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Navigating Childhood Obesity: A Systems Thinking Approach to Complexity, Leverage, and Stakeholder Engagement

Alan Silburn*

University of Tasmania, Hobart, 7001, TAS, Australia.

Corresponding Author: Alan Silburn

University of Tasmania, Hobart, 7001, TAS, Australia.

Email: alan.silburn@health.nsw.gov.au

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Abstract

This study employs a systems thinking approach to unravel the complexity of childhood obesity, utilizing the Cynefin framework and causal loop diagrams. It identifies childhood obesity as a complex problem, emphasizing its dynamic and interconnected nature. Leverage points within the school system, including information flow, rule modification, and physical infrastructure, are highlighted. Stakeholder engagement is crucial, involving service providers, local-level supporters, and decision-makers. The research challenges simplistic views, advocating for nuanced, systems-based interventions. The findings provide insights for addressing other public health issues through a similar systems inquiry.

Keywords: Childhood obesity; Systems thinking; Causal loop diagram; Leverage points; Stakeholder engagement; Public health intervention.

Introduction

Paediatric and childhood obesity is a growing global epidemic that requires systematic attention due to the burden placed on the healthcare system for children and adults. Paediatric and childhood obesity is the most prevalent nutritional disorder among children and adolescents worldwide [1] and is influenced by a complex and interrelated array of issues. Due to the complexity of the childhood obesity epidemic, the use of a systems thinking approach is essential as it is a way of gaining a further understanding of complex situations by identifying the relationships between individual elements of the system and how these elements interact as a dynamic whole [2]. The following will form a systemic inquiry to define childhood obesity as a complex problem, how the under-standing of the problem has changed by utilising various systems thinking strategies, how the problem would benefit from public health engagement, and how the system can be applied to other situations in public health.

Childhood obesity

A complex problem: Systems thinking can be used in many aspects of public health, however, it is particularly advantageous when problems have been identified as being complex. Characteristics of a complex problem are when the problem involves multiple interacting agents, the context the problem operates within keeps changing and does not conform to linear or simple patterns, or elements within the system can learn new things and create new patterns as they interact over time [3]. The Cynefin framework is a tool used to determine the complexity of a problem or situation by assigning the problem to one of five types of complexity [4]. The types of complexity are simple, complicated, complex, chaotic, and disordered. Childhood obesity can be assigned as a complex type of problem as there is little understanding of how childhood obesity is affected by the system and the outcome is unpredictable due to the changing dynamics [4]. Likewise, the relationship between the cause and effect of childhood obesity requires analysis and the application of expert knowledge, thus meeting the requirements to classify it as a complex problem [4].

Characteristics of complex problems can likewise be attributed to childhood obesity. Firstly, childhood obesity does not have a clear solution and the dynamics of the problem are not well understood [5,6]. Furthermore, the outcome of childhood obesity progression is unpredictable as the dynamic continuously

changes due to food production, social trends, and environmental factors [7]. Also, childhood obesity complexities can be witnessed as the problem affects multiple layers of the public health system from the family household to the federal government. In turn, this affirms the final characteristic of a complex problem as a multitude of actors are required to take action to resolve the childhood obesity problem by altering the system's dynamic whole [4].

Childhood obesity is defined as a child with abnormal or excessive fat accumulation that presents a risk to health [8]. For adults, the simple index to classify overweight and obesity is the Body Mass Index. The Body Mass Index classifications are defined using the individual's weight in kilograms divided by the square of the individual's height in meters [8]. The Body Mass Index is considered the most useful population-level measurement tool for overweight and obesity in adults as it is comparable for both sexes and adults of all ages [8]. However, the measurement of overweight and obesity in children and adolescents with one simple index, such as the Body Mass Index, is difficult because paediatric bodies undergo several physiological changes as they develop. Depending on age, different methods can be used to measure a paediatric body's healthy weight to compare with generalised population-based data.

The World Health Organisation [8] stipulates that the fundamental cause of childhood overweight and obesity is an energy imbalance between the calories consumed and the calories expended. This can be attributed to the global shift in diet towards a higher daily intake of energy-dense foods that are high in fat and sugars but low in vitamins, minerals and other healthy micronutrients [8]. Likewise, there is a decreased trend in physical activity levels due to the increasingly sedentary nature of many forms of recreation time, ease of transportation modes, and urban expansion and influences [8].

Discussion

Preliminary consideration

Therefore, it is the preliminary consideration that limiting the availability of energy-dense foods and increasing the availability of healthy food options to children, in addition to promoting the benefits of physical activity, will reduce the prevalence of childhood obesity. Nevertheless, this consideration appears to be a linear approach to problem-solving that is more appropriate for addressing simple problems and may, in fact, prove detrimental to the desired outcome [3]. Thus, further investigation by utilising systems thinking is required to produce a comprehensive resolution that addresses the complexities of the childhood obesity problem.

Applying the causal loop diagram

Systems thinking incorporates a way of seeing the system from various perspectives and the application of a set of tools and methods. Systems tools and methods can be applied to any situation, however, the outcomes generated are influenced by the perspective of the individual applying the tool. Therefore, different results will be achieved each time creating an information bias [9]. Effective systems tools are crucial for strong systems practice as this will generate reliable outcomes of the work under investigation because a wider range of inputs and influences are engaged [9]. Likewise, systems tools can be easily utilised by others to replicate the outcome as new perspectives or dynamics become apparent.

Causal loop diagrams are a qualitative system dynamics method that enables a graphic visualisation of the emergent properties of a problem. The graphic produced provides an understanding of the systemic structures and behaviours that contribute to the problem and may highlight specific leverage points at which policy and practice can be improved [10]. A causal loop diagram can be applied to childhood obesity to define the key elements contributing to the problem by defining the variables, causality, polarity, and feedback loops. [11].

Firstly, variables are items of interest in a causal loop diagram that change over time and are measurable, quantifiable, clear and specific [11] such as the prevalence and severity of childhood obesity in the Australian school system. The prevalence and severity of childhood obesity may change over time as the population adapts to changing food and physical exercise trends. Causality is the relationship between two variables [11]. Causality has been documented between calorie intake, physical activity, and childhood obesity. The evidence suggests that an increase in calorie intake will increase the prevalence and severity of obesity indicative of positive polarity [12]. A positive polarity means that if the cause increases, then the effect likewise increases. Inversely, a negative polarity means that if the cause increases, then the effect decreases [11]. This is notable as a decrease in physical activity causes an increase in obesity supporting a negative polarity.

Furthermore, a central element of a causal loop diagram is feedback loops as they indicate changes in the system that initiate a cascading effect through other variables. Feedback loops can either positively or negatively reinforce the system or balance the initial change within the system [11]. Negative reinforcing loops also termed vicious cycles, are obvious throughout the causal loop diagram illustrating the childhood obesity problem. An example of such is the relationship between obesity and eating. It is notable that obese individuals will consume food for comfort due to poor self-esteem or depression as a result of being obese [13]. This, in turn, creates a vicious cycle increasing the severity of the individual's obesity causing a continuum.

During consideration, the causal loop diagram highlights the sensitivity of the system to revert in a negative direction. This can occur if the resolution is not implemented effectively. Thus, further investigation is needed to address how and where in the system a change is best targeted.

Leverage points

Causal loop diagrams highlight leverage points by which specific areas, systemic structures, and behaviours that contribute to the problem can be manipulated to promote resolution. Meadows [14] describes leverage points as "…places within a complex system where a small shift in one thing can produce big changes in everything". The causal loop diagram of childhood obesity is the school system highlighted that leverage can be applied in three key areas. Firstly, childhood obesity is best targeted at the school systems as this has had proven successes as a leverage area due to the ease of policy implementation that affects a large cohort of the targeted population [15]. Specifically, Meadows's [14] 6th point of leverage hierarchy whereby information flows to everyone it affects can be applied as healthy food practices can be translated to the affecting stakeholders, such as students, teachers, caterers and families to improve healthy food consumption, thus lowering calorie intake, resulting in a decrease in obesity prevalence within the school

system. Story, Nanney, and Schwartz [16] affirm this by proposing that education and healthy eating are intertwined, thus, the provision of information and education on healthy eating subsequently reduces the prevalence of obesity. For this, food education should be implemented into the primary and secondary school teaching syllabus under the authority of each of the state's education departments.

Secondly, the food supplied at the school canteen was identified as a place of leverage. Interventions such as the implementation of constraints on high sugar and energy-dense foods supplied at school canteens have been witnessed to successfully reduce childhood obesity [17]. This affirms Meadows's [14] 5th point of leverage hierarchy whereby the rules of the system can be modified to create positive change. Similarly, to the flow of information, modifying rules within the school system is subject to the education department governing each state.

Lastly, the layout of the school infrastructure was noticed to be a point of leverage. This applies to Meadows's [14] 10th point of leverage hierarchy whereby the structure of material stocks and flows, and nodes of intersection can be modified. The stock identified here as the students, and the flow, identified as moving throughout the school campus, could be modified to promote physical activity. As there is a decreasing trend of physical activity levels due to the increasingly sedentary nature of many forms of recreation time, ease of transportation modes, and urban expansion and influences [8], it is a consideration that by orientating the school campus in a way that promotes exercise rather than ease and efficiency will, in turn, reduce the prevalence of childhood obesity. This could be achieved physically by implementing barriers, such as gardens or fences, to prompt a longer walking route when moving around the campus, or could be achieved administratively, by organising student timetables to alternate between sides of the campus to force students to walk across the campus multiple times during the school day, thus enforcing physical exercise.

However, when considering this stage, there is a realisation that Meadows's [14] 9th point of leverage hierarchy whereby the lengths of delays, relative to the rate of system change have a predominant influence. The length of delay is notable as the school term influences all system modifications and may not be effective when the targeted paediatric population is not in school. Thus, further investigation is needed to identify a resolution strategy that may be sustained to overcome this hurdle.

Stakeholder role in the complex public health problem

Stakeholders with a role in public health that were identified within the causal loop diagram need to be engaged to achieve improvements regarding childhood obesity. Complex problems fundamentally involve a range of stakeholders who require effective engagement to establish a strong foundation for systems change. The stakeholders identified during the previous analysis can be classified into three main groups.

Firstly, service providers who engage with public health issues by conducting face-to-face services are required to connect with people [18]. Service providers are at the forefront of providing the required delivery of public health information to educate the targeted population. This allows for the distribution of information that can be contextualised and interpreted for individuals of different levels of understanding and in different situations [19]. An example of this would be educating children on healthy food consumption at school compared to educating the child's parents.

Secondly, people and organisations who provide support or advocacy at the local level, such as people with a personal passion for the issue or those who have personal contact and provide support to people experiencing the issue [18]. These people and organisations can involve and collaborate with other stakeholders to develop alternative and preferred solutions [20]. Life Ed Australia [21] is an organisation that has contributed positively to childhood obesity by creating a partnership with schools, parents, and children to adopt a healthy lifestyle. This has been achieved through an interactive curriculum-based program for Preschools, Primary and Secondary schools. The Life Ed Program [21] is a seamless example of the positive influences people and organisations can have to implement a system-wide approach to public health problems.

Lastly, decision-makers such as people representing key constituencies have an interest in the issue and an inherent ability to influence change in a system [18]. Decision-makers are those who can affect public health problems by implementing policy. Public health policy has a profound impact on the health status of the affected population [22]. Thus, public health policy needs to be conducted after a thorough investigation from various perspectives and supported by evidence. For this, decision-makers must employ a systems thinking approach to childhood obesity policy development to maximise the leverage on the problem's system and empower all of the affected stakeholders.

Final reflection

During the final reflection, the initial understanding of childhood obesity as a simple problem was challenged and has evolved throughout the inquiry. It was thought that a simple change in the system by implementing diet control measures and promoting exercise would resolve the problem of childhood obesity. It is now clear that childhood obesity is a complex problem requiring multiple systems analysis and perspectives to gain the required understanding to implement effective change. As the systems inquiry progressed, new perspectives were noted that could not otherwise be seen. This was prominent when conducting the causal loop diagram depicting childhood obesity's key contributors. Likewise, the causal loop diagram provided insight into the important leverage areas that would be most effective to target to promote change. Furthermore, by enlisting and empowering the system's stakeholders to act on these leverage areas, the implementation of system change has the best environment to be successful.

Insights for systems thinking

A systems inquiry can be applied to other problems of interest. It is a consideration that the author's understanding of adolescence's excessive consumption of alcohol and tobacco usage may be as naive as the initial impression of childhood obesity. It is reasonable to suggest that a systems inquiry into each issue would discover new perspectives and points of interest to target them within a public health context. Likewise, it will be interesting to note if any similarities between the three issues are present so that a multisystem resolution plan may be conceived. Nevertheless, the use of systems thinking has its obvious advantages and can give insight into the unknown unknowns [23] of public health's complex problems.

Conclusion

In conclusion, paediatric and childhood obesity is a growing

global epidemic that requires systematic attention due to the burden placed on the healthcare system for children and adults and is influenced by a complex and interrelated array of issues. Due to the complexity of the childhood obesity problem, the use of a systems thinking approach and various systems thinking strategies is essential as it is a way of gaining a further understanding of complex problems by identifying how complex the problem is, the system's structure, key stakeholders, and the relationships between the elements of the system and how they interact as a dynamic whole [2].

Declarations

Author statement: This study did not require ethical approval as it involved a retrospective analysis of publicly available and anonymized data, with no direct involvement of human subjects.

Declaration of interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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