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THE ROLE OF HERITAGE DATABASES IN TYPOLOGICAL REIFICATION: A CASE STUDY FROM THE FINAL PALAEOLITHIC OF SOUTHERN SCANDINAVIA

Felix Riede

ABSTRACT:

Large tanged points are cherished cultural index fossil artefacts in European prehistory. In different research traditions and different regions, they are known by different labels – Lyngby points, Bromme points, and Teyjat points, for instance – and they are mobilised in interpretations of culture-historical processes such as migration, territoriality, contact and even ethnic identity. Yet, some studies, including recent ones employing computational methods, highlight that (i) the size and weight of such points are suggestive of their use as dart-tips rather than arrowheads, and (ii) they are so variable that regional or chronological groups are difficult to demarcate clearly. Together these studies imply that typological schemes that seek to identify culturally and chronologically meaningful large tanged point variants fail, questioning their efficacy as culture-historical marker artefact. In this chapter, I review the research historical roots of the notion of large tanged points as cultural index fossils and discuss the implications of recent analyses. In particular and with a focus on Denmark, I intersect the research history of Final Palaeolithic archaeology in region with the development of typological thinking and the phasing-in of a national digital heritage database. In doing so, I show how notions of overly normative types had been transferred from the Metal Ages to the Palaeolithic and how database structure subsequently reified a particular view of large tanged points as salient marker artefact. As a result, there is arguably an increasing rift between the epistemic status of Final Palaeolithic large tanged points and the way in which the bulk of these objects are registered in the national database. If true, this has important implication for how this period is understood but also for the ideal design principles of heritage databases whose ambition it is to avoid typological reification by integrating registration practice with the results of on-going research.

Introduction: From object to catalogue to database

Artefacts are the empirical backbone of archaeological knowledge creation. The shape, temporal, and spatial position of a given object make up essential metadata that facilitate linkage between different objects, their respective differentiation into different classes – traditionally, into types (Adams and Adams, 1991) – and the reconstruction of material culture change over time. Many recording systems, object labels, and their associations to specific concepts of culture and of culture change have developed historically. In the course of the 20th and 21st centuries, digital tools and methods have further impinged on the recording of particular objects, both in the form of digital registers and increasingly in the form of digital and computational analytical methods. This chapter chronicles the journey of a particular and cherished artefact – the large tanged points of the southern Scandinavian Final Palaeolithic – from their initial discover to their inclusion in analogue catalogues or so-called “thing-editions” (Hofmann et al., 2019), on to their assimilation into the Danish sites and monuments register, and finally to the present where an unpacking of these registrations reveals critical issues in how these objects are labelled and hence how they enter this archaeological pipeline.

Large tanged points are a form of projectile point, which is an iconic class of artefacts that has always attracted the attention of archaeologists, just as they evoke public imagination (e.g., O’Brien and Lyman, 1999). For many regions and periods – and especially so in the Stone Age – projectile points are considered the premier ‘index fossil’ used as a metronome of cultural change. Elevating change in projectile points with change in culture as such imports a range of problematic assumptions about gendered technologies; and the traditional archaeological focus on projectile points likewise reflects the skewed gender balance in the profession. That said, projectile points do represent an artefact class that does seem to have undergone particularly dynamic changes in many prehistoric periods, albeit not in every part of the world (Araujo, 2015). In addition, there is a rich history of ethnographic attention to projectile points as analytical units and as proxies for tracking social networks, transmission, and interaction (Nishiaki, 2013; Sinopoli, 1991; Wiessner, 1983). Moreover, there is little doubt that projectile points – for hunting, warfare, or prestige – did constitute part of a vital technology (cf. Crosby, 2002). For both reasons of research history and reasons of relevance to people in the past, projectile points do warrant particular attention.

This chapter seeks to document a series of conceptual slippages that occurred in the transformation from object to data. To do so, it reviews the research historical roots of the notion of large tanged points as cultural index fossils in the Final Palaeolithic of southern Scandinavia, and places them in the context of recent computational analyses. With a focus on Denmark and building on earlier work (Riede, 2017), I intersect the research history of Final Palaeolithic archaeology in region with the development of typological thinking and the phasing-in of a national digital heritage database. In doing so, I show how (i) cultural labels originally applied to particular strata come to stand for ethnic groups, and (ii) how notions of overtly normative types had been transferred from the Metal Ages to the Palaeolithic, and (iii) how database structure subsequently reified a particular view of large tanged points as salient marker artefact. Classification practices enshrined in the Danish sites and monuments register defy set logic in continuing to equate large tanged points with a particular cultural group. Importantly, the ease with which lists, numerical and cartographic output can be generated from the register reinforces the traditional view of these artefacts as characteristic of a particular region and period. As a result, there is arguably an increasing rift between the epistemic status of Final Palaeolithic large tanged points and the way in which the bulk of these objects are registered in the national database.

Early conceptualisations of prehistoric cultures in Scandinavian archaeology

Before looking in detail at large tanged points and their transformations from object to data, it is necessary to, in fact, return to the very birth of archaeology. In 1825, the Danish intellectual and antiquarian Christian J. Thomsen (1788–1865) famously implemented his three-age systemic ordering – Stone Age, Bronze Age, Iron Age – in the context of the Danish Royal Commission for the Collection and Preservation of Antiquities, the foundational collection of the later Danish National Museum. He had been charged with this task as expanding and intensifying agricultural activity at this time steeply increased the number of artefacts that entered the royal collections. Thomsen's ordering was as much conceptual as it was practical. Conceptually, he was drawing on classical sources such as Lucretius as well as later learned clerics who had already written about sequential stages of human culture (Gräslund, 1981). His ordering was also practical, however, both in an empirical sense of ordering an immense and growing volume of material in a systematic manner. It was also practical in the sense that Thomsen faced the fundamental logistic constraint of quite literally placing objects in boxes and cabinets (Fig. 1). This placement served the dual purpose of categorising the finds neatly – after all, objects could only be in one cabinet – and of displaying them to the public. In this very real and material sense, the technologies of the display cabinet 'machine' (cf. Bryant, 2014) in part determined the way in which Thomsen thought about and handled the material at hand.

Figure 1. *The cabinets of the Danish National Museum in the 1930s. Artefacts were classified by type, and typological differences translated directly into physical differentiation by cabinet, shelf, drawer, and box. © National Museum of Denmark.*

Some years after the three-age system was first implemented in practice, Thomsen (1836) published his scheme at which point the direct linkage between the physical constraints of the cabinets and the typologising of objects into discrete conceptual categories became obscure. Thomsen's ground-breaking classification had a lasting impact on archaeology, not least because his periodisation fundamentally stood the test of time, at least in a European context. In Thomsen's own time, prehistory barely extended into the Stone Age and the true antiquity of human biocultural evolution had not yet been fully appreciated (Gamble and Kruszynski, 2009). In the course of the 19th century, fossil bone finds of long-extinct Ice Age mammals and obviously humanly made objects in contextual association, primarily in the British Isles and in France, extended the temporal scope of prehistory tremendously. Catalysed by the new evolutionary theory published by Charles Darwin (1859), many archaeologists sought to refine the chronological subdivisions of this new and greatly extended Stone Age. Gabriel de Mortillet (1821–1898) was one of these influential scholars who focused specifically on systematising the material culture variation observed across the many French cave sites under investigation at this time (Schlanger, 2014).

De Mortillet famously borrowed the notion of the 'index fossil' from biogeography and earlier studies of the French caves by Édouard Lartet (1801–1871; see Lartet and Christy, 1875) who labelled particular layers by the animals that dominated in the faunal assemblages. But, vitally, de Mortillet's interest rested with the material culture found in those layers and so transferred the indexing quality to particular kinds of tool classes (de Mortillet, 1873). Focusing on just one of Thomsen's three ages, de Mortillet further subdivided the Stone Age (cf. Sackett, 1991). In doing so, he drew inspiration from ethnology (Richard, 2012); his writings reveal the equation – common at that time – of stratigraphic labels defined by artefactual indices with ethnic groups (Fig. 2), an equation that can similarly be found in subsequent scholarship. Breuil (1912, p. 201), for example, writes:

... it truly appears that the Solutreans of La Cave were strongly influenced by Magdalenian tribes already established in the Pyrenees region and perhaps Montauban.

References to prehistoric tribes identified by labels that in turn refer to index artefacts are also common in the literature specific to Scandinavia, namely in the further developments of the typological method by the Swede Oscar Montelius (1843-1921; Åberg, 1966; Gräslund, 1999) and the writings of the great synthesiser Grahame Clark (1907-1997; Rowley-Conwy, 1999). Montelius' contribution specifically was to refine the use of typology as a method, and so to better constrain the chronology of later prehistory in Scandinavia in particular. In doing so, Montelius (1899) did draw on fledgling evolutionary theory. While he never pursued this analogy in any great detail later on (cf. Riede, 2010, 2006), this notion has in recent years re-emerged and now provides a robust framework for understanding culture change (Riede, 2011; Shennan, 2008). More important in the present context, however, is the fact that the specific material Montelius used to elaborate both his most robust chronologies and to illustrate his conceptual notion of cultural evolution were bronze objects.

Montelius' detailed typologies have proven long-lasting but recent research also points to some important properties of Bronze Age types and the cultural transmission properties underwriting these. Detailed observation of makers' marks and crafting traces suggest that many objects of the same 'type' were actually made on the same moulds or by the same craftspeople associated with particular workshops catering for specific elite tastes (e.g. Nørgaard, 2018a, 2018b, 2015). Stone has very different mechanical properties from metal (cf. Andrefsky, 1998; Cotterell and Kamminga, 1990) and – with rare exceptions – was a quotidian raw material used more or less expediently for working tools. This is not to say that there may not have been social value in flint-working skill or that lithics did not, in some periods of prehistory, play their part in symbolic display. Yet, the critical conceptual slippage involved in transferring the notion of formal types from Bronze Age elite metalwork to the lithics tools of the Palaeolithic also entailed the transfer of a similar notion of craft normativity. Methodological developments in cultural evolution have provided conceptual and analytical handles on how to capture and rate such normativity, which is also referred to as biased transmission (cf. Laland, 2004). Formal assessments of normativity require an analysis of variability beyond the assumption of ideal types; with this in mind, we can now turn specifically to the large tanged point of the Final Palaeolithic found in Southern Scandinavia.

Large tanged points and the Final Palaeolithic of southern Scandinavia

In 1915, the geologists Jessen and Nordmann (1915) published a large tanged point discovered in evidently Late Pleistocene levels in the very north of Denmark, from where faunal remains of reindeer – a species that went extinct in the region at the close of the Pleistocene – were also recovered. Similar points had already been found outside of stratigraphic contexts in other parts of the country. Montelius (1921) was quick to find (incorrect) typological parallels in the French Solutrean. This find also led Ekholm (1925) to discuss the pioneering settlement of Scandinavia, to seek parallels with Palaeolithic finds from outside the region, but to also highlight that he saw this as a phenomenon distinct from continental Europe; with reference to the large tanged point from Nørre Lyngby, he coined the term 'Lyngby civilisation'. Shortly thereafter, he cements the term 'Lyngby-culture' – presumably as a synonym for 'Lyngby civilisation' – in the authoritative *Reallexikon der Vorgeschichte* (Ekholm, 1926), again with direct reference to the finds from northern Denmark. The notion of a Late Palaeolithic 'Lyngby-culture' distinct from contemporaneous group caught on and by the time Clark (1936) published the first major overview of the Late Palaeolithic and Mesolithic in Europe – in which he leaned heavily on Scandinavian evidence – the Lyngby-culture had become firmly enshrined. A decade later again, the publication of the excavations at the Bromme site were published (Mathiassen, 1946).[1] The Bromme assemblage was dominated by large tanged points, and it was convincingly dated into the warm part of the Late Glacial (initially via pollen analysis by Iversen, 1946; and later by AMS dating by Heinemeier and Rud, 2001). Mathiassen continued to refer to the large tanged points as 'Lyngby points' but also introduced the term 'Bromme culture'. This and other excavation in the region led Clark (1950) to sound caution as to the reality of the 'Lyngby-culture'. His revised culture-historical scheme now aligned the 'Lyngby-type' tanged points with the Bromme site and hence the Bromme culture, relegating Nørre Lyngby to a transitional phase in a continuous sequence of typological cultural development (Fig. 2).

[1] Subsequent archival and re-exavation work has shown the original fieldwork to have been not without its problems, both in terms of assemblage coherence and field methodology (Fischer and Nielsen, 1986; Solberg, 2022), not least because of personal conflicts between the original avocational finder of the site, Erik Westerby, and the excavator, Therkel Mathiassen from the National Museum of Denmark (see Fischer, 2002; Westerby, 1985).

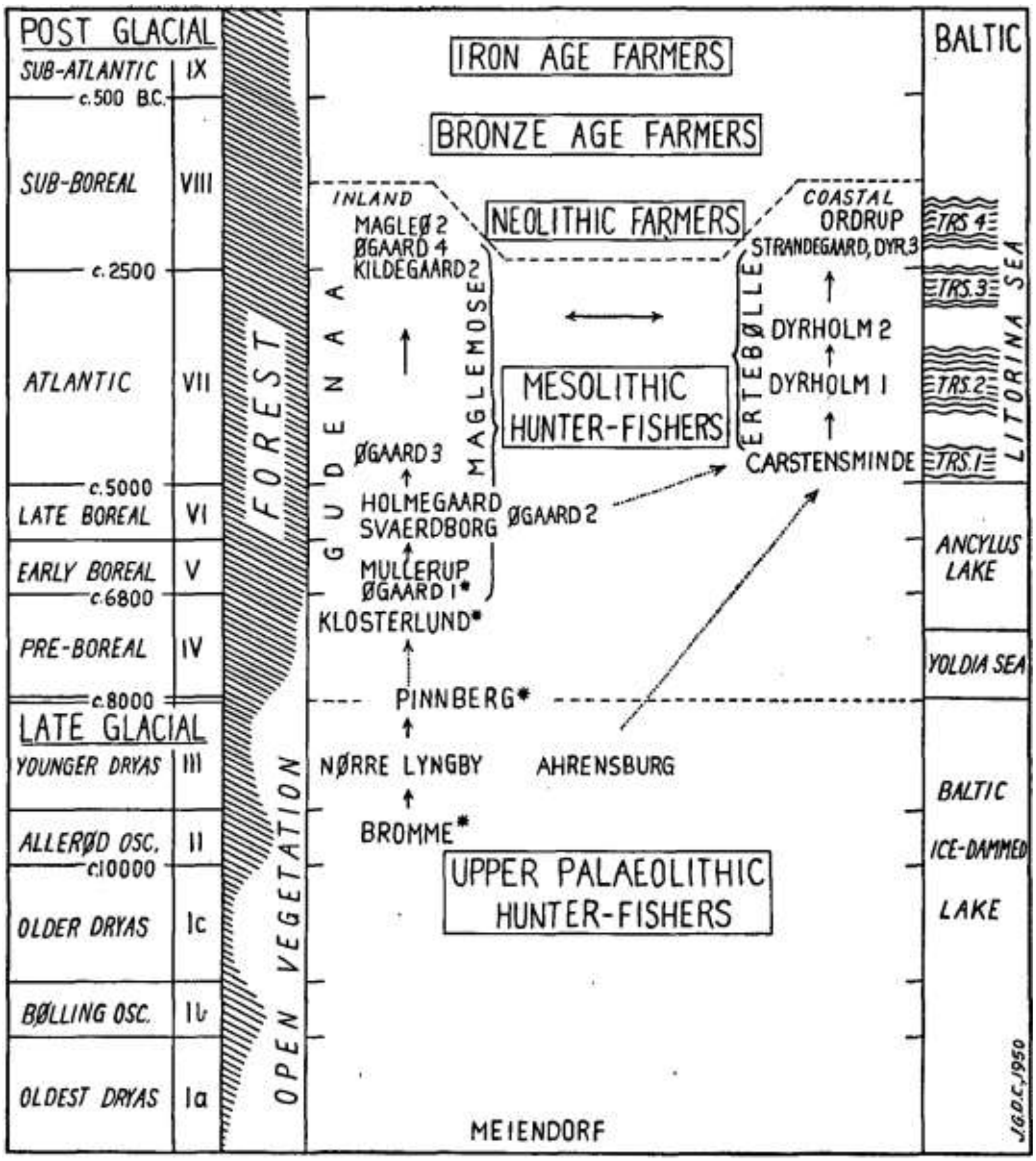

Figure 2. *A culture-historical scheme for the 'reindeer-hunting tribes of Northern Europe' as defined by a succession of typological forms, by Clark (1950). Note that the notion of 'tribe' – an ethnic denotation – is linked directly to archaeological types.*

Reviewing the early research history of large tanged points in southern Scandinavia serves to show that by the time the Palaeolithic settlement of the region was seriously discussed, strong ethnic and genetic notions of cultures had become inextricably linked to the particular types – both by stratigraphic, chronological and chorological association. Note, for instance, Clark's use of the term 'tribe' by which he was likely referring to a mixture of cultural and biological commonalities (see Fried, 1975 for a further discussion of the term), arguably identifiable by typological proxy. Montelius, Ekholm, Clark, and their contemporaries operated very much in a paradigm where cultural and biological descent were coupled, and where certain key artefact types – not only in late prehistory but also in the very remote periods of the Pleistocene – were seen to index such ancestry relations.

What is striking in the interpretation put forward by Montelius and Ekholm is the paucity of relevant finds. Montelius makes direct evidence – including an illustration – to the Nørre Lyngby point itself, mentions similar objects found in Norway and illustrates some much older French tanged points; Ekholm illustrates and maps five large tanged points, all from Denmark (Fig. 3). The more richly illustrated report on the excavations at Bromme added many an object to this expanding list of 'Lyngby points', some of which are used by De Molyn (1954) to argue strongly for eastern affinities, although he, too, sees draws false typological parallels between the southern Scandinavian material and much earlier (Gravettian) Palaeolithic phenomena. Both Mathiassen and De Molyn had the benefit of a greater number of known and illustrated large tanged points for comparison. A more extensive catalogue, however, was missing until Schwabedissen (1954) published his treatise on the so-called Federmesser-Gruppen, a Late Magdalenian variant that emerged in the warmer part of the Late Glacial.

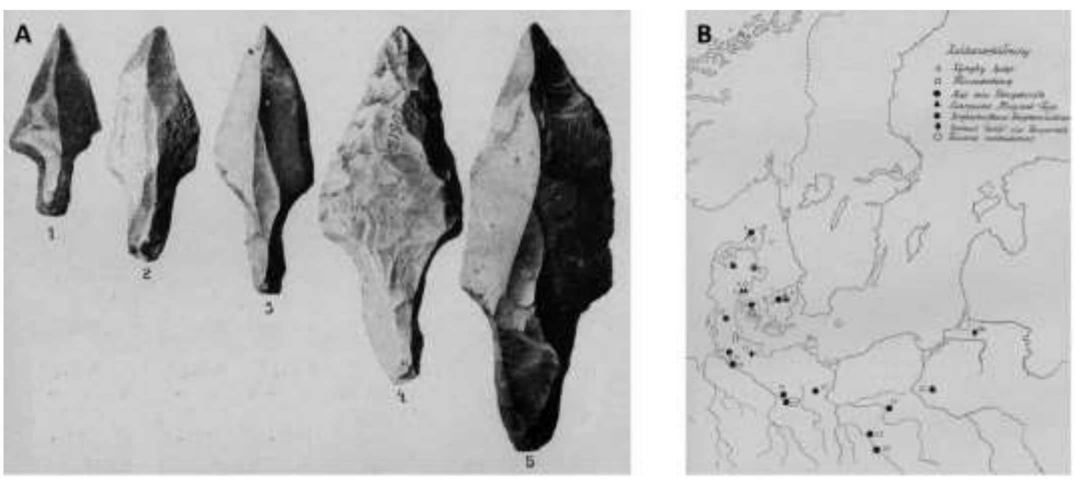

Figure 3. *The large tanged points illustrated (A) and mapped (B) by Ekholm (1925). Note the variability already evident in this minute sample of objects and the limited mapping of comparable forms suggesting a tightly circumscribed occurrence, and affiliations to the east rather than the west, as was suggested by Montelius.*

In his monograph, Schwabedissen listed many sites and their typological composition, illustrated many objects and provided distribution maps of both lithic and organic artefacts. Although his focus lay with the arch-backed points rather than large tanged points, he demonstrated clearly that the latter regularly occurred in assemblages otherwise dominated by the former. He uses the label 'Lyngby type' for these and relates them to the 'Bromme/Lyngby civilisation'. In his discussion of cultural relations during the closing millennia of the Pleistocene, Schwabedissen accepted this 'Bromme/Lyngby civilisation' as a real phenomenon with a clearly separate identity and territorial distribution. An even more comprehensive attempt to map, illustrate and discuss tanged points was presented by Taute (1968) some years later. With focus on tanged points as key artefact type, Taute – using some of the same sites already discussed by Schwabedissen – highlighted the similarities across this artefact group. In his terminology, he separated a 'Segebro-Bromme group' from other variants. Anchoring his classificatory group-building in the excavated sites of Bromme and Segebro in southern Sweden (Salomonsson, 1964) as well as the many stray finds of large tanged points, Taute viewed point size as the main factor demarcating this group from the others. Taute focused on size as the key difference between 'Lyngby points' and 'Ahrensburgian points, with the former being large (length >55mm; width ≥17 mm) and the latter small (length <55mm; <17 mm). Taute's classification – meant to capture stylistic differences – actually matches the functional distinction between dart-tips and arrowheads as derived from metric and ballistic considerations and with reference to ethnographic comparisons (Hughes, 1998; Shott, 1997; see also Riede, 2009).

His catalogue of drawings is extensive and in full alignment with the scientific ambition – especially pronounced in contemporaneous German archaeology – to create complete graphic overviews of a given artefact class that Hofmann has labelled as 'thing-editions' (Hofmann et al., 2019). Mirroring the elaboration of the type concept by Montelius on the basis of finds from the Bronze Age, the compilation of thing-editions was most vigorously pursued for material from that period. Artefacts were logged, described in basic terms and drawn, as well as placed on maps; this methodology was followed by Taute when presenting his catalogue (Fig. 4).

89 **Sprenge**
Kreis Stormarn

Der Fundplatz Sprenge 4, über den H. SCHWABEDISSEN (1954) berichtet hat, ist auf einer sandigen Kuppe am Nordrand des Gölmer Moores gelegen.

WERKSTOFF: Überwiegend grauer, vereinzelt gelblich und braun gefärbter Feuerstein.

GERÄTE: 1 kurze Lyngby-Spitze (a. a. O. Taf. 3,4). – 1 kräftige Ahrensburg-Spitze (a. a. O. Taf. 3,5). – 1 Gravette-Spitze (a. a. O. Taf. 3,3).
Das Inventar umfaßt ferner aus Klingen gearbeitete Stichel, meist Einschlag-Eckstichel mit und ohne Retusche, 1 Doppelstichel, lange und kurze Klingenschaber sowie Halbrundschaber, mehrere Klingenschaber mit umlaufender Randretusche, die das untere Ende stielartig verjüngt, 1 kurzen Doppelschaber; außerdem mehrere Klingen mit partieller Retuschierung (a. a. O. Taf. 3–5).

Figure 4. *An extract from Taute's (1968) catalogue of sites with tanged points. This log shows strong similarities with other contemporary 'thing-editions (cf. Hofmann, 2018). Note also how this particular site was classified earlier by Schwabedissen as belonging to the arch-backed point groups on the basis of the presence of the supposed diagnostic for this group, while Taute placed it with his tanged point groups based on the presence of tanged points. Which if any of these types should be the main determinant of group membership was not clarified (cf. Riede, 2017).*

In reviewing cataloguing projects of this kind, Hofmann (2018) notes that these concise object logs were seen to capture the 'natural' properties of the objects under study. Placing these artefacts in a typological and spatial coordinate system was viewed as the foundation for interpreting territorial and cultural-historical relations between prehistoric groups the constitution of which was rarely if ever problematised. Beyond the basic and largely administrative tags associated with each site or object, the drawings were meant to carry the remaining important information. Yet, drawings of flint objects can be executed very differently (e.g. Saville, 2009), and their epistemological status in Palaeolithic archaeology is not fully transparent (Hussain, 2021; Lopes, 2009). Taute's work and not least his catalogue made an enormous contribution to the field, rightly celebrated, for instance, some 30 years later in the dedication of another landmark publication on tanged points (Kozłowski et al., 1999). His magisterial review contributed to the eventual dissolution of the 'Lyngby culture' in favour of the 'Bromme culture', which were no longer seen as separate and successive phenomena but as synonymous (Brinch Petersen, 1970). Taute's work did not, however, lead to a critical appreciation of the internal diversity among the large tanged points in the region. The Bromme culture – also in its guise as 'Segebro-Bromme group' – remained firmly in place as a regional entity.

Practitioners within and outwith southern Scandinavia accepted the territorial reality of the Bromme culture. They did so despite early reports that finds of the Federmesser-Gruppen also occurred in the region (e.g. Fugl Petersen, 1974; Kapel, 1958) and arguments for a differentiation rooted largely in economic differences. Echoing Schwabedissen, Bokelmann (1978) showed that a discrete border between sites with arch-backed points and those with large tanged points cannot be drawn but that there is instead a gradient of increasing numbers of large tanged points to the north. At the same time, reports of stray large tanged points accumulated (Fischer, 1985).

Arguably, the identification of an autochthonous Palaeolithic culture had been a matter of national scientific pride (cf. Tomášková, 2003), not least in Denmark where archaeology played a substantive role in the formation of modern national identity (Kristiansen, 1993). With its seeming distribution limited to southern Scandinavia, the Bromme culture slotted neatly into models of prehistoric cultural development rooted in concepts of territorial continuity and methodological nationalism (Kohl, 1998; Shnirel'man, 2013). Despite the evidence for the occurrence of large tanged points in the context of not only Federmessergruppen assemblages in the immediate neighbourhood of southern Scandinavia but also in, for instance France (Combier and Desbrosse, 1964; de Sonneville-Bordes, 1969), the Netherlands (Paddayya, 1973), and the British Isles (Mace, 1959; Wymer, 1971), the diagnostic power of these artefacts as cultural index types of the Bromme culture were not questioned.[2] By the end of the 1970s, the Bromme culture stood strong as a unique and widely accepted regional phenomenon.

Transformations from Catalogue to Database to Digital Shape File

The second half of the 20th century saw the introduction of personal computers in the sciences, and eventually also in archaeology. Numerous reviews take stock of their importance and promise (e.g. Aldenderfer, 1987; Clark and Stafford, 1982; Whallon, 1972). Most of these discussions focus on analytical techniques and graphic representations. Less attention has been paid to the more the structuring effects of database construction. In parallel with the

[2] In an unpublished dissertation, Susanne Stevnhoved (1980) did in fact critically discuss the relation between these two cultural phenomena, stressing that large tanged points do not qualify as a diagnostic for the Bromme culture.

accumulation of traditional 'thing-edition', many European countries also began to digitise their sites and monuments registers. In Denmark, this process began in the late 1970s and led to the establishment of *Den Kulturhistoriske Centralregister* (https://www.kulturarv.dk/fundogfortidsminder/), a national database of finds, sites, and monuments from deepest prehistory to the recent, and which was designed to include the entire back-catalogue of finds for which documentation was available as well as to be a repository for excavation and survey reports (Christoffersen, 1992; Hansen, 1992, 1990). Going live in 1984, this database began its life under conditions of computing power vastly different from today. Yet, mirroring the ambition of the carbon-copy 'thing-editions', this register seeks to classify all finds according to the predefined scheme in order to allow chronological and spatial analysis (Hansen and Dam, 2002). Alongside, user manuals have been published that tersely describe the classification categories for the different archaeological find categories (https://slks.dk/omraader/kulturarv/kulturarvsdatabaserne/fund-og-fortidsminder/vejledning-til-fund-og-fortidsminder). Precise instructions for how to classify given material are difficult to find, however, leaving it unclear what protocol or key traits the many different contributors have used over time. For the Final Palaeolithic, the database contains at present the following entries: Hamburgian culture (n= 15), Federmessergruppen (n= 9), Bromme culture (n= 182), and Ahrensburgian (n= 28), all arranged in contiguous chronological sequence.[3] Focusing in on those two cultural groups where large tanged points are found – the Federmesserguppen and the Bromme culture – it becomes apparent that more than 80% of the entries for the Bromme culture are stray finds and that most of these consist of nothing other than large tanged points.

In contrast to true 'thing-editions', the entries in this database are only associated with object images – photographs or drawings – in rare instances. Fischer (1985) had already raised doubts as to the unanimous identifiability of 'Lyngby points' in relation to large tanged points of later Neolithic cultures. Yet, the vast majority of large tanged points found in Denmark were entered into the sites and monuments database as belonging to the Bromme culture. In recent years, however, further doubt as to the diagnostic power of this artefact has been mounting, especially given the ever increasing number of large tanged points being found outside of southern Scandinavia. Some of these are associated with absolute chronological information and predate the appearance of this artefact class in southern Scandinavia; others occur in secure Late Magdalenian/Federmessergruppen contexts (Breest and Gerken, 2008; Kobusiewicz, 2009a; Riede et al., 2011). Moreover, large tanged points are now known to occur across a wide swath from the British Isles (Barton and Roberts, 2001) far into Eastern

[3] This sequence recalls Clarke's (1968) critique of 'brick models' of culture history where one phase of culture is stacked on top of another.

Europe (Sinitsyna, 2002). The culture-historical interpretation of when, how, and why large tanged points first made their appearance in Final Palaeolithic assemblages are debated: Some would link them to hunting reindeer (Thévenin, 1997), marine mammals (Thissen, 1995), or elk (Mortensen et al., 2014); some see these as territorial group markers (Sinitsyna, 2002; Szymczak, 1987) or as evidence of cultural contact (Breest and Gerken, 2008), while others put more emphasis on the apparent disappearance of the arch-backed arrowheads (Federmesser) in favour of the much sturdier large tanged points and their notable lack of symmetry (Dev and Riede, 2012; Riede, 2009). No matter the culture-historical drivers behind this possible transition, these studies do raise additional doubts as to large tanged points' efficacy as a diagnostic type. Logically, therefore, large tanged points can no longer be accepted as strictly indexing the Bromme culture. Instead, large tanged points, found out of context, may equally well reflect the Federmessergruppen or the Bromme culture, if indeed the latter really can be defined as a stand-alone cultural unit (Kobusiewicz, 2009b; Riede, 2017).

As noted by Hofmann and colleagues (2019), one way to reinvigorate 'thing-editions' and the information value they carry is to move their existence into the digital realm, and to make the underlying data transparent, replicable and reusable. As noted above, many previous cataloguing exercises that included large tanged points, listed these as part of site registers but did also include drawings. Building on these and the available literature at large, recent efforts have focused on image analysis comparing the outline shape of these objects. The 2D outline shapes of objects can be readily acquired from existing photographs or drawings facilitating the accumulation of large datasets. For lithic artefacts and especially for unifacial ones, 2D outlines offer cost-efficient alternatives to fully three-dimensional models that require both access to original objects but also significantly more expensive and time-consuming data capture methods (García-Medrano et al., 2020). Accurate 2D representations of lithic artefacts can be obtained from photographs and drawings, all of which provide sufficiently robust sources for subsequent computational shape analysis (Hoggard et al., in press). In this spirit, recent analyses of large tanged points in Northern Europe have sought initially to compile linear measurements (Riede, 2009), later indices of symmetry (Dev and Riede, 2012), and eventually landmark- and outline-based geometric morphometric shape descriptions (Ivanovaitė et al., 2020; Matzig et al., 2021; Riede et al., 2019; Serwatka and Riede, 2016). These studies demonstrate that the large tanged points of southern Scandinavia are likely to represent dart-tips rather than arrowheads as has often been assumed, and that they cannot be discriminated from large tanged points that occur outside of the region and that are clearly indicative of Late Magdalenian affinities. Importantly and in an effort to follow best practices of reprucibility (cf. Hofmann et al., 2019; Marwick et al., 2017), the data and analytical protocols used to arrive at these conclusions are openly available.

Conclusion: Research History, Epistemology, and Digitisation

The increasing digital availability of archaeological data is substantially impacting the discipline (e.g., Bevan, 2015; Gattaglia, 2015; Kansa and Kansa, 2021; Zubrow, 2006). This deluge of data does not replace research-historical and epistemological acumen, however. An awareness, in particular, of how successive steps of digitisation have structured the research landscape are necessary to evaluate the most appropriate ways in which the digitisation of particular artefact classes – in the case of this chapter large tanged points knapped of stone – may proceed. This chapter has attempted to chronicle how the notion of artefactual type fossils first was introduced and then applied in European Palaeolithic archaeology. Critical slippages were highlighted where, first, stratigraphic separation was aligned with ethnic separation, and where, second, discrete type definitions were transferred from the very normative objects of the Metal Ages to the often significantly more variable artefact classes of the Palaeolithic. Specifically, this chapter has intersected this development with the use of large tanged points as markers of a particular regional culture: the Bromme culture of southern Scandinavia.

The adoption of large tanged points as the key artefactual marker for the Bromme culture grew organically through a series of field discoveries and publications, the sequence of which was important: Large tanged points became associated with the Bromme culture *before* their presence and chronological significance in other cultural contexts was fully appreciated. It was also significant that the inferred spatial extent of the Bromme culture overlapped strongly with a modern nation state both in the sense of research biases and priorities (Hakonen, 2021; Plets, 2016) as well as in the way in which the registration protocol of a national register reified previous typological assumptions. Mirroring the way in which, in the 19th century, the 'display cabinet machine' in part shaped the definition of types via their requirement of objects having to belong to one or another drawer, the 'database machine' of the Danish sites and monuments register strongly encouraged the linkage between large tanged points and the Bromme culture. This linkage in turn directly shapes the numerical and spatial representation of this culture. In contrast to earlier carbon-copy 'thing-editions' – catalogues containing vital information and drawings – the database entries were rarely accompanied with visual representations of the objects presumed to dictate their culture-historical placement. Only recently, additional digitisation efforts besides the national register have, to the degree possible, made drawings/photographs of a substantive corpus of large tanged points available. Computational analyses of their shapes confirm earlier suspicions that this particular artefact class in fact does not perform its function as cultural marker well, neither on clearly discriminable form nor on contextual and chronological associations.

The activation of legacy data in the context of novel computational approaches is an important task for contemporary archaeology (Katsianis et al., 2022). In relation to the large tanged points of southern Scandinavia, the ongoing digitisation and morphometric analysis of drawings and photographs of large tanged points has revealed a fundamental epistemological conflict between their presumed culture-historical diagnosticity and their status as a registration category in the national register of sites. Databases such as national registers are long-lived and often cumbersome infrastructures, however, and recent debates suggesting that large tanged points found out of context should be re-classified as undiagnostic cannot be readily implemented. At the same time, the lack of visual representation in the register makes an empirical validation of the listed finds and their culture-historical status difficult. Mindful of the costs associated with digitisation, this chapter does not lay blame but neither does it present ready solutions.

There is little doubt that the enthusiastic embrace of the Bromme culture by Danish archaeologists was in part conditioned by the specifics of research history, the empirical record, and its growth, but also by national research and documentation infrastructures and biases. Used uncritically, the chronological and geographic inferences drawn based on these entries are likely to be flawed; high-order interpretations about cultural relations or adaptations deploying these data are similarly vulnerable. At the heart of this conundrum is the concept of the 'type' as normative and essentialist, and its application to the highly variable lithic craft of the Final Palaeolithic. The integration of supposed diagnostic types into databases – especially when not accompanied by visual representations of the objects themselves – amplifies the problem in that an immediate evaluation of the defining object itself is no longer possible. Recent advances in computational archaeology and the ease with which high-quality digital object photos or even scans can now be produced enable rich analyses of legacy artefact drawings and photographs. One implication of these new opportunities is that future site registers should combine the virtues of analogue 'thing-editions' – comprehensive artefact representations – with the open availability of data such that strictly typological categorisations may be validated through computational methods like morphometrics. By the same token, this chapter has demonstrated that computing power does not substitute for theoretical clarity. Typology and classification are and should be of constant concern to archaeologists, a concern that has become all the more urgent as many ongoing projects (e.g., https://ariadne-infrastructure.eu/) now seek to link national registers whose underlying epistemologies may differ.

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F QUANTUM COMPUTER AND ITS LIMITATIONS

Siti Munirah Mohd [*1], Bahari Idrus [2], Muriati Mukhtar [3], Hishamuddin Zainuddin [4], Kamarudin Shafinah [5] , Amelia Natasya Abdul Wahab [6]

[1,2,3,6] Faculty of Information Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia

[4] Laboratory of Computational Sciences and Mathematical Physics, Institute for Mathematical Research, University Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

[5] Faculty of Agriculture and Science Food Sciences, Universiti Putra Malaysia Bintulu Sarawak Campus (UPMKB), Nyabau Road, P.O.Box 396, 97006 Bintulu, Sarawak, Malaysia.

ABSTRACT:

Quantum computers have grown as an essential study in the field of physics and computer science throughout the country since 20 years ago although at the time, the existence of quantum computers is still a mystery. However, studies on quantum computers have successfully provided a new breath in the development of the latest technology. Thus, the brief descriptions in this paper are aimed to guide computer science experts to fully understand how the quantum computer differs from the current computer. Next, this study will explain the basic concepts of quantum mechanics that make quantum computers more powerful than other computers today. Then, two algorithms that apply the concepts in quantum computers will also be explained in details. Finally, this paper will describes the constraints faced when developing quantum computers in reality.

KEYWORDS:

Quantum computer, quantum bit, entanglement, quantum cryptography, image processing, artificial intelligence, quantum algorithm.

I. INTRODUCTION

The field of computer science was explored around 1936 by a mathematician named Alan Turing [10]. Turing had built a computer model known as a programmable Turing machine for calculating mathematical calculations. This study was continued by Von Neumann when he successfully created a computer using electrical components. The computer created by Von Neumann was based on a simple computer model theory that included all important components which are similar to the computer model built by Alan Turing. The evolution of micro and optoelectronic devices had led to the rapid development in the field of computers. Previously large components of computers have been converted to smaller sizes. By reducing the size, it allows computer components to be loaded into a small-sized computer chip capable of storing and processing data with a large capacity.

From this evolution, Gordon Moore, co-founder of the Intel Company [10] introduced Moore's law in 1965 after realizing that the number of transistors loaded in the computer chip will double exponentially every two years. This had caused the transistor's size to shrink. His prediction was proven to be precise because some of these laws are being used in the semiconductor industry to expect long-term output as well as set targets for research and development purposes. However, most researchers during that time assumed that Moore's law faced constraints in transistor storage at a later time when the size of the computer chip becomes too small; down to atomic size. Intel companies reported that the use of the latest chip technology requires more power over faster execution for processing as well as assuming the end of Moore's law [31]. Thus, a shift was done by switching to a quantum computer to replace the current computer because only a quantum computer can process data in atomic size. Accordingly, the time taken to process data can be accelerated exponentially using the quantum parallelism concept, which is a method in quantum computers that is capable of performing two simultaneous processing. Therefore, the field of quantum computers is an option because of its ability to process data faster than the current computer.
In 1985, David Deutsch [10] considered the law of physics to simulate the universal computer quantum problem more accurately. He attempted to define computer tools that were capable to simulate precisely in any physical system. Hence, he was the first person to consider quantum-based computer tools as well as to introduce the modern concept of Church-Turing machine known as the Universal Quantum Computers. However, Deutsch cannot determine whether this conjecture is sufficient or not to simulate any physical system. He assumed that the quantum computer has the power of compute data that exceeds the current computer.

Additionally, Richard Feynman [4,10] a physicist has put forward in 1982, the idea of using a quantum computer that uses the concept of quantum mechanical phenomenon. He also noted that there is a constraint in simulating quantum mechanics in the current computer. Therefore, Feynman proposed the development of a quantum mechanics-based computer to overcome the problem. Furthermore, quantum computers have the advantages with the existence of new concepts of quantum bit (qubit), superposition and entanglement that are capable of processing more data faster than the current computers.

Today, there are many recent achievements made by scientists in the field of quantum computers. One of them is the creation of D-Wave by Eric Ladizinsky, the head of science experts with his colleagues at the D-Wave manufacturing company. D-Wave is said to be the first quantum computer to be built theoretically by using nitrogen fluid to cool the hardware. It is also known as a quantum computer simulator based on some of the predicted benchmark results [3,15,17]. D-Wave has succeeded in producing 439 qubits that could satisfy standard qualification. In line with D-Wave construction, the company has partnered with Google companies to test the types of solutions generated by quantum computers and compare these solutions to the current CPU. As a result, Hartmurt Neven, Google's Engineering Director has successfully proven a solution with this quantum simulator, which is capable of processing at 108 times faster than the current computer. Neven has stated in his blog that the D-Wave is able to counter the current computer for a huge optimization problem at 100 million speeds [16].

Additionally, the development of quantum computer technology has attracted Intel computer companies to study deeper. Intel chief executive officer Brian Krzanich issued a promissory note to allocate 50 million US dollars and provided an independent source of information and expertise in this study for the long term. The study was conducted in collaboration between CPU giant and QuTech, a quantum study institute at TU Delft, the largest and oldest technical university. This research was conducted at a laboratory at College Park, Maryland with a focus on quantum cryptography [29]. The United Kingdom (UK) has allocated 270 million pounds Sterling for this quantum technology research [19].

This paper is divided into four main sections. Section 2, describes the basic concepts of quantum mechanics used in quantum computers. This section aims to explain the mathematical formulas and notations used with the basic concepts of quantum mechanics in quantum computers. This section also describes the concept of quantum bits (qubits) that represent the data during the calculation. Section 3 briefly explains two well-known algorithms, i.e., the Shor algorithm and the Grover algorithm. The Shor algorithm is also known as a polynomial time-factoring algorithm. This algorithm utilizes the quantum parity advantage by using the Fourier analog quantum transformation [25] exponentially. Meanwhile, the Grover algorithm [7] is used in data searching that is not sequenced in steps on quantum computers. Computer capabilities are now only limited using polynomial steps. The current computer cannot exceed the speed of Grover's algorithm, which is able to complete the search for a short period of time exponentially. Applications of quantum computer are described in Section 4 including quantum cryptography, image processing and artificial intelligence. Section 5 explains the advantages of quantum computers and constraints faced to build a quantum computer.

II. BASIC CONCEPTS OF QUANTUM MECHANICS

Quantum mechanics, or also known as quantum physics is one of the branches of knowledge in physics theory which describes physical phenomena of nature in the form of atoms or sub-atoms. The quantum mechanical phenomenon is difficult to understand because the description is about the behavior of photons, electrons and other atoms of very small sizes that cannot be seen with the naked eye. However, these quantum mechanics applications can be seen through superconducting, LED, laser, transistor, and semiconductor magnetics such as imaging and electron microscopy.

This section is divided into two subsections. First, the notation used to measure the quantum state. The second subsection explains the concept of quantum bit (qubit) used to represent data during information processing.

Space of State and Ket / Bra Notation

Quantum state in Hilbert space represents the space of state in quantum system, which includes position, polarity and spin of elements. For quantum computers, the system used is a finite quantum system that uses vector space for complex vector dimensions inner product of a vector.

The quantum state and the transformation of the state are represented by vector and matrix or in bra / ket notation created by Dirac [25]. The ket notation, $|x\rangle$ represents the column vector and is used to describe the state of quantum. The bra notation, $\langle x|$ is complement for ket notation to represent the conjugate transpose. As an example, two bases $|0\rangle$ and $|1\rangle$ in the ket notation in Equation (1):

$$|1\rangle = \begin{pmatrix} 0 \\ 1 \end{pmatrix}, |0\rangle = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \tag{1}$$

while the conjugate is as follows:

$$\langle 1| = (0 \quad 1), \langle x| = (1 \quad 0) \tag{2}$$

The inner product of the two vectors is a combination of $\langle x|$ and $|y\rangle$ simplified as $\langle x|y\rangle$. For example, vector $|0\rangle$ is a unit vector, hence, the inner product is $\langle 0|0\rangle = 1$. Since $|0\rangle$ and $|1\rangle$ are orthogonal, then$\langle 0|1\rangle = 0$. The outer product is represented with the notation $|x\rangle\langle x|$. For Example,

$$|0\rangle\langle 1| = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \otimes (0 \quad 1)$$
$$= \begin{pmatrix} 1(0 & 1) \\ 0(0 & 1) \end{pmatrix}$$
$$= \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix} \tag{3}$$

Quantum bit (Qubit)

Quantum bit or qubit [12] is a unit vector for two dimension complex vector space that is represented with standard bases $\{|0\rangle, |1\rangle\}$. Orthonormal bases $|0\rangle$ can be represented as $|\uparrow\rangle$ or $|\nearrow\rangle$ for photon polarization and spin up or spin left for electron. $|1\rangle$ can be represented as $|\rightarrow\rangle$ or $|\nwarrow\rangle$ for photon polarization and spin down or spin right for electron. Qubit is used to represent the element in computing data and information storage in quantum computer. Qubit in quantum is equivalent to bit 0 or 1 in the current computer [24]. Qubit can be represented by the state of unit vector $|0\rangle = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$ and $|1\rangle = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$.

Figure 1 illustrates the qubit representation in geometry using the Bloch sphere. The bits can only be represented at the North pole position, $|0\rangle$, and the South pole, $|1\rangle$. Qubit can be described at any point on the surface of the sphere. The surface of this sphere is a 2-dimensional space representing the state of the space for a pure state.

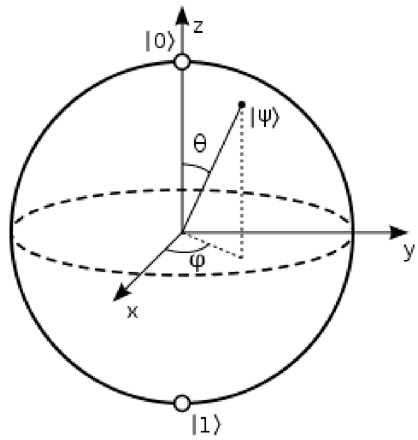

Figure 1. Qubit representation based on Bloch sphere

III. QUANTUM ALGORITHM

This section discusses the two famous algorithms, namely the Shor algorithm and the Grover algorithm.

The Shor Algorithm

The Shor algorithm is an extension of Simon's algorithm. In 1994 [14], Peter Shor had published his algorithm and is one of the most important algorithms in the world representing quantum computers. This algorithm is a modification of Simon's algorithm to a periodic function $f(x) = f(x + a)$ with the addition of two modulo bits.

In 1993, Shor had shown that the quantum computer must be in the form of a major factor principal of the combined integer in polynomial time. He used factoring problems to be applied in finding periods in a function. In detail, it includes the process of finding two prime numbers of factors p and q for $N = pq$ and the duration of function $f_{a,N}(x) = a^x \mathrm{mod}\ N$, with a as the arbitrary number, smaller than N and the prime number that has no common factor with N. This function is periodically with period r and dependent on values a and N [20].

Shor's algorithm is also able to factor the number exponentially faster than the current computer because the it is dependent on the capability of a quantum computer being available in many states simultaneously. The Shor algorithm will assay the number to prime factor as polynomial at one time, which equals as the input size that has been calculated. On the other hand, the current computer can takes a long time to do the same task, even though it has been done exponentially. This causes difficulty in the field of cryptography because the system uses public keys (represented in prime numbers) during communication. For example, many RSA security systems use this in electronic financing, such as credit card transitions, using a key that is made from the product of two major prime numbers. Shor's algorithm will easily break the key to counter the problem of RSA systems and other cryptographic systems [18].

The Grover's Algorithm

The Grover's algorithm differs from the Shor's algorithm because this algorithm is a search algorithm used to search certain values in an unorganized database. In 1996, Grover considered a problem in databases and introduced a more meaningful and efficient algorithm than an existing algorithm that was not an exponent form [20]. In the current computer, the fastest solution that can be done is a simple search conducted by checking for each item looking one-by-one. This means that on average, current computers have to search nearly half the data in order to find the right value. On the other hand, Grover's algorithm is able to solve this problem by a square root faster than the current computer. This is because in a quantum system, the situation can be in a superposition state and simultaneously determines the multiple solutions for each item searched [18].

IV. QUANTUM COMPUTER APPLICATION

This section describes the quantum computer applications, which include three fields, i.e., quantum cryptography, image processing, and artificial intelligent.

Quantum cryptography

Quantum cryptography describes the effects of quantum mechanics on quantum communication to destroy the security of cryptographic security systems. Quantum cryptography measures the state to detect the eavesdropper in quantum system immediately. This concept involves the production of a pair of photons that are constantly entangled. Two parties who want to communicate will measure every photon used. The eavesdropper would try to detect the photon used and retransmit photons in the system for not being detected by the party during the communication held. However, the detection of photons by the eavesdropper will destroy the entanglement between the photon, which can be easily detected by the party. Thus, the system will be safe without any eavesdroppers [18].

An example that is always associated with this cryptography system is the process of sending a security key through quantum communication without any eavesdroppers. This can be seen in the importance of quantum cryptography not only to allow security protocols, such as BB84 [5] and B92 [6] to be used. This can be seen during the transmission of information between Alice and Bob during communication, Alice creates a random bit from random base to send one photon, either 1 or 0 to Bob. Bob will receive this photon without knowing the basis used by Alice. Bob measures this photon randomly for both bases. Next, Alice and Bob will determine the chosen base to be measured through the public channels and throw any bits not measured by Bob on the same basis as Alice. This process allows the transmission of information in a secure channel because the eavesdropper needs to guess the basis used by Alice and Bob in this channel. If Alice and Bob chose the same base, but the eavesdropper chose a different bases, then the opportunity for Bob to measure the bit value differently from what Alice sends is 50-50. With that, Alice and Bob can detect eavesdropper by comparing and removing certain numbers of bits other than the bases they have chosen.

Image Processing

Image processing is one of the important areas in the current computer field because of the need to extract vital information from the three-dimensional world. Among the frequent studies are the complexity algorithm, 3D image representation to 2D, and visual information. In the sequence of the development of quantum computers, the image of processing field has become influenced when the image processing field is able to extend using a quantum computer. Quantum image processing uses quantum computer technology to capture, manipulate, and refine images obtained in quantum format for specific purposes. In general, the image retrieval requires a representation to encode the image based on mechanical quantum. Many studies related to quantum computers include qubit representation to encode quantum images, quantum image characterization using Lattore's real ket and flexible representation of quantum images from 2003 to 2011. Now, researches are more focused on the development of basic equipments needed to process images in quantum computers. Therefore, in order to make it a success, computer scientists must determine and implement “disruptive algorithms” and “killer apps” (high impact apps) to demonstrate the power and advantages of quantum image processing compared to existing [32, 33].

Artificial Intelligence

The main contribution of quantum computers in the field of artificial intelligence is the creation of real random numbers. Actual random causes increased performance on genetic programming and other automated induction programming methods. Thus, Monte-Carlo, simulated annealing, random coating and other analogy search methods are expected to benefit. Two researches related to quantum artificial intelligence are the quantum games theory and quantum evolution programming. Artificial intelligence techniques that have been built and quantum computer features that can reduce the time complexity to the polynomial range are applied in NP-issues [26].

The lab, known as Quantum Artificial Intelligence Lab (QuAIL) has been established in collaboration with NASA, Universities Space Research Association, and Google (Google Research). This lab was built to research how computer quantum can help with machine learning and other computer science problems. The main goal of QuAIL is to show in the future those quantum computers and quantum algorithms are able to increase agency capabilities to solve optimization problem in aeronautics, as well as earth and space exploration. Their researchers also hope to discover new findings in solving real world problems with the use of sophisticated technology. Their aim in the next five years is to develop quantum artificial intelligence algorithms, decomposition problems, application software techniques and classic quantum hybrid algorithms [22].

V. ADVANTAGES AND LIMITATIONS OF THE QUANTUM COMPUTER

In this section, the advantages of a quantum computer, compared to the current computer, and the limitations and challenges to build quantum computer are explained.

Advantages of Quantum Computer

Quantum computers have special features, known as quantum superposition and entanglement that make them more powerful than the current computers.

Quantum superposition

The current computer processes data stored in bits that only represent two values of either 0 or 1. The current computer also performs calculation on the string bits. Thus, the string of n bits only represents one of the 2^n different values. Compared to quantum computers, the current computer uses qubits to store data and can exist in superposition state, as shown in Equation (4) [10,25]:

$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle \tag{4}$$

where $\alpha, \beta \in \mathbb{C}$ are complex dimensions and $|\alpha|^2 + |\beta|^2 = 1$. For example, in the case of polarization, if the superposition state is measured based on the orthonormal bases $\{|0\rangle, |1\rangle\}$, the probability of measuring $|0\rangle$ is $|\alpha|^2$ and the probability of measuring $|1\rangle$ is $|\beta|^2$.

If the bit is manipulated using logic gate, the superposition state can also be manipulated by using quantum logic gate. The quantum register contains n qubits that can exist in 2^n different superposition conditions at one time. It shows the ability of a quantum computer, which can perform simultaneously for all qubit conditions that cannot be performed on the current computer. This feature is called quantum parallelism, which is one of the advantages of quantum computers.

Figure 2 [8] illustrates a vector that shows the direction of the value between 0 and 1, which is known as superposition.

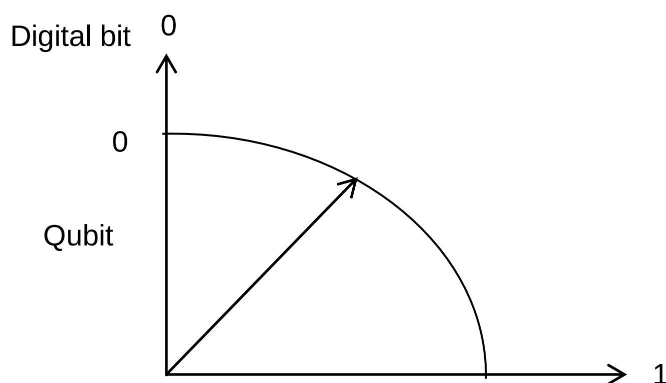

Figure 2. Superposition state

Table 1 summarizes the differences between the current computer and the quantum computer in some of the major parts related to the computing and communication mechanisms [8].

Table 1. The different between current computer and quantum computer

CURRENT COMPUTER	ITEMS	QUANTUM COMPUTER
Bit: 0 or 1	**DATA REPRESENTATION**	Qubit: 0, 1 and superposition
1 in one time	**NUMBER OF SIMULTANEOUS CALCULATION**	More than 1 in one time
Bit movement in logic gate	**CALCULATION METHOD**	Change of atom state
Data can be copied without interruption	**DATA TRANSMISSION**	Data cannot be copied or read even without interruption
One direction	**DATA NATURE**	Many direction simultaneously like

		overlapping of waves
Low: Communication channel easily can be interrupt.	**SAFETY**	High: Noisy in communication channel can be detect easily

Entanglement

Entanglement or quantum correlation is the immediate relationship between two or more particles without considering the distance between them [27]. Since the 1990s, a lot of researches have been ongoing since the current computer does not have this feature, including qubit and superposition [21]. Entanglement makes the quantum computer more powerful because the transmission of information can be done simultaneously. Measuring the condition of one of the qubits of an entangled pair of qubit will immediately determine the condition of the other qubits. For example, Figure 3 shows a pair of entangled photons separated at a long distances. Photon A represents the upper spin, while photon B is entangled with photon A, representing the lower spin automatically [30].

Figure 3. Entangled photons separated at long distances

The latest study involving entanglement in the journal "The Optical Society's (OSA)" [27] describes a microscopic study that can match the large-scale optoelectronic components by using photons that are entangled with one another. Spanish scientists have acknowledged the advantages of quantum computer production using faster processing. They have successfully acquired 103 dimensions through two entangled particles [28]. Physicists from the Massachusetts Institute of Technology (MIT), Cambridge and the University of Belgrade have also developed new techniques that allow 3,000 atoms to be entangled using a very weak single photon [9].

Systems that use the concept of entanglement can be divided into two types, namely two qubit systems and multiqubit system. The difference between the two qubit entangled and the multiqubit entangled is quite large in terms of the determination of the degree of entanglement and classification of entanglement classes. This is because multiqubit system structure is more complicated and some problems could occur [2].

Limitations of the Quantum Computer

The qubit used to represent the data is able to store data in large quantities at a time. For example, 100 qubits can store 1,267,650,600,228,229,401,496,703,205,375 different numbers. This amount is a trillion times more storage capacity than the current computer. This shows how powerful quantum computers are able to process information faster than the current computers. However, in an experiment, creating that much data is harder [11,23]. Even though the process of making quantum computers can be said to be well-established, the manufacturing of qubits in quantum computers is much harder than the existing bits. Accordingly, no one is able to prove the best way to build a quantum computer.

To date, several techniques have been implemented, such as ion, electron, or other particles being trapped, using superconductors to create microscopic quantum circuits, and the use of complex photons and optical equipment. All these techniques have been successful, but on a small scale as they are difficult to realize on a larger scale. This is because the existence of decoherence would be trying to be eliminated during the process. Hence, quantum systems that want to be built should be without external interference because it can turn a quantum computer quantum into current computer [11,13]. Additionally, quantum computers use the principles in quantum mechanics to retrieve information and this is impossible to build on current computer. Computational problem solving for certain problems, such as integer factorization, can be done faster than the current computer, but previous analysis has concluded that quantum computers can only solve minimal problems [1].

VI. CONCLUSION

Quantum computers are able to solve problems that current computers cannot because of the special features that exist in them. However, to build quantum computers is more challenging when trying to be applied in the real world. It would require more experimental studies to be done to make sure that the quantum computers can be used in real the world the same way as the current computers.

VII. ACKNOWLEDGEMENTS

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TURKEY'S INTERESTS IN SOMALIA

Abdirazak Dayib Shiekh

ABSTRACT:

This study examines Turkey's policies in Somalia, and it's guided by the conceptual framework composed of national interest and analysis of foreign policy. The research employs qualitative methods of data collection, and it collects data mainly from official documents and speeches of political leaders. This study finds that Turkey has historical relations with Somalia and has significant interests in the country. Turkey's Justice and Development Party(AKP) government has paid great attention to its increasing political, economic, and social ties with Somalia. Growing diplomatic relations between Turkey and Somalia pave the way for increasing their economic and trade relationship. Turkey has been developing its economic and trade ties with Somalia by diversifying its foreign policy.

The study also finds that Ankara, the former capital city of Turkey, implemented a policy to strengthen its geostrategic position in Somalia. Furthermore, Somalia required Turkey's assistance as well. Hence, Turkey has been launching developmental projects across the country in areas such as education, health, transportation, agriculture, infrastructure, and security sectors, contributing to the rebuilding process of Somalia. Turkey helped Somalia's stabilisation and reconciliation efforts by providing necessary aid. In this context, the Turkish government played a mediation role and hosted reconciliation talks between the Somali government and Somaliland. This study suggests that it would be in the best interest of Turkey to continue assisting Somalia. In exchange, the Somali state will be able to help Turkey in the pursuit of its interests. Therefore, Turkey should assist in the resolution of the Somali conflict and the state- building process.

KEYWORDS:

Turkey, Somalia, national interest, economic ties.

Introduction

The Republic of Turkey is an economically and politically rising regional power. Its influence in the Middle East, the Balkans, Central Asia, and the African continent is growing. In addition, it is interesting to observe that, despite there being no colonial history with African nations, Turkey-Africa relations can be traced back to the Ottoman period. Turkish-Somali relations can be dated back to the 16th century when the Ottomans aided the Somalis in fighting against the expeditionary forces of the Portuguese. As a result, Somalia initiated its diplomatic mission in Ankara in 1976, while Turkey began its first diplomatic mission in Mogadishu in

1979. Turkey's relations in Somalia served the country until the Somalian Civil War began in 1991.

Turkey has become actively engaged in Africa since the rise of the Justice and Development Party (AK Party) to power. It introduced the policy of the "African initiative", which focuses on humanitarian, economic, and security assistance to Somalia. Moreover, Turkish interest has focused on contributing to political and financial stability in Somalia within the framework of the Strategic Development of Economic Relations with Africa.

Turkey intends to expand its influence on the continent not only in terms of trade volume but also in terms of humanitarian aid projects. In 2011, then-Turkish Prime Minister Mr Erdogan (now the president), some ministers, and several affiliates of Turkey's cultural and commercial elite visited Somalia. Their visit provided moral support to Somalis who were experiencing food scarcity. In addition, Mr Erdogan became the first leader who went to Somalia in the last two decades. In 2011, Turkey became the first nation among the European and Asian countries to assign an emissary to Somalia after the collapse of the central government in 1991. Thus, this study examines Turkey's interests in Somalia. It tries to answer the following questions: -

1. Why does Turkey want to stabilise the Somali state?
2. How Turkey world’s humanitarian, economic, and security relations with Somalia help achieve its interests?
3. What is the outlook of the Somali elites on the interest of Turkey in Somalia?

Conceptual Framework

This study investigates Turkey's role in Somalia. The conceptual framework guiding this study is based on the role of national interest, with reference to Turkey's role in Somalia.

National Interests

National interests are a significant concept in international relations. All states are constantly involved in the process of fulfilling or establishing their objectives in the national interest. Every state aims to advance and broaden its national interests. According to Van Dyke, national interest is one that states hope to secure or accomplish in collaboration with other nations. Therefore, national interests are divided into three categories: core interests, middle-range interests, and long-range interests.

Core Interests

Core interests are those that must be accomplished at all times. These include independence, national security, regional integrity, and the welfare of the people. The principle of protecting Turkey's autonomy and regional integrity within its constituted borders, as well as anticipating strength and battle in relation to its interests against external threats, are critical values that should be part of Turkey's national interest. Therefore, the nation's foreign policy should always be focused on defending its core interests.

Middle-Range Interests

Middle-range interests, such as economic growth and social development, are less urgent and require collaboration from states. The financial circumstances of a nation decide the status of its global field. Turkey implemented "the Strategic Development of Economic Relations with Somalia", which became a strategic policy for the continent.

Long-Range Interests

Long-range interests are the slightest prompt. They relate to the state's long-term interests and are the subject of very deliberate alteration. Leaders have sufficient time to determine their progress and accomplish these goals.

Argument

The Somali state collapsed in the 1990s. Many attempts have been made to revive it, but they all failed. The question is whether Turkey will be able to stabilise and revitalise Somalia. This study argues that Turkey, like any other state, seeks to pursue its interests, and a more potent, more stable, and inclusive Somali state will help Turkey achieve its objectives. Furthermore, this study assumes that Turkey is interested in transforming Somalia into an inclusive and sound condition.

Methodology Research design

This research is qualitative. It gathers non-numerical data and aims to interpret meaning from these data so that the researcher can better understand social life by studying target populations or places. It is used to improve an understanding of fundamental reasons, ideas, and motivations.

Data Collection

In order to examine Turkey's interests in Somalia, the data for this study will be collected from primary and secondary sources.

Primary sources such as official documents, agreements signed between the two countries, commentaries, and official speeches were gathered, studied, and analysed.

On the other hand, secondary sources included books, journal articles, newspaper reports, articles published by various international agencies, correspondence, photographs, and diaries from the internet.

It is expected that the multitude of sources of information will provide a complete understanding of the subject matter and will be of great support in delivering significant results in this study.

Data Analysis

The paper adopts an interpretive analysis approach. Interpretive researchers view social reality as part of social settings in which they interpret reality through a sense-making process rather than a hypothesis-testing process. An interpretive analysis is a technique for making inferences through systematic analysis of written documents or recordings of verbal messages.

Turkey's Interests in Somalia

Turkey's interests in Somalia are political, economic, and military. However, before discussing Turkey's interests, diplomacy and political interests will be considered first.

Dipomacy and Political Interests

he first official contact between Turkey and Somalia occurred on the 29th and 30th of January 2007, when the former Turkish Prime Minister, Mr Erdogan, attended the African Union (AU) Summit in Addis Ababa. At the summit, Mr Erdogan met with Somali President Abdullah Yusuf Ahmed and requested that he submit a proposal to Ankara addressing Somalia's issues and needs. Hence, the former Transitional Federal Government (TFG), President Sharif Sheikh Ahmed, made three visits to Turkey before Mr Erdogan paid his first official visit to Somalia in August 2011. However, the first Turkey-Somalia conference was held in Istanbul from 21st to 23rd May 2010, and the Istanbul Declaration was adopted at the conference. The UN General-Secretary and high-level representatives of international organisations took part in this conference.

It is important to note that Turkey appointed Mr Cemalettin Kani Torun as the Turkish ambassador in Somalia. Mr Erdogan highlighted that the primary purpose of Turkey's involvement in Somalia included: (1) strengthening historical relations, (2) alleviating the humanitarian crisis, (3) rebuilding the country, (4) restoring peace and security in the country, (5) attracting the attention of the most significant drought in the world, and (6) contributing to peace and security in the region. President Erdogan emphasised that "regardless of which culture we come from or where we live, I am confident that our common heritage as human beings will motivate us to ease the suffering of Somalia". On May 26, 2012, Turkey organised a Somali Civil Society Groups meeting in Istanbul, and more than 300 representatives from Somalia attended this meeting. The representatives discussed existing problems surrounding Somalia and its future. The Second Turkey-Somalia conference was held in Istanbul from 31st May to June 2012 under the theme "Preparing Somalia's Future: Goals for 2015

President Erdogan opened the largest and most advanced Turkish embassy in Africa on June 3, 2016, in Mogadishu, the capital city of Somalia. In December 2018, the Istanbul conference explored Turkey-Somalia and East Africa partnerships as the theme of the "East Africa Development Forum." An annual conference in Istanbul aims to push for groundwork for high-level collaboration on future Somali-Turkish ties by pursuing non- African outlooks in an effort to clarify misunderstandings and add new perspectives on the new Turkish strategy towards East Africa. The core of Turkey's diplomatic efforts in Somalia is to stabilise the war-ridden country. Hence, Turkey's strategy for stabilising Somalia is due to its geostrategic significance in Turkey's foreign policy, which will be discussed in the following section.

5.2 Geostrategic Interests

Turkey aimed to broaden its influence and strengthen bilateral relations with Somalia and other African countries. Turkey stated this as a win-win situation and that Somalia is a component of this policy. Besides, Somalia has the longest coastline in the Indian Ocean, a significant sea route through which more than 20,000 ships pass yearly. Somalia has some resources that would make it a promising partner in the long term. It strategically sits on the Gulf of Aden, just at the entrance of the Red Sea and the Suez Canal, a pivotal global shipping lane connecting the Mediterranean Sea to the Indian Ocean, as indicated in figure 5.

This sea route is crucial to the world economy, accounting for 20% of global yearly exports as of 2012. Turkey recognised Somalia's strategic location along some of the world's major shipping lanes and saw opportunities to build seaports and other transportation infrastructure. Furthermore, Turkey's experience with Somalia will significantly impact its broader African agenda. It was argued that Turkey's interests in Somalia recognised Turkey as a "political" role in Africa and expanded its policy into a more complex and multifaceted one. It also assumes that Turkish engagements in Somalia have been effective, contributing to both Somalia's recovery and Turkey's status as an emerging global player.

ROLE OF HEALTH INFRASTRUCTURE IN CONTAINING THE PANDEMIC – DECODING THE STIGMA

Atul Gupta
Rupali Sanskar

INTRODUCTION

Coronavirus Disease 2019 (COVID – 19) is an infectious disease originated in the Wet market of Wuhan, Hubei, China in November 2019, thereby earning this name on 11th February 2020. From that day onwards this disease has proliferated throughout the world and it was declared Pandemic by WHO on 11th March 2020. Every country in the world, no matter developed or underdeveloped, is using every possible way to contain this pandemic which has taken above 7 lakh lives around the world. (Till 7th August, 2020; Source: WHO).

With the rising fatality rate in the countries, a perception formed in everyone's mind that fatality rate is indirectly proportional to health infrastructure in the country. Does this perception hold truth? Invigorated by this question, we decided to research the health infrastructure of meticulously selected 12 nations; their health infrastructure and fatality rate and tried to find a correlation between health infrastructure and the Corona fatality rate which could prove the role of health infrastructure in containing the pandemic. This paper provides you a thorough journey of research methods we used and conclusion. But first, we need to understand what health infrastructure is and what it includes.

Health Infrastructure

Public health infrastructure provides communities, states, and the Nation the capacity to prevent disease, promote health, and prepare for and respond to both acute (emergency) threats and chronic (ongoing) challenges to health. Infrastructure is the foundation for planning, delivering, evaluating, and improving public health. Health infrastructure includes all health-related infrastructure that a country possesses (HealthyPeople.gov). Be it advance machines, number of physicians, number of nurses, number of beds, expenditure on health or other such paraphernalia. An advanced health infrastructure provides the country an edge over countries with less advanced infrastructure in preventing diseases, better standard of living and low mortality rate. Health infrastructure lays the foundation of planning and strategizing to face any kind of health situation in the country.

In order to keep the health infrastructure relevant to our study, we decided to take on the factors that affect the situation of pandemic in our country i.e. no. of beds (per 1000 person), no. of physician (per 1000 person), no. of nurses (per 1000 person), Density (P/Km2) and tests (per 1000 person).

Next, we will have a look at the objective of our research.

Objective

This study aims at articulating the role of health infrastructure in containing the pandemic by drawing out a comparison between countries on the basis of their Health infrastructure, mainly comprising of Hospital beds (per 1000), Current Expenditure on Health, Nurses (Per 1000), Physicians (Per 1000), Density (P/KM^2) and Tests (Per 1000); all these are the factors that affect rate of recovery of patients, rate of Infection etc. This comparison allows us to identify the countries that lagged behind despite having the best resources and countries with poor resources who managed to keep the situation in check.

Criteria for Choosing the Countries

This research paper looks at the trajectory of the effects that COVID-19 has had on different countries with different parameters of health services. By gauging the level and quality of healthcare departments of countries, the paper draws and detects the correlation between the health infrastructure of a country in terms of COVID-19 and its effect. The countries have been chosen consciously; keeping in mind the necessity to cover a large range. Thus, spanning from developed superpowers to countries which are still developing, the paper has manifested all possibilities in a nutshell. Moreover, countries which are/were worst affected by the virus have been given place to further enlarge the prospects of the paper. In terms of hospital beds, emerging European countries like Germany, Spain, France, and Italy have been taken into consideration, some of which were badly affected by the COVID-19 in economic and social terms. Australia, an island country, has also been added for greater representation. Not forgetting the hegemonic power of the US and competing nation Russia, the paper includes developed countries on one and stifled countries on the other. For instance, terror-stricken Iran.

Asian countries like Singapore and India have been included as these are one of the worst affected countries. India being the growing economy as it is, its place marks an important role. A close observation portrays how less India spends on its health sector compared to how large its population is. It was also important to keep in the list, a geographically large country like Canada. Our erstwhile colonizer, the United Kingdom gets a spot too, for the rapid rise in their number of cases caught international attention.

Research Methodology

The requirements of this research recommend a promising methodology to fulfill its objective: identifying key components and countries to explore, pinning down data requirements, collection of data, maneuvering it as per the need and probing into the output yielded.

The data for the research purpose has been collected from the official sites of WHO, World Bank, OECD and many other sources which collect their data from the countries themselves, hence secondary data has been used extensively.

Six major factors have been chosen for study and relevant data has been collected, these are as follows:

1. Number of hospital beds (per 1000).
2. Number of physicians (per 1000).
3. Number of nurses and midwives (per 1000).
4. Population density (per square km).
5. Current expenditure on health as percentage of GDP.
6. Number of tests for corona, as on August 4, 2020.

The official sites and online articles publish the latest data of 2018 for the 1st five factors, therefore in order to compare the data with the cases in 2020; the data for 2020 has been extrapolated using LINEAR REGRESSION (In statistics, linear regression is a linear approach to model the relationship between a scalar and one or more explanatory variables; we have used Microsoft excel as a tool to model the relationship between year and data for the factors) . The data for the number of tests was available and hence no further extrapolations were done to it.

In order to calculate the case fatality rates, the number of deaths due to the virus has been divided by the total number of cases.

Following tables; Table 1 shows the data for each parameter for each country for year 2020 along with a benchmark standard for each parameter and Table 2 presents us the fatality rate for each country.

Further, countries have been allotted scores taking WHO standards as the benchmark. More details are presented in the SCORING section. Using the derived scores and case fatality rate, a matrix has prepared, and all the 12 countries have been classified into different categories for comparison.

Scoring

For the purpose of allotting scores to the countries for each factor, the collected data has been sorted country-wise and factor-wise.

Benchmarking was found to be the most suitable technique to allot the marks to the countries. In this technique, a benchmark is set as standard and then something else is evaluated against that standard. We further have allotted scores to the standard and a country's score is proportionate to the difference in the standard and data for that country for that particular parameter. For ex- Standard set is 5 for a particular parameter and score allotted at this standard is 5. The country X's data for this particular parameter is 8, so the score for that parameter for country X will be (8*5)/5 = 8 (Formula is explained in the following paragraph).

The WHO standards for each factor taken have been set as benchmark, and in case of Current expenditure and Number of tests, where the standard was not available; the median of the data of all countries has been taken as benchmark.

The score at the benchmark has been set equal to 5 and maximum score has been set equal to 10 and the following formula has been used to calculate score:

(Extrapolated data (2020) × Score at the benchmark) / Benchmark

In order to calculate the scores for population density, it has been taken into consideration that unlike other factors, the lesser the numerical value for population density, the better the score will be. Hence, the following formula has been used:

10 - (Extrapolated data (2020) × Score at the benchmark) / Benchmark

The scores of all factors have been added for each country on the assumption that all factors have equal weightage and hence, a composite score has been obtained.

Table 3 shows calculated individual score according to the formulas written above and total score for every country.

KEPATUHAN MINUM OBAT HIPERTENSI PADA LANSIA MELALUI EDUKASI PEER SUPPORT DI WILAYAH KERJA PUSKESMAS WOLOMARANG KABUPATEN SIKKA

Agustina Sisilia Wati Dua Wida

PENDAHULUAN

Hipertensi merupakan penyakit tidak menular serta sering disebut sebagai silent deseas karena penderita tidak mengetahui bahwa tekanan darahnya sudah melebihi batas normal (Kemenkes, 2013). Hipertensi merupakan penyakit multifaktorial yang munculnya oleh karena interaksi berbagai faktor. Dengan bertambahnya umur, maka tekanan darah juga akan meningkat. Setelah umur 45 tahun, dinding arteri akan mengalami penebalan oleh karena adanya penumpukan zat kolagen pada lapisan otot, sehingga pembuluh darah akan berangsur-angsur menyempit dan menjadi kaku. Tekanan darah sistolik meningkat karena kelenturan pembuluh darah besar yang berkurang pada penambahan umur sampai dekade ketujuh sedangkan tekanan darah diastolik meningkat sampai dekade kelima dan keenam kemudian menetap atau cenderung menurun. Peningkatan umur akan menyebabkan beberapa perubahan fisiologis, pada usia lanjut terjadi peningkatan resistensi perifer dan aktivitas simpatik. Pengaturan tekanan darah yaitu reflex baroreseptor pada usia lanjut sensitivitasnya sudah berkurang, sedangkan peran ginjal juga sudah berkurang dimana aliran darah ginjal dan laju filtrasi glomerulus menurun (Black, 2014)

Secara global menurut data WHO, sekitar 972 juta orang atau 26,4% orang di seluruh dunia mengidap hipertensi, angka ini kemungkinan akan meningkat menjadi 29,2% di tahun 2025. sebanyak 972 juta pengidap hipertensi, 333 juta berada di negara maju dan 639 sisanya berada di negara berkembang, termasuk Indonesia (Yonata, 2016). Berdasarkan Global Status Report on Noncommunicable Disease tahun 2010 dari WHO menunjukkan bahwa sebesar 40% negara berkembang mengalami hipertensi. Afrika merupakan kawasan dengan penderita hipertensi paling tinggi dengan persentase sebanyak 46%, kemudian Asia Tenggara dengan persentase sebanyak 36% dan kawasan Amerika dengan persentase kejadian hipertensi sebanyak 35% kemudian berdasarkan Riskesdas tahun 2018 di Indonesia penyakit hipertensi tertinggi di Yogyakarta dengan prevalensi sebanyak (12,04%) dan terendah di Papua dengan jumlah (22,2%) dan prevalensi di Provinsi Nusa Tenggara Timur adalah 1.582 kasus, terdapat tiga kabupaten/kota dengan prevalensi tertinggi kasus hipertensi yakni Kabupaten Sikka (11,4%) sekitar 180.348 orang, Ende (11,1%) sekitar 175,602 orang dan Ngada (11,1%) sekitar 175,602 orang. Data yang di peroleh dari Dinas Kesehatan Kabupaten Sikka bahwa dua tahun terakhir ini yakni pada tahun 2019 dan 2020 penyakit hipertensi tertinggi terdapat di wilayah kerja Puskesmas Wolomarang dengan prevalensi 1.013 pada tahun 2019 dan meningkat menjadi 1.025 penderita hipertensi di tahun 2020 dan paling banyak terdapat pada usia lanjut atau lansia yakni pada tahun 2019 sebanyak 412 orang lansia meningkat menjadi 454 orang lansia di tahun 2020.

Berdasarkan hasil wawancara peneliti dengan perawat pengelola penyakit tidak menukar di Puskesmas Wolomarang bahwa jumlah hipertensi tertinggi untuk tahun 2022 dari bulan Januari sampai dengan bulan April terdapat di Kelurahan Wuring yakni sebanyak 20 orang lansia dengan usia 60 – 69 tahun. Tercatat hampir setiap tahun ada satu sampai dua orang yang meninggal dunia dikarenakan menderita penyakit hipertensi. Meningkatnya jumlah hipertensi pada lansia disebabkan karena kurang mendapat perhatian dari keluarga untuk mengingatkan jadwal posyandu, jadwal minum obat, dan kurang aktifnya keluarga mengantar lansia ke posyandu lansia guna mengontrol tekanan darah dan mendapat pengobatan selain itu lansia tidak menjalankan diet dengan benar, meskipun telah dilakukan berbagai upaya dan pendekatan yang ada di Puskesmas Wolomarang seperti posyandu lansia, senam lansia, edukasi, dan kunjungan rumah untuk pasien hipertensi namun belum cukup untuk mengurangi dan mengatasi jumlah peningkatan penderita hipertensi pada lansia.

Usia, gaya hidup, mengkonsumsi alkohol, aktivitas, serta nutrisi yang dikonsumsi tinggi akan natrium dan kalium serta ketidakpatuhan minum obat antihipertensi merupakan faktor – faktor penyebeb terjadinya penyakit hipertensi (Yulanda & Lisiswanti, 2017). Hipertensi yang tidak terkontrol akan menimbulkan berbagai komplikasi, bila mengenai jantung kemungkinan dapat terjadi infark miokard, jantung koroner, gagal jantung kongestif, bila mengenai otak terjadi stroke, ensevalopati hipertensif, dan bila mengenai ginjal terjadi gagal ginjal kronis, sedangkan bila mengenai mata akan terjadi retinopati hipertensif. Dari berbagai komplikasi yang mungkin timbul merupakan penyakit yang sangat serius dan berdampak terhadap psikologis penderita karena kualitas hidupnya rendah terutama pada kasus stroke, gagal ginjal, dan gagal jantung. Tekanan darah pada penderita hipertensi harus dikontrol agar tidak mengakibatkan komplikasi hipertensi yang mengancam nyawa salah satunya dengan rutin atau patuh mengkonsumsi obat hipertensi (Nuraini, 2015).

Kepatuhan dalam pengobatan (medication compliance) adalah mengkonsumsi obat hipertensi yang diresepkan dokter dengan dosis yang tepat dalam pengobatan dan akan efektif apabila mematuhi ketentuan dalam meminum obat. Kepatuhan minum obat dipengaruhi oleh faktor demografi, faktor pasien, faktor terapi dan hubungan pasien dengan tenaga kesehatan. Salah satu indikator dari kepatuhan pasien minum obat anti hipertensi adalah pengendalian tekanan darah (Dewanti et all, 2015). Menurut Hazwan et all (2017) tingkat pengetahuan dan tingkat pendidikan juga dapat mempengaruhi kepatuhan minum obat pasien hipertensi. Obat-obat hipertensi dapat mengontrol tekanan darah, dan juga sangat berperan dalam menurunkan risiko komplikasi kardiovaskular, namun penggunaan obat hipertensi saja terbukti tidak cukup untuk mengatasi tekanan darah jangka panjang sehingga salah satu intervensi yang akan dilakukan yaitu dengan memberikan intervensi Edukasi Peer Support

(Saepudin, 2011). Masalah ketidakpatuhan minum obat umumnya dijumpai dalam pengobatan penyakit kronis yang memerlukan pengobatan jangka panjang seperti hipertensi. Kepatuhan minum obat pasien dengan hipertensi merupakan hal penting karena hipertensi merupakan penyakit yang tidak dapat disembuhkan tetapi harus selalu dikontrol atau dikendalikan agar tidak terjadi komplikasi yang dapat berujung pada kematian (Palmer & William, 2007).

Peer Support merupakan dukungan yang melibatkan ekspresi, rasa empati, perhatian, peduli, penghargaan positif dan dorongan terhadap sesama lansia sehingga dapat membuat seseorang merasa lebih baik dan memperoleh kembali keyakinan pada saat stress (Sarafino & Hensarlin, dalam Yusra 2011). Melalui penghargaan positif dan dukungan yang dirasakan, seseorang akan merasa lebih tenang (Santrock 2005). Dengan adanya dukungan sosial yang baik maka lansia akan memiliki kemampuan untuk melakukan tindakan-tindakan untuk mengatasi segala permasalahan yang dihadapinya salah satunya yakni patuh mengkonsumsi obat hipertensi.

Berdasarkan latar belakang tersebut diatas maka peneliti memilih untuk memberikan edukasi peer support sebagai salah satu bentuk intervensi keperawatan agar melalui peer support lansia menjadi lebih patuh mengkonsumsi obat hipertensi untuk mencegah dampak dan resiko terjadinya komplikasi sehingga peneliti merasa tertarik untuk meneliti Kepatuhan Minum Obat Hipertensi pada Lansia melalui Edukasi Peer Support membuktikan apakah terdapat pengaruh intervensi edukasi Peer Support wilayah kerja Puskesmas Wolomarang

METODE

Jenis penelitian merupakan suatu strategi untuk mencapai tujuan yang telah ditetapkan dan berperan sebagai pedoman atau penentuan penelitian pada seluruh proses penelitian. Penelitian ini bersifat pengaruh (causal) untuk menguji pengaruh variabel independent terhadap variabel dependent (Nursalam, 2013). Jenis penelitian causal yang dipilih adalah quasy experiment atau pra eksperimen yang dilaksanakan pada satu kelompok saja tanpa ada kelompok perbandingan atau kelompok kontrol.

Desain penelitian adalah keseluruhan dari perencanaan untuk menjawab pertanyaan ilmiah penelitian dan mengantisipasi beberapa kesulitan yang mungkin terjadi selama proses penelitian (Saifuddin,2016). Penelitian ini menggunakan desain atau rancangan one grup pre-post test design yang diukur dengan menggunakan pre test dan dilakukan sebelum diberikan perlakuan, selanjutnya perlakuan diberikan dalam bentuk intervensi edukasi Peer Support. Sampel pada penelitian ini adalah 20 lansia hipertensi dengan teknik sampling non probability sampling berupa accidental sampling dengan ketentuan berdasarkan kriteria inklusi yaitu lansia berusia 60-69 tahun yang menderita hipertensi di Puskesmas Wolomarang, lansia hipertensi yang tinggal serumah dengan keluarganya dan bersedia menjadi responden.

HASIL & PEMBAHASAN

Hasil

Karakteristik respoden berdasarkan kepatuhan minum obat hipertensi pada lansia di wilayah kerja Puskesmas Wolomarang sebelum diberikan edukasi peer support dapat dijelaskan sebagai berikut: