need to record them prior to assigning the cause of any death event has been highly recommended across different research platforms globally[4,8-10] and carries huge public health policy significance. Similar to VA, SA, which is comparatively a newer technique, focuses explicitly on recording data related to these NBDs pertaining to death event and thereby helps in assigning social cause of death (SCoD) similar to VA which helps in assigning biological cause of death (BCoD).

Separate conceptual frameworks for VA and SA

Much research and efforts have been paid over the years in the development of VA methodology, especially in maximizing the interpreted evidence from VA data. WHO has recommended that the overall construct of any VA tool should follow few basic requirements. These recommendations were raised in 2007 and have been continuously incorporated in every updated version of WHO VA tool[11-13]. These recommendations include that the VA tool should be addressing three age-groups (perinatal, neonatal and under four weeks; children aged between 4 weeks-14 years, and adult deaths i.e. 15 years and above), CoD certification and coding resources should be consistent with the International classification of diseases version-10 (ICD-10); and the list of cause of death be prepared according to ICD-10[13]. A recent consensus has been established on nominating the VA tool developed by WHO as standardized, in comparison with several other existing VA tools[14]. This was due to the fact that WHO's VA tool holistically incorporates important

variables and integrates the indicators compulsory to run presently available automated diagnostic algorithms[14].

Similarly, several of the theories, models, and conceptual frameworks (CFs) have been utilized during the evolution of SA methodology. 'Health Belief Model' (HBM)[15&16] and 'Theory of Reasoned Action' (TRA) focuses respectively the health-seeking behaviour; and on how the population will behave (during care-seeking) based on the population's pre-existing attitude and behavioural intentions towards taking any action during any illness[17]. However, after the early 19th century, the 'Three Delay Model'[18] (TDM) emerged as one of the models for understanding maternal deaths by incorporating variables (apart from populations' behaviour relating to health seeking) additional to HBM and TRA. The TDM focuses on recording barriers against access to healthcare services at three different levels i.e. within-home; during the transit to health-facility; and in receiving adequate healthcare at health-facility[18&19]. With the further extension, these theories and models were later incorporated in Mosley and Chain framework in 1984 which led to the development of 'The Pathway to Survival Conceptual Framework' (TPtoSCF)[20]. The backbone of TPtoSCF includes the barriers and issues raised during the continuum of care right from the conception of the mother till the fatal illness of the child. It is at present the most well-structured and complete framework that recognizes, classify, consolidate and is helpful in analyzing the social, cultural and health-system factors that could be modified both inside the home, and in the community in order to prevent child illness and return sick children to health[21&22] keeping in mind all the relevant determinants which could be contributory to the death event. It helps the researcher in capturing failures (and identifying barriers) at any of the steps of healthcare access that directly or indirectly could have led to the death of the respective child[23].

The CF ultimately assists in developing new interventions and focusing the existing ones (in the presence of more explicit evidence) towards preventing child mortalities and ultimately has strong policy implications in child survival4. Global literature suggests evidence in support of using TPtoSCF for understanding the complete range of social determinants linked with child death events[24-26].

Integrated conceptual framework for VASA tools

In order to explore the extended data on different determinants of child mortality, undertaking VA and SA for every death event has been highly suggested in a very recent timeframe and is currently the need for developing countries[7,21,22&27]. This approach can give extended data on most relevant biological and social determinants related to specific death event and ultimately help in assigning a broader cause of death. However, the literature shows that such investigations have been undertaken by either way; administering VA and SA tools separately (but in synergy) for each death event[28-31] or using an integrated tool where SA is merged with VA, thereby making a single tool for recording data on biological and social determinants[8,21-26,32-35]. However, logically, the single integrated tool should be based on an integrated CF that should be holistic in recording biological and social determinants of child mortality. The existence of several versions of integrated VASA tools and separate WHO guidelines for VA and Kalter's recommendations for SA; however, no evidence exists on the availability of integrated VASA CF, and, none of the VASA studies in the literature have discussed this.

Based on the gap in knowledge, the initial aim of the study was to undertake a review on how successfully the VASA studies have been able

to record and organize biological and social determinants using their integrated tool based on integrated CF. However, despite the existence of several integrated VASA tools, literature does not show any official recommendation from any agency or existence of any integrated CF, on which the integrated VASA tool should be based on. Therefore, ultimately, this paper reviews the literature to appraise how successfully the VASA studies have been able to record data on biological and social determinants through VA and SA tool using separate WHO guidelines for VA and separate (Kalter's) recommendations for SA.

Methodology

Search strategy

An electronic literature search was conducted for searching primary studies, reports and reviews using keywords and MeSH Terms: 'mortality', 'death', 'child', 'verbal autopsy' and 'social autopsy' on the online databases of PubMed, Cochrane library, WHO, Science Direct, Embase, Google Scholar, BioMed Central and Google database. References quoted in the original publications were also searched for additional information. Two reviewers independently reviewed the articles, extracted data and checked for relevancies.

All studies published between January 1995 and January 2018 in the English language, with an abstract published in a peer-reviewed journal or a report accessible through a web search were included in the review. All included studies should have used the primary data, where the researcher have conducted verbal and social autopsies either in segregation (as separate tools/questionnaires), or as a single tool/questionnaire (but should have attempted VA and SA at a single point of time) with an aim to identify the biological-cause of death and the social determinants linked with the death of deceased children died during age from birth to 5 years of age (including stillbirth). The overall analysis should have utilized data from VA as well as SA components.

Data extraction and study characteristics

Initially, the abstracts of studies were examined and all the retrieved relevant articles were reviewed and discussed with co-reviewers based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Checklist[36]. References cited in original publications were also searched for further information. Data were extracted from papers selected for further review using a standardized data extraction sheet. The following variables were retrieved (if available) from studies: Author name; Publication date; Study setting; Age group studied; study objective/s; the format of study (i.e. Quantitative, Qualitative or mix-methods); Source of SA tool; Conceptual framework; the number of deaths investigated; recall-period.

Assessment of included studies

a) Quality assessment of included studies

The included studies were assessed on different parameters to see whether these have taken necessary precautions to keep their quality robust.

Table 1: Checklist to assess quality of included studies (Modified from US national institutes of health)

Items	Yes	No
Was the research question or objective in this paper clearly stated?	1	0
Was the study population clearly specified and defined?	1	0
Was the participation rate of eligible persons at least 50%	1	0
Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study pre-specified and applied uniformly to all participants?	1	0

Was a sample size justification, power description, or variance and effect estimates provided?	I	0
For determinants that can vary in amount or level, did the study examine different levels of the determinant as related to the outcome? (e.g. categories of the determinant, or determinant measured as a continuous variable)	I	0
Were the determinant measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	I	0
Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	I	0

One such checklist, 'Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies' suggested by The USA National Institutes of Health, has been utilized for this purpose (after being revised accordingly for this research)[37]. The checklist comprised of total 14 items that evaluate several traits of a research study. Only 8 out of 14 items were found relevant for this review. All of the studies have been assessed on the basis of these 8 relevant items (Table 1). Scores of 0 and 1 were allocated for each trait (item of the checklist). If the study has addressed the trait of the checklist, 1 point will be allocated, otherwise 0. Total points achieved by each study will be divided by 8 (relevant items) will yield quality points each study achieved and is mentioned in table 2.

b) Assessment of VA & SA tools

The plausibility of SA and VA tools of the included studies were assessed on the basis of certain assessment criteria as mentioned in table 2 & 3 respectively.

1. Assessment of SA component: As a continuation of Kalter's review[4], our review uses Kalter's recommendations and examines whether the SA tools of the included studies have addressed five key objectives—(i.e. ability of SA tool in providing data on the care-seeking process; making a social diagnosis; providing representative national or large area data; supporting health program or policy development; and/or community empowerment) raised by Kalter's review[4]. In addition, two more variables were also used to assess VASA studies i.e. use of TPtoSCF as a CF; and recall period of the studies.

2. Assessment of VA component: Similarly, this review assess the VA tool of included studies on the basis of three key recommendations from WHO in World Health Report[13] (i.e. the tool should address three separate age groups; mortality classification based on International Classification of Disease-10th revision (ICD-10) classification; and the cause of death list for VA mapped according to ICD-10).

Results

This review included 16 studies on the basis of strict inclusion-and-exclusion criteria and studies were assessed using the PRISMA checklist[36]. In total, 19,685 articles were identified initially from electronic databases with 60 supplementary archives from other sources. After reviewing the abstract, irrelevant articles outside the inclusion and exclusion criteria were exclude and a total of 28 full-text articles came up in the records, which were further strictly assessed and a final list of 16 articles were concluded.

Based on our inclusion and exclusion criteria, a total of 16 VASA studies have been identified during the period of January 1995 and January 2018 (Table 2). All studies were cross-sectional investigations and followed mixed methodology (i.e. quantitative and qualitative). From 2008 onwards, the concept of VASA integration was initiated, however, pre-2008 studies either didn't mentioned about their methodologies[38&39] or conducted their study

using separate VA and SA tools[28-31]. Those who mentioned their methodologies used varied versions of VA and SA tools (from different agencies). Out of 16 studies, 10 used a single integrated tool[8,21,24-26,32-35&40], 04 conducted VA and SA as separate tools[28-31] and the remaining 02 did not mention about integration[38&39].

Figure 1: PRISMA 2009 Flow Diagram for the article selection.

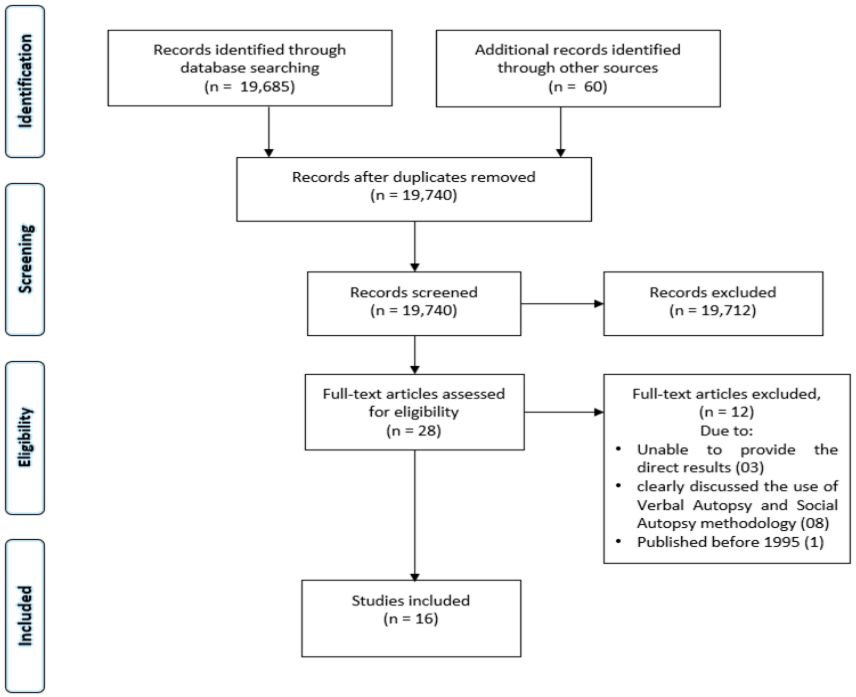

Table 2 organizes the included studies in chronological order and tabulates with how much depth (in relation to 7 key objectives for assigning social contributors of death) the SA tools of the included studies captured the data on non-biological determinants (Column A, B, C, D, and E) specific to child mortality. Table 3 shows a comparison of VA component of included studies in chronological order in pursuit of three key recommendations from WHO[13] in capturing biological determinants and assigning the biological cause of child death. It is evident from the literature that the concept of recording biological and social determinants for child mortality was initiated using VA and SA components in developed countries. However, such technique was later also adopted by developing ones especially African countries: Niger and Uganda, followed by Nigeria and India[8,21,26,33&34].

The empirical evidence shows that the methodology of SA has changed over the time and took several transitions by incorporating new sets of variables relating to care-seeking, case-management and health care delivery process and integrating different theories and models over the time since 1995. It is clearly depicted in table 2, that the most commonly used CF adopted by included studies is TPtoSCF, where 10 studies[21,24-26,28,31,32,34&40] (Pathway studies-PS) adopted it. Three delay model stands out to be the second most commonly used CF, which was used by 02 studies (Delay model studies-DMS)[8&33]. Out of the 10 PS's, one study used a premature version of Pathway to Survival framework named as Road to Survival framework[29], while four studies used an unclear methodology[30,35,38&39]. The review identified that there is a higher trend of recognizing

childhood illness at home. All studies recognized severe illnesses except Indian study[30] at the household level, however, home care was provided by only 12 studies. During the care-seeking process, the caretakers' concerns in terms of socio-cultural and knowledge-based issues were captured by 11 studies[21,24-26,29,31,32,34,35&40], while same studies discussed barriers during the care-seeking process and health-care delivery process[21,24-26,28,29,31,32,34&40].

Table 2: Assessment of SA component of eligible studies (arranged in chronological order)

Study Characteristics							Points for SA tool assessment						
Author & reference #	Year	Study setting	Age group studied	No. of deaths investigated	Conceptual Framework	Integrated/ segregated VASA tool	Data collected on the care seeking process: 1) illness recognition; 2) home care; 3) recognition of severe illness; 4) times; 5) sequence, and 6) type of healthcare sought, 7) CSk delays; 8) CSk constraints; 9) quality of care: 10) referral; 11) compliance with home care and/or referral advice (A)	Was Social diagnosis of contributors to death made? (B)	Data provided were: 1) representative; 2) large area (district/ regional/ national) (C)	Data were utilized to support health program or policy development: 1)advocacy/ accountability; 2)data sharing and interpretation; 3)intervention development = responsiveness (D)	Data were utilized to support community empowerment: 1)data sharing and interpretation; 2) intervention development; 3) monitoring and revision (E)	Comparison group (F)	Recall period (G)	Quality score
Sodemann	1997	Guinea Bissau	1-30 months	125	Not clear	Not clear	1; 3; 7; 11	No	1)Yes; 2) Not stated	1/2/3) Not stated	1/2/3) Not stated	Yes	7 months	0.63
Aguilar	1998	Bolivia: El Alto city	Under 5 years old	271	TPtoSCI*	Integrated	1; 2; 3; 5, 6; 7; 9; 11	Yes	1) Yes; 2) No	1) Yes; 2/3) Not stated	1) Yes; 2/3) Not stated	No	2 weeks-2 months	0.63
De Bocaletti	1999	Guatemala	Stillbirths & 0-6 days old	101/36	Road to Survival	Segregated	1; 2; 3; 6; 7; 8; 9; 11	Yes	1) Yes; 2) No	1/2) Yes; 3) No	1/2) Yes; 3) Not stated	No	3 months	0.63
RACHA study	2000	Cambodia	Perinates & 1 wk-59 months Old	59/119	TPtoSCI*	Segregated	1; 2; 3; 4, 5, 6; 7; 8; 9; 11	Yes	1/2) Yes	1/2) Yes; 3) No	1) Not stated; 2) No; 3) Not stated	No	Not stated	0.87
Schumacher	2002	Guinea	0 days-59 months old	330	TPtoSCI*	Segregated	1; 2; 3; 4, 5, 6; 7; 8; 9; 11	Yes	1/2) Yes	1/2/3) Yes	1/2) Yes; 3) Not stated	No	Not stated	0.75
Bojalil	2007	Mexico: Hidalgo	Under 5 years old	75	Not clear	Not clear	3; 4, 6; 7; 8; 9	Yes	1/2) Yes	1/2/3) None stated	1/2/3) Not stated	No	90 days	0.75
Kallander	2008	Uganda	Under 5 years old	164	Not clear	Integrated	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11	Yes	1/2/3) Not stated	1/2/3) Not stated	1/2/3) Not stated	Not stated	4-6 weeks	0.75
Waiswa	2010	Uganda: Iganga/May uge DSS	Neonates	64	Three delays model	Integrated	3; 7; 9	Yes	1/2) No	1/2/3) Not stated	1/2/3) Not stated	Not stated	Not stated	0.87
Koffi	2015	Cameroon	Neonates	164	TPtoSCI*	Integrated	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11	Yes	1/2) Not stated	1/2/3) Not stated	1/2/3) Not stated	No	4 years	1.0
Koffi	2015	Malawi	Neonates	164	TPtoSCI*	Integrated	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11	Yes	1/2) Not stated	1/2/3) Not stated	1/2/3) Not stated	No	4 years	1.0
Kalter	2016	Niger	Neonates	453	TPtoSCI*	Integrated	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11	Yes	1/2) Yes	1/2/3) Yes	1/2/3) Yes	Yes	3-5 years	1.0
Deshmukh	2016	Rural India	Under 5 years, neonates, and infants	1488	Three delays Model	Integrated	2; 7; 8; 9; 10; 11	Yes	1/2) Not stated	1/2/3) Not stated	1/2/3) Not stated	No	Not stated	1.0
Nonyane	2016	Bangladesh	Neonates	331	Not clear	Segregated	3; 6; 7; 8; 11	Yes	1/2) No	1/2/3) Not stated	1/2/3) No	Yes	2.5 years	1.0
Koffi	2016	Niger	1-59 months	601	TPtoSCI*	Integrated	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11	Yes	1/2) Yes	1/2/3) Yes	1/2/3) Yes	No	3.5 years	1.0
Koffi	2017	Nigeria	1-59 months	2,057	TPtoSCI*	Integrated	1; 2; 3; 4; 5; 6; 7; 8; 9; 10;11	Yes	1/2) Not stated	1/2/3) Not stated	1/2/3) Not stated	No	5 years	1.0
Navale	2017	Rwanda	Infants	1330	TPtoSCI*	Integrated	1; 4a); 4b); 4c); 5; 6; 7; 8	No	1/2) Not stated	1/2/3) Not stated	1/2/3) Not stated	No	Not stated	1.0

In order to minimize the recall bias and to improve the probability of assigning correct CoD, it has been recommended that the time of interview between death and VA interview should not be more than one year[41]. Only five studies[32,35,38&39] conducted their interview within the recommended duration, however, five studies[8,28,29,31,33&40] failed to mention and six studies[21,24,25,26,30&34] conducted interviews beyond 1 year of death ranging from 2.5-years to 05-years and hence carries a higher chance of recall bias with under or over-estimation of their assigned cause of death[41&42].

To find out the sensitivity and specificity for the sets of questions and algorithms, it would be better to have a comparison or control group with known causes of death, however, it will be very difficult to get hold of such controls for comparing the cases with near-miss controls with matched age-group, socio-economic background, lifestyle and exposure to same risk factors. None of the studies except the one[32] did mention the reason why they did not take any comparison with matched controls, whose results came consistently with the expectations of the researcher. Only South Asian studies[30&33] used well-trained data collectors i.e. Physicians and highly trained data collectors. The rest of the other studies only involved locally trained non-medics.

Similarly, table 3 shows that almost all of the studies except five[29,31,32,38&39] have incorporated separate sections for three different age groups in their VA tools. Only three studies[33,35&40] did follow ICD-10 classification for CoD certification and coding, however, none have mentioned that they followed the CoD list mapped according to ICD-10 except the one which used WHO's VA tool[40].

Table 3: Assessment of VA component of eligible studies as per WHO VA. Gold Standards

Author and reference #	Study setting	Publication Date	A least three separate sections included on different age groups	Mortality classification based on ICD-10 Classification	The cause-of-death list for VA mapped according to the ICD-10
Sodemann	Guinea Bissau	1997	Not stated	Not stated	Not stated
Aguilar	Bolivia: El Alto city	1998	No	No	Not stated
deBocaletti	Guatemala	1999	No	No	Not stated
RACHA Study	Cambodia	2000	Yes	No	Not stated
Schumacher	Guinea	2002	No	No	Not stated
Bojalil	Mexico: Hidalgo state	2007	Not stated	Not stated	Not stated
Källander	Uganda	2008	Yes	Yes	Not stated
Waiswa	Uganda: Iganga/Mayuge DSS	2010	Yes	No	Not stated
Koffi	Cameroon	2015	Yes	No	Not stated
Koffi	Malawi	2015	Yes	No	Not stated
Kalter	Niger	2016	Yes	No	Not stated
Deshmukh	Rural India	2016	Yes	Yes	Not stated
Nonyane	Bangladesh	2016	Yes	Not stated	Not stated
Koffi	Niger	2016	Yes	No	Not stated
Koffi	Nigeria	2017	Yes	No	Not stated
Navale	Rwanda	2017	Yes	Yes	Yes

There is no marking criterion being set in the current review for selecting the best VA and SA study/ies that focused on three recommendations by WHO criteria and the number of social determinants mentioned in table 2 respectively. Studies which focuses on the maximum numbers of these objectives stand out to be the best among the others. Based on the comparative information, the three studies[21,31&34] were found to have stronger SA methodology as they focused most of the components mentioned in the table 2 pertaining to non-biological determinants (Kalter's key points).

Hence the three studies[21,31&34] were found robust in comparison to others in relation to focusing on social determinants. These three studies which focused on most of the non-biological determinants mentioned in column-A, B, C, D and E of table 2 did assign a social diagnosis of contributors to death; their data were collected from larger area; their data were utilized to support health policy, advocacy, intervention development and community empowerment which is an integral part of social autopsy.

Out of these three studies, only one had a comparison group21 and three[21,26&34] had high recall-period. Similarly, table 3 shows that only three studies[33,35&40] out 16, have their VA component consistent with WHO recommendations[13], despite the fact the none of them had listed the cause of death according to the ICD-10 classification except the one[40].

Types of VASA tools

All of the included studies used varied versions of SA and VA tools from different agencies. 10 out of 16 included studies used integrated tool[8,21,24-26,32-35&40], 04 conducted VA and SA as separate (but conducted in conjunction) exercises[28-31], while the remaining 02 did not mention about it[38&39].

The VASA studies whose VA components are based on WHO recommendations are mentioned in column-B of table 4, while those VASA studies whose CF was based on the points raised by Kalter's review are mentioned in column-D of table 4. In our review, three of the VA tools (INDEPTH Network VA tool, INCLEN VA tool, and WHO VA tool) and two of SA tools (CHERG's SA tool and BASICS SA tool) were found based on CFs who have fulfilled VA and SA recommendations respectively and are mentioned in columns-A and C of table 4. It is evident from previous literature that the earlier versions of VASA tools were efforts from the researcher and its team (focused specifically for the research)[8,30,33,35,38&39], however, the trend shows a recent involvement of certain agencies (for example CHERG's and INDEPTH Network's) and their efforts for developing standardized tools for global research purposes. No single integrated VASA tool has been identified according to the literature that followed all the recommendations given by WHO (for VA) and Kalter's review for SA. The table 4 shows three VA and two SA tools that fall close to these recommendations.

Table 4: VA tools (which were developed according to WHO recommendations) and SA tools (which captured most of the NBDs), used in included studies

VA tool			SA tool		
Name of VA tool (A)	Used in studies (B)	Year	Name of SA tool (C)	Used in studies (D)	Year
INDEPTH Network VA tool	Källander	2008	CHERG SA tool	Kalter	2016
				Koffi	2016

INCLEN VA tool	Deshmukh	2016	BASICS SA tool	Schumacher	2002
WHO VA tool	Navale	2017			

Discussion

Although the VASA integration is a newer concept, this systematic review includes peer-reviewed literature addressing original research articles with primary data. This paper is based on an explicit systematic literature review to ensure the inclusion of all relevant articles. Out of 19,685 articles, this review filtered out 16 primary VASA articles from 14 countries (three continents: USA, Africa, and South Asia), which explored biological and social causes of under-five deaths. Despite the strengths, our review was limited to English language articles published in indexed journals, there is a possibility that research article with strong findings published in any other journal and language may be missed out.

Our review shows that VASA and SA investigators are now preferring to conduct studies based on TPtoSCF as their core CF for SA tool[21,24-26,28,31,32,34&40], however, the WHO's recommendations for VA tool are followed on a very limited scale globally. There is a great need that VA specific studies and VASA integrated studies should have their VA tools based on WHO's recommendations.

The included studies showed that CFs for SA tool has modified over the time, (by adopting varied methodologies) for capturing and organizing data on non-biological determinants related to child deaths. Although the SA models are explicitly developed and over the time have shown positive outcomes on elaborating social determinants, especially TPtoSCF, which, since 1995, has been known to be the most holistic CF for SA tool[23], however, future modifications of TPtoSCF by incorporating diverse sets of variables and varied models can be tested and tried for updating and upgrading this SA tool framework. This potentially may provide more extensive and explicit methodology of SA tool and may lead to further strengthening the linkages between different variables involved during child mortality incidents. There is an additional opportunity for future researchers to consider the options of undertaking VASA studies with near-missed children (which is lacking in the literature).

Literature indicates that there is no official recommendation from any agency which would help us for developing an integrated CF on which the integrated VASA tool should be based on. There is a strong need to address this gap. Moreover, there is an additional option where we can at least develop an integrated VASA tool that is based on Kalter's recommendations for SA and WHO's recommendation for the VA component. But before that, a need for extensive research is all that is needed in this regard. Additionally, much research needs to be undertaken to explore, the comparison of segregated and integrated VASA tools in terms of cost-effectiveness, their efficiency, and reliability. This should also be complemented with efforts on validation studies of VASA integrated questionnaire with its corresponding VA and SA components separately for each age group, especially for developing countries.

Over the years, the use of VASA investigations has been more frequently

conducted in developing countries of Africa[21,24,27&34], with explicit methodology after 2008 onwards. South Asian countries have also contributed with their data[30&33]; however, they did not follow the explicit methodology compared to African experts. Therefore, South Asian countries need to make more efforts in conducting VASA investigations with the explicit methodology.

Conclusion

The VASA studies have a strong potential to explore BCoDs and SCoDs pertaining to child mortalities, however, the integrated VASA tool supporting the data collection; organizing and analyzing the collected data, should be based on a well-structured and holistic integrated VASA CF specifically for recording, organizing and analyzing the biological and non-biological determinants of child mortality.

Conflicts of Interest

None.

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