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Systems thinking for Aboriginal Health: Understanding the value and acceptability of group model building approaches

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ABSTRACT

Systems thinking is increasingly applied to understand and address systemic drivers of complex health problems. In Australia, group model building, a participatory method from systems science, has been applied in various locations to engage communities in systems-based health promotion projects. To date there is limited evidence regarding GMB use with Australian Aboriginal communities. This study aimed to determine the value and acceptability of group model building (GMB) as a methodological approach in research with Aboriginal communities and identify any adaptations required to optimise its utility. Semi-structured interviews were undertaken with 18 Aboriginal health and university staff who had prior experience with a GMB research project. Interview transcripts were inductively analysed using thematic analysis and key themes were organised using an Indigenous research framework. Participants reported that GMB methods generally aligned well with Aboriginal ways of knowing, being, and doing. Participants valued the holistic, visual and collaborative nature of the method and its emphasis on sharing stories and collective decision-making. Group model building was viewed as a useful tool for identifying Aboriginal-led actions to address priority issues and advancing self-determination. Our findings suggest that by bringing together Aboriginal and non-Aboriginal knowledge, GMB is a promising tool, which Aboriginal communities could utilise to explore and address complex problems in a manner that is consistent with their worldviews. In adapting group model building methods, non-Aboriginal researchers should aspire to move beyond co-design processes and enable Aboriginal health research to be entirely led by Aboriginal people.

1. Introduction

Systems science and *systems thinking* approaches are increasingly being applied to tackle complex problems. A complex problem is characterised by non-linear cause and effect relationships that interact over varying periods of time and space, whose interactions through feedback yield counterintuitive and hard to predict responses over time (Hovmand, 2014). Complex problems cannot be reduced to simple linear models, such as 'a causes b'. Rather, they arise from the dynamic interaction of circular relationships, or feedback loops, between variables within a system (Hovmand, 2014). Although systems approaches are used across multiple disciplines, they are gaining popularity in public health research and practice as a lens for understanding and addressing complex health issues (Friel et al., 2017). There are a growing number of systems-oriented public health initiatives including obesity (Allender et al., 2015; Finegood et al., 2010; Hammond, 2009), chronic disease (Jones et al., 2006; Loyo et al., 2013; Milstein et al., 2007), tobacco control (Cavana & Tobias, 2008; Levy et al., 2002; Tobias et al., 2010), mental health (Moustaid et al., 2019; Smith et al., 2015), alcohol (McKelvie et al., 2011) and other drugs (Chalmers et al.,

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2009; Hoffer et al., 2009). There are multiple definitions and approaches to applying a 'systems approach' in public health, though it usually involves looking at the 'big picture' to study the effects produced by the interactions between the multiple variables within a complex system (Meadows, 2008). Systems science is particularly interested in how system structure and behaviour adapts and changes over time, including in response to external stimuli such as public health interventions (Luke & Stamatakis, 2012).

Within systems science, community based system dynamics is a participatory approach where decisionmakers, researchers, or external facilitators partner with communities in the process of understanding and finding solutions to complex problems. System dynamics started out as an application of electrical engineering principles to complex business problems (Forrester, 1997). Participatory input into modelling was a principle in system dynamics from its inception (Forrester, 1997), but over time, practices related to participatory modelling within system dynamics came to be called group model building, a technique larging developed in business, but with input from other fields (Vennix, 2001). In the last decade, system dynamics and group model building have been adapted further for use in partnership with communities, in an approach called community based system dynamics (CBSD) (Hovmand, 2014), which incorporates concepts from social work and related fields of community capacity building, social change, and community development into system dynamics and group model building practice. CBSD is differentiated from previous iterations of participatory system dynamics in particular by its extensive focus on community definition of the complex problem to address and an intent to build community capacity over time to apply system dynamics independently of external researchers and consultants (Király & Miskolczi, 2019). By working with communities to capture and understand the dynamic feedback structures underpinning complex problems, community based system dynamics can be used to design interventions that address the complexity of priority issues through system change (Hovmand, 2014).

GMB is used extensively in community based system dynamics to document, understand and find new ways to intervene in complex systems (Vennix, 2001). It is a participatory method which engages key members within a community to create a shared understanding of a problem and collaboratively devise courses of action (Vennix, 2001). Using facilitated discussion and visual representation of community members' shared mental model of a priority problem, GMB enables consensus building and commitment regarding agreed action (Scott, 2018). GMB workshops typically include a range of facilitated group exercises to elicit the variables linked to the problem; how these have changed over time; and the relationships between these variables (Allender et al., 2015; Hovmand et al., 2012). This information is used to develop a causal loop diagram, which provides a visual model of the group's shared understanding of the causal relationships underpinning the problem within the system (Hovmand, 2014). The causal loop diagram may be reviewed, refined and broken into themes in subsequent workshops and, ultimately, used to formulate and track actions to achieve system change (Stroh, 2015).

In south-eastern Australia, GMB projects have been implemented across various locations to enable community stakeholders to collectively consider the drivers of childhood obesity and prioritise obesity prevention interventions (Allender et al., 2015, 2019; Maitland et al., 2021; Owen et al., 2018; Wardle et al., 2020; Whelan et al., 2020). While GMB has been demonstrated to be an effective approach for engaging communities in systems-based health promotion in rural and regional Australia (Jenkins et al., 2020), there are only a handful of published examples of these methods being used with Indigenous communities worldwide; set in Aotearoa/New Zealand and Canada (Gerritsen et al., 2019; Heke et al., 2019; LaVallee et al., 2016). As such, there is limited evidence regarding the relevance, acceptability and most effective use of systems science methods, including GMB, among Aboriginal communities in Australia.

Aboriginal and Torres Strait Islander peoples are the original inhabitants of the lands now known as Australia. Aboriginal people, the First Peoples of mainland Australia and the State of Tasmania, comprise a diversity of nations, language groups, cultures, and knowledge systems and represent the longest continuous civilisation on Earth (Rasmussen et al., 2011). As such, Aboriginal people have an abundance of wisdom, from which all Australians can benefit. While "systems science" is relatively new in the Western world, elements of systems thinking have been strongly present in Aboriginal communities for thousands of years. For example, many Aboriginal people have a holistic view of health, broadly defined as "not just the physical well-being of an individual but refers to the social, emotional and cultural well-being of the whole Community". (National Aboriginal Health Strategy Working Party, 1989).

When Australia was colonised by the British, many Aboriginal people were forced off their traditional homelands, killed by colonisers or introduced diseases, and separated from their families and kinship systems through policies of forced assimilation (Dudgeon et al., 2010, pp. 25–42). Today, Aboriginal and Torres Strait Islander peoples experience persistent health inequities as a result of the enduring impact of colonisation, oppression, and ongoing interpersonal and institutional racism (Sherwood, 2013). These inequities are intensified by inadequate access to healthy food, housing, employment opportunities and appropriate preventative health services (Carson et al., 2007).

It is increasingly recognised that Aboriginal cultural knowledge should be incorporated into policies and strategies designed to improve health outcomes for Aboriginal communities (Parter et al., 2019). The United Nations Declaration on the Rights of Indigenous Peoples (Article 18) states that "Indigenous peoples have the right to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedures" (United Nations, 2007). However, Australian Indigenous affairs policy has been criticised for being government-driven, based on deficit discourse, and imposed on, rather than co-designed with, Aboriginal organisations and communities (Askew et al., 2020; Coalition of Aboriginal and Torres Strait Islander Peak Organisations, 2019; The Centre of Research Excellence in Aboriginal chronic disease knowledge Translation and Exchange, 2020). Aboriginal leaders have long advocated for greater self-determination and amplification of Aboriginal voices in policy decision making (Coalition of Aboriginal and Torres Strait Islander Peak Organisations, 2019; Referendum Council, 2017).

Community based system dynamics approaches, such as GMB, may offer an opportunity to address this gap and in so doing advance Aboriginal peoples' empowerment and participation in the design of strategies to address priority health issues. It has been proposed that community-based participatory research and systems science methods can be integrated to address racial and socioeconomic health inequities (Frerichs et al., 2016; Friel et al., 2017). Furthermore, evidence from overseas suggests that, when implemented from an Indigenous perspective, GMB aligns well with Indigenous worldviews and holistic conceptions of health (Heke et al., 2019; LaVallee, 2014). Given the history of colonisation and subjugation of Aboriginal knowledge in Australian policy and research, the appropriateness of GMB for use with Aboriginal communities in Australia should not be assumed. Therefore, this study aimed to determine the value and acceptability of GMB as a methodological approach in research with Aboriginal communities and identify any adaptations required to optimise its utility.

2. Theory

Data collection and analysis were informed by Miller's theoretical framework for Indigenous and Indigenist research (Martin, 2003). This has previously been demonstrated as a useful framework for understanding Aboriginal staff perspectives about health promotion and research approaches (Askew et al., 2020). Miller's framework consists of three interrelated constructs grounded in Indigenous ontology: Ways of

Knowing, Ways of Being, and Ways of Doing. According to Miller, "Knowing" is about the contexts and processes for establishing what is known about the entities of Aboriginal groups and systems; "being" is about establishing respectful relationships amongst entities, including country, self and others; and "doing" is about "enacting ways for maintaining these relations".47, p.208 As such Ways of Knowing inform Ways of Being which, in turn, shape Ways of Doing.

3. Material and methods

3.1. Study design

We applied a qualitative insider/outsider approach to explore the perspectives of Aboriginal health and university staff who had prior experience with a GMB research project. Insider/outsider teams, where one or more researchers are relative insiders to the population or phenomenon under investigation and one or more members are relative outsiders, can enhance rigour in qualitative research through the integration of diverse perspectives and interpretations (Thomas et al., 2000). Our research team comprised both Aboriginal and non-Aboriginal investigators, some of whom had direct involvement with GMB projects, while others were experienced in Aboriginal health research more broadly.

3.2. Participant recruitment

Participants in this study were Aboriginal staff working in the fields of Aboriginal health policy, practice, or research. Purposive sampling was used in the first instance to recruit Aboriginal staff who had been investigators or authors of publications arising from health-related GMB projects involving Aboriginal people identified through a search of academic and grey literature. To be included participants had to be over 18 years old, identify as Aboriginal and/or Torres Strait Islander, and they must have had at least one previous experience with a GMB project. Best practice scripts from the literature (Hovmand et al., 2012), supported by Systems Thinking in Community Knowledge Exchange (STICK-E) software (Hayward et al., 2020), guided the facilitated GMB workshops experienced by all participants. Additional key informants were identified through snowball sampling, whereby participants were asked if they are able to recommend additional potential participants. Potential interview participants were approached via email. Participants were contacted again if a reply was not received within two weeks. Our sampling strategy enabled the recruitment of participants from a number of different settings and geographical areas, allowing the exploration of a range of perspectives and experiences.

3.3. Data collection

We collected data via qualitative semi-structured telephone/video conference interviews. These included both individual interviews conducted by one investigator (JB) and small group interviews conducted by two investigators (JB and SS). Interviews were undertaken between July and December 2020 and were audio recorded. Participants were asked to describe their previous experiences in projects involving GMB, their perceptions on the value and acceptability of the approach and how current methods and tools can be culturally adapted. Interview transcripts were transcribed and returned to participants for approval. Participants were given the opportunity to amend any of their interview responses or add further details to their responses if they wished. All participants received a $50 shopping voucher to compensate them for their time and knowledge.

3.4. Data analysis

Audio recordings of interviews were transcribed by a member of the research team. De-identified interview transcripts were then uploaded into NVIVO software and analysed using qualitative thematic analysis (Braun et al., 2012). After initial familiarisation with the data, transcripts were independently coded, line by line, by two investigators (TW and RC), one of whom was Aboriginal. Initial codes were discussed with a third investigator (JB) and grouped into categories to create a coding framework which reflected the recurring concepts in the data. Themes were generated through an iterative process of applying the coding framework to the interview transcripts and discussing emergent findings with the research team. While themes were identified inductively, those related to the value of GMB in Aboriginal health research and cultural adaptations required were actively pursued. Finally, themes were mapped to Martin's framework for Indigenous research (Martin, 2003). One investigator (JB) performed the initial mapping in consultation with Aboriginal members of the research team (TW, SS and ME). The final thematic framework was then presented to and agreed on by the wider research team.

3.5. Ethics

Ethics approval was granted by the Deakin University Human Research Ethics Committee (project no. 2020–080) and the Aboriginal Health and Medical Research Council Ethics Committee (project no. 1692/20). Written informed consent was obtained from all participants.

4. Results

Twenty-four Aboriginal staff members were invited to participate, 18 of whom agreed to be interviewed. Half (n = 9) participated as individual interviewees while the other half (n = 9) were interviewed in two small groups. Participants included staff from organisations such as Aboriginal Community-Controlled Health Organisations, health services, government agencies, Non-Government Organisations, and universities. Most were female (n = 13) and worked in rural or regional areas (n = 13). All participants were based in the south-eastern Australian states of New South Wales (n = 11) and Victoria (n = 7).

Fig. 1 provides an overview of the nine themes derived from the data, organised under the three concepts from Martin's framework: Ways of Knowing, Ways of Being and Ways of Doing. There was considerable similarity in the themes discussed by the various participants, both in terms of the relevance of GMB in Aboriginal health and suggestions for how the methods could be adapted or improved for future projects. Key findings are described below under each thematic heading, using illustrative quotations from interview participants as supporting evidence. Each quotation is attributed using the participant code (P01, P02 and so on).

4.1. Ways of knowing: sharing stories, connecting the whole picture, and visual learning

There was agreement among participants that the GMB approach aligned well with Indigenous ways of knowing. Participants appreciated the "community-driven" (P07) nature of the method and its ability to accommodate some Aboriginal learning styles. One participant described how the systems orientation helped bring together Aboriginal and Western knowledge systems and fostered "understanding how they worked together rather than separately" (P01). Participants reported appreciating the opportunity to come together to share their experiences and learn together through storytelling. As one participant explained:

> *I think it brings back a little bit of the ancient traditional ways of yarning for resolving issues or problems (P02)*

A key aspect of GMB that participants reported aligned with Indigenous ways of knowing was the emphasis on uncovering the whole picture and the interconnectedness between elements. Participants valued how the construction of causal loop diagrams enabled them to

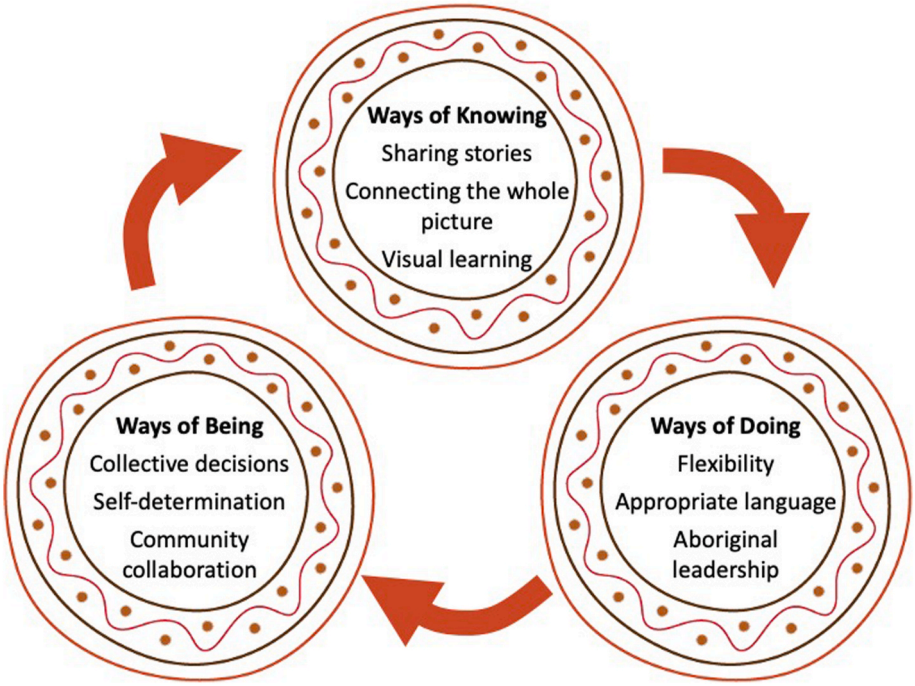

Fig. 1. Themes derived from interviews with Aboriginal staff (n = 18) about the value and acceptability of GMB as a methodological approach, mapped to Martin's Indigenous research framework (Martin, 2003). The three elements form a feedback loop, where Ways of Knowing inform Ways of Being which underpin Ways of Doing, which in turn prompts learning and, therefore, shapes Ways of Knowing. Artwork: Casey Atkinson, Bangerang.

see the "birds eye view" (P09) of health issues where "nothing sits separately … one thing can't exist without the other" (P01). This holistic perspective that the systems approach encouraged was not a new concept to Aboriginal staff. Throughout the interviews, participants described how Aboriginal organisations and communities already view health holistically where "it's including everything: houses, living conditions, environmental health, all that sort of stuff" (P04). Unlike many biomedical approaches, GMB supports this Aboriginal model of health, as one participant explained:

> *The group model building or systems approach, I feel like that aligns more with how we do it in our Community. We're always looking at health holistically. For so long now, a lot of medical people or health people have been looking at health in such isolation where our Communities have always been looking at health holistically (P09)*

All participants commented that the visual activities undertaken during GMB workshops were particularly engaging and consistent with Indigenous ways of knowing. Terms such as "visual people" (P03) were used by several participants, either when describing their own learning styles or those of their local Aboriginal communities. A feature of the GMB process that participants particularly valued was the building of causal loop diagrams in real time as the group's ideas evolved. This instant visual feedback was described as "rewarding for Community" (P06) as they "really felt a sense of building that together" (P09) and could see how their knowledge was contributing to the final product. Compared to other consultation methods where results are compiled into a written report, participants reported that real time, visual feedback provided opportunities for collective and cross-cultural learning. Many participants reported breakthroughs in understanding of complex systems during the GMB workshop sessions once they were able "to see the big picture" (P16) and really visualise the relationships between variables. As this participant explained, the visual maps produced through the GMB process helped bridge the gulf between Aboriginal and Western ways of knowing:

> *I remember sitting down with two of the Aunties and looking at it after [the researchers] left and they were like: We know this! We've always known this but it's actually displayed in how we would like to articulate it. So they could actually see what they tried to explain verbally, they could actually see it physically on a piece of paper (P02)*

This real time visual communication was also highlighted as being particularly culturally relevant. The use of visual aids was compared by one participant to traditional methods for passing on Indigenous knowledge: "through artwork, through song, through dance" (P01). Other participants suggested that "putting a cultural lens" (P07) over the workshop activities and outputs, through cultural activities and Aboriginal artwork, would be an important adaptation for future GMB projects. Despite some need for cultural tailoring, several participants noted that, compared to other research methods they had experienced, GMB had potential to honour Indigenous ways of knowing, as this participant described:

> *As far as best practice is concerned, I think it aligned best with the way of knowing and doing in the context of Indigenous cultures, Indigenous knowledge (P01).*

4.2. Ways of being: collective, collaborative, self-determined

Participants considered the GMB approach to be consistent with the ways in which Aboriginal organisations and communities operated on a day-to-day basis. The collective nature of the decision-making process was reported to align with cultural protocols where, "everything is done collectively, as a group" (P01). For many participants, bringing a mix of key community stakeholders together and "talking and working towards the same thing" (P15) was particularly important. Although the possibility of conducting GMB workshops online was discussed, for example during the COVID-19 pandemic, many participants agreed that, with Aboriginal communities, meeting face to face was preferable for building relationships and "getting the discussions going" (P09). Participants emphasised the need to "see our people's faces and talk to them and see

them in person" (P05) and the need to accommodate non-verbal communication. Another participant suggested that, by bringing people together, "the brain power in the room was amplified." (P13). One Aboriginal health academic emphasised that if GMB workshops were to be held online, this would be misaligned with what is considered best practice in accommodating Aboriginal learning styles as "Aboriginal people and communities enjoy that face to face, that tactile, that kin-aesthetic, very much that hands-on type of learning" (P01).

Central to the collective decision making way of being was the notion that Community voices were being heard. Participants appreciated how the GMB workshops gave everybody an opportunity to contribute in their own words, thereby "allowing their voice to come through" (P02) and fostering a sense of ownership over the end product. Several participants reflected on how, during the GMB workshops, "the solutions come from the Community" (P08) and that this Community-driven, consensus building process was the ideal way of working with Aboriginal communities. As one participant explained, "that's something we always push for: self-determination and people leading their own way" (P06). The ability of GMB methods to support Aboriginal self-determination was raised by several participants, for example:

You want Community consensus, you want self-determination so it's the voices of them … because the facilitator's not there to tell you what to do, that's the thing. So I think it's really honouring self-determination (P08).

We want to have the ownership and the self-determination to have the solutions, come up with the solutions ourselves. So [group model building is] very much an ideal way of doing it (P03).

The opportunities for collaboration was another strength of the GMB process. Participants from Aboriginal organisations described working in partnership with mainstream (non-Aboriginal) organisations as an important yet challenging aspect of Aboriginal health. Some of the GMB workshops described by participants were attended by a variety of stakeholders, including Aboriginal health staff, Community members, mainstream health staff, civil society organisations, and local government representatives. Participants valued this rare opportunity for strengthening relationships with mainstream organisations and decision-makers. One described GMB as "a tool to kind of get all those people in a room together and hear the Community's thoughts" (P09). Although collaboration was highly regarded, participants also frequently mentioned that it takes time for some people to feel "comfortable to talk up" (P18) with external stakeholders. For this reason, having enough time to get people "warmed up" (P07) was considered an important factor in planning workshop sessions as some participants reported running out of time just when things started to get "really juicy and all the information was coming up" (P08). The alignment of GMB with Aboriginal ways of being was summarised as follows:

I think that it aligns fairly well with the way that we do business, as a people, because we like small groups, we like talking, we like talking a lot, and we also like to see that someone is listening, that they're paying attention (P05).

4.3. Ways of doing: flexibility, accessible language, Aboriginal leadership

The ways of doing, expressed by participants, were underpinned by the ways of knowing and being, outlined in the previous sections. Many participants reported that GMB was a promising approach for research with Aboriginal communities but emphasised "it's just got to be delivered right" (P08). Participants articulated many principles for undertaking Aboriginal health research in an appropriate and respectful manner. Participants discussed the fundamental components of taking the time to build Community trust, being flexible and community-driven, and utilising Aboriginal facilitators wherever possible. Terms such as "cultural awareness", "cultural competence" and "cultural safety" were used frequently; however, participants also emphasised that "people are never 100% culturally competent" (P02) and "we're not a homogenous group" (P01). Similarly, another participant suggested that GMB may be a useful method for overcoming the common assumption that "Aboriginal issues are the same everywhere" as "each community you go to, there's something different" (P06).

Flexibility was considered particularly important for ensuring the research process "aligns in its entirety with the Community's agenda" (P01). This included being flexible with the number and timing of the GMB workshops, as some participants expressed a preference for completing all GMB sessions in one day, while others favoured several shorter workshops, as full days were considered "a bit long for the Elders" (P15). Participants emphasised the need to allocate enough time to avoid the feeling of "cramming information and … not thinking things through as thoroughly" (P13). Flexibility was also considered important during the workshop sessions. Participants suggested incorporating cultural activities and holding sessions over a meal so that "people aren't just sitting there feeling like they have to concentrate and look straight at the board or the speaker all the time" (P02).

The language used throughout GMB sessions was another area where participants suggested some flexibility was required. Some participants reported "a language barrier" (P01) between researchers and Community members and recommended reducing the amount of "systems type jargon" (P05) to help create a relaxed, informal environment where Community members could feel comfortable to engage in the discussions. The need to accommodate different literacy, numeracy and computer literacy levels was raised throughout the interviews, including a concern that some Community members may not feel confident with graphs or computer software as "not all of us were tech savvy" (P03), so alternative visualisation activities may be needed. The need for universal, accessible language was summarised by this participant:

I think that we have to be clear in what we say and don't use too many big words. If you do, break it down. People forget about that sometimes (P04).

The Aboriginal health staff we interviewed were unanimous in the belief that future GMB workshops with Aboriginal communities would ideally be led by Aboriginal facilitators. Participants explained how having a facilitator "that understands both worlds" (P09) could help overcome the communication barriers, outlined above, and enhance the engagement with Aboriginal communities throughout the research process. The need for more Aboriginal leadership of research projects, in general, was also emphasised, with many participants describing Aboriginal people as "the most researched people in the world" (P02). For this reason, participants suggested that if Aboriginal-controlled organisations were leading GMB projects, Communities would be "more inclined to participate" (P06). The need to build the capacity of Aboriginal people and organisations to lead future research projects was raised by almost all participants and is summarised by this quotation:

You can call it what you want and you can use different types of research that are more suitable but nothing's suitable until it's being Indigenous-led (P01).

5. Discussion

We aimed to assess the value and acceptability of GMB as a methodological approach in research with Aboriginal communities and to identify any adaptations required to optimise its utility. The Aboriginal health and university staff we interviewed (all of whom had prior experience with a GMB project) reported that GMB generally aligned well with Aboriginal ways of knowing, being, and doing. Participants valued the holistic, visual and collaborative nature of the method and its emphasis on sharing stories and collective decision-making. Critically, GMB was viewed as a useful tool for identifying actions to address priority issues and advancing Aboriginal self-determination. Our findings

suggest that adapting language, artwork, and workshop activities may enhance the relevance and cultural safety of this research method, and that capacity building is required so that GMB workshops, and ideally entire research projects, can be led by Aboriginal people.

While 'group model building' is a relatively new research method, Aboriginal communities, like many Indigenous peoples worldwide, have been using sophisticated approaches that have great synergy with systems thinking for millennia. Examples include sustainable food systems based on intimate knowledge of plants, animals, and seasons (Pascoe, 2014); Aboriginal astronomy, used for navigation and timekeeping (Clarke and Ruggles, 2014); and traditional land management practices used to sustain biodiversity and prevent bushfires (Bird et al., 2012). These knowledge systems are all interconnected: knowledge of astronomy is connected to knowledge of seasons which, in turn, is connected to knowledge of land, plants, animals and food systems. The alignment of what is now called "systems thinking" with Aboriginal worldviews is demonstrated in the following quotation:

"In Aboriginal philosophy the universe is a pattern comprised of other patterns, of systems inside systems. It is a holistic view in which everything is interrelated and interdependent. Nothing exists in isolation. All life – and everything is alive in an Aboriginal worldview – exists in relationship to everything else".(Kwaymullina & Kwaymullina, 2010), p.146.

Similarly, in her seminal text on systems thinking, Donella Meadows described the fundamental concepts of systems approach as "connectedness, relationships and community — concepts which are the essence of a deep spiritual awareness". (Meadows, 2008), p.7 A research method underpinned by these core values aligns well with Aboriginal ways on knowing, being, and doing, as reported by participants in our study. Our findings build on evidence from Aotearoa/New Zealand, which found that GMB was a useful tool in Maori health promotion and that systems thinking had many commonalities with Maori worldviews (Heke et al., 2019). It has been suggested that a framework combining systems thinking with cultural-centredness and community engagement provides a promising approach for planning and implementing interventions to improve health equity for Maori and other Indigenous peoples (Oetzel et al., 2017). Future research, based on the insights provided by our participants, should evaluate the utility of such an approach for Aboriginal communities in Australia.

The need for capacity building and Aboriginal leadership in future GMB projects, articulated by our study participants, is consistent with the philosophy of community based system dynamics. Unlike other research approaches, community based system dynamics places a particular focus on developing community capacity to use GMB and other system science methods independently from external researchers (Hovmand, 2014). The findings of our study suggest that this approach is consistent with the principle of self-determination. While some examples of systems science methods being applied with Indigenous communities exist in the literature (Gerritsen et al., 2019; Heke et al., 2019; LaVallee et al., 2016; Muthayya et al., 2020), our findings further highlight the need to go beyond simply facilitating GMB workshops with Aboriginal audiences, but rather to partner with Communities in a process of two-way learning. Such an approach builds capacity "both ways", enabling more Aboriginal-led health research projects while developing relationships with non-Aboriginal researchers to build respectful partnerships with Aboriginal communities (Browne et al., 2013; Haynes et al., 2019). These collaborative partnerships may help ameliorate any potential power differentials between researchers and community members so that more participants feel comfortable "speaking up" during workshops while concomitantly breaking down the barriers implicit in the interpretation of public health research (Andress et al., 2020).

The recommendations our participants made for improving GMB are consistent with previous Aboriginal-led recommendations for relevant, effective, and culturally respectful health research (Jamieson et al., 2012). Examples included ensuring the project aligns with the Community's agenda; taking the time to build trust; having a flexible approach; and supporting Aboriginal leadership and capacity building. Many of these principles are detailed in the guidelines for conducting ethical research (National Health and Medical Research Council, 2018), and more recently, checklists for reporting and appraising research with Indigenous peoples (Harfield et al., 2020; Huria et al., 2019). It is increasingly recognised that research that is co-designed and co-translated with Aboriginal communities will not only be more meaningful but is more likely to improve Aboriginal health outcomes (Sherriff et al., 2019; Thomas et al., 2014). Our findings suggest that, with some co-designed adaptations to the process, community-based system dynamics and GMB offer one approach for operationalising best practice principles in Aboriginal health research.

A strength of this study is that it adhered to many of the internationally-agreed best practice principles for research with Indigenous peoples (Huria et al., 2019). Key elements included a collaborative partnership between a university and a peak Aboriginal health organisation; employment of Aboriginal researchers; genuine engagement between Aboriginal and non-Aboriginal team members throughout research process; approval by an Aboriginal ethics committee; interviews which privileged the worldviews of Aboriginal health and university staff; and application of a culturally relevant analysis framework, which enabled interpretation of the findings from an Aboriginal perspective. As a research team, we are committed to translating the findings of the current project to develop a culturally adapted GMB methodology, and associated capacity building strategies, to support the advancement of Aboriginal-led health research. Key to future research in this field will be monitoring and reporting the development and implementation of GMB projects, using existing Indigenous research tools (Harfield et al., 2020; Huria et al., 2019), in order to advance our understanding of how systems science can be led by Aboriginal researchers and relevant and valuable to Aboriginal communities.

This study had several limitations. While our participants were drawn from a variety of Communities, they were all based in the south-eastern Australian states of New South Wales and Victoria. GMB projects were conducted in a variety of settings and included locations in major cities, inner regional and outer regional areas of Australia. For this reason, our findings cannot necessarily be generalised to other Aboriginal communities within Australia or Indigenous communities internationally. Although our participants were all members of their Aboriginal communities, the views of Aboriginal health and university staff may not be representative of the broader Aboriginal community in the region, especially those who may be less familiar with research concepts. Critically, none of our participants were from remote Aboriginal communities, which are contextually very different to urban and regional areas of Australia. Application of systems thinking has been used to plan strategies for improving food security in remote Aboriginal communities (Brimblecombe et al., 2015), and it has been suggested that GMB could be used to guide future work in this area (Brimblecombe et al., 2017). Further research is needed to identify and evaluate the cultural and linguistic adaptations required for GMB projects in remote communities.

Despite these limitations, several implications for research, policy and practice can be drawn from our study. Our findings suggest that GMB has the potential to be a useful and culturally relevant tool for embracing shared understandings of the complex issues that Aboriginal communities identify as priorities, and collaboratively designing courses of action to address them. Moreover, by enabling the identification of priority solutions directly from Communities, GMB offers a powerful mechanism for increasing Aboriginal participation, representation and, ultimately, self-determination in policy development processes. For this potential to be realised, Aboriginal leaders need to be proactively engaged to take into their own hands the task of adapting GMB methods in the direction of their choosing so that future research projects fully align with Aboriginal ways of knowing, being, and doing. In doing this, non-Aboriginal researchers should aspire to move beyond co-design

processes and enable Aboriginal health research to be entirely led by Aboriginal people.

6. Conclusion

Group model building provides a promising methodology for research with Aboriginal communities that, if applied in a culturally safe manner, is generally consistent with Aboriginal ways of knowing, being, and doing. GMB provides tools for identifying community-led actions to address priority issues in health and other sectors. By bringing community members and key stakeholders together, identifying a shared understanding of the issue, agreed solutions and providing an avenue for an Aboriginal voice on important issues at the local, state, and national policy levels, this approach can be used to increase political capital among Aboriginal communities across a wide range of issues.

Given the call for research with Aboriginal communities to be led by Aboriginal people, our findings suggest that culturally-adapted GMB methods, grounded in the principles of community based participatory research and capacity building, provide genuine direction for efforts to address previous weaknesses of research on, rather than with, Aboriginal communities. This study laid the foundation for bringing together Aboriginal and non-Aboriginal knowledge of systems thinking to inform the development of a tool which Aboriginal communities can utilise to explore and address complex problems in a manner that is consistent with their worldviews.

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Author statement

Jennifer Browne: conceptualization, investigation, writing-preparation of original draft Troy Walker: data analysis, writing-reviewing and editing Andrew Brown: methodology, writing-reviewing and editing Simone Sherriff: investigation, Rebecca Christidis: formal analysis, Mikaela Egan: conceptualization, validation, Vincent Versace: supervision, writing-reviewing and editing, Steven Allender: methodology, supervision, writing-reviewing and editing, Kathryn Backholer: supervision, writing-reviewing and editing. All authors reviewed and approved the final manuscript.

Declaration of competing interest

None to declare.

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