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Research Article

Reduce childhood obesity via new form of nano hexa topological space

R. MOHANAPRIYA[1], S. SANTHIYA[1,*]

[1]Sri Krishna Adithya College of Arts and Science, Tamil Nadu, 641042, India

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ABSTRACT

Childhood fat has reached pestilence levels in both developed and growing countries Overweight and obesity in children have significant impacts on both physical and psychological health. Children who are overweight or obese are more likely to prevail obese into adulthood and face a higher threat of developing NCD such as diabetes and cardio vascular diseases at a younger age. While the exact mechanisms behind the development of obesity are not fully understood, it is believed to be a multi factorial disorder, persuaded by a blend of genetic, environmental, and behavioral factors. The importance of research in this area lies in identifying the most significant factors that contribute to reducing obesity in children aged five to fourteen years. In this context, the use of Nano Hexa Topological Space (N hTS) provides a novel approach to understanding and addressing childhood obesity. Research using N hTS has revealed six key areas of action that can be leveraged to combat obesity in children. By integrating this advanced methodology, we aim to identify and implement effective interventions that can help reduce childhood obesity and its associated risks. This innovative approach, N hTS, provides a unique framework to analyze the complex factors contributing to childhood obesity and design targeted strategies for its prevention and reduction.

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INTRODUCTION

Childhood obesity is a pressing medical concern that affects children and adolescents, posing significant long-term health risks. Alarmingly, excess weight during childhood often sets individuals on a trajectory toward chronic conditions typically seen in adults, such as type 2 diabetes, hypertension, and high cholesterol. Beyond these physical consequences, obesity in children can also severely impact mental health, contributing to low self-esteem, depression, and social isolation. Addressing this issue is essential not only to prevent immediate health complications but also to equip children with the tools to lead healthy and fulfilling lives.Numerous studies have explored the prevalence and causes of childhood obesity. Al Arjan [1] investigated the prevalence of obesity, overweight, and underweight among students, while other researchers have approached the issue using mathematical and topological frameworks. Asmaa and Qaddoori [2] introduced identification functions in Hexa Topological Spaces, contributing to the field of abstract topology.

***Corresponding author.**
*E-mail address: santhiyamrs26@gmail.com

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Buvaneshwari and Rasya Banu [3] defined the concept of Nano bi-topological spaces, and Chandrasekar [4,5] introduced Nano Tri Star and Nano Quad Topologies, expanding the study of topological spaces from single to multiple layered structures. The exploration of these multilayered spaces continued with Chandra and Pushpalatha [6], who introduced h-open sets and h-continuous functions in Hexa topological spaces. Levine [7] had laid the foundation by initiating the study of semi-open sets and their properties. Mukundan [8] extended the study to Quad topological spaces, and Khan [9] analyzed p-Continuity and p-Homeomorphism in Penta topological spaces.

A significant contribution to understanding childhood obesity came from [10], which used factor analysis to identify five key factors influencing childhood overweight and obesity. Recent years have seen a convergence of mathematical theory and health science applications. In pure mathematics, Reilly and Vamanamurthy [11] introduced the concept of -sets in topological spaces, while Salh and Jasim [12] studied micro topological spaces in medical contexts, such as Thalassemia. Saelens et al. [13] conducted a clinical trial comparing motivational strategies for pediatric obesity treatment. Silva et al. [14] found that autonomous motivation for exercise predicted significant Long term weight loss in women. Seema and Aaron [15] offered a comprehensive review of childhood obesity, including its epidemiology, etiology, Comorbidities, and treatment, while Teixeira et al. [16] examined how motivation, eating behavior, and body image impact weight control.

On the applied mathematics side, Nano Topological Spaces (NTS), introduced by Thivagar and Richard [17], have found relevance in various aspects of civilian life. They further proposed a computing technique based on nano-topology to optimize recruitment processes [18]. In parallel, Wilfley et al. [19] reviewed behavioral interventions for obesity in both children and adults, highlighting novel approaches and practical applications. Wong and Cheng [20] explored the benefits of motivational interviewing in promoting weight loss among obese children. Moreover, Yaseen, Shihab, and Alobaidi [21,22] advanced the field of nano and penta topologies by introducing Nano Penta Topological Spaces and characterizing penta-open sets, offering new theoretical tools for abstract mathematical modeling.

Definition 1.1 (11)**.** Let H be a non-empty finite set of members called the universe and R be an equivalence relation on H named as the indiscernibility relation. Elements belonging to the same equivalence class are said to be indiscernible with one another. The pair (H, R) is saidto be the approximation space.

Let ς ⊆ H.

1) The lower approximation of ς concerning R is the set of all members, which can be for positive classified as ς concerning R and is noted by ե$_R$ (ς). That is ե$_R$ (ς) = ∪{ R (ς): R (ς)⊆ς, ς ∈ H} where R (ς) denotes the equivalence class determined by ς ∈H.
2) The upper approximation of ς concerning R is the set of all members, which can be possibly classified as ς concerning and it is noted by Џ$_R$ (ς). That is Џ$_R$ (ς) = ⋂{R (ς) : R (ς)⋂ς ≠ ϕ, ς ∈H}.
3) The boundary region of ς concerning is the set of all objects, which can be classified neither as ς nor as not-ς concerning R it is noted by B$_R$ (ς). That is, B$_R$ (ς) = Џ$_R$ (ς) – ե$_R$ (ς)

Property 1.2 (11)**.** If (H, R) is an approximation space and ς, η⊆ H, then

1) ե$_R$ (ς) ⊆ ς ⊆ Џ$_R$ (ς)
2) ե$_R$ (R) = Џ$_R$ (R) = R and ե$_R$ (H) = Џ$_R$ (H) = H
3) Џ$_R$ (ς ∪ η) = Џ$_R$ (ς) ∪ Џ$_R$ (η)
4) Џ$_R$ (ςη) ⊆ Џ$_R$ (ς) Џ$_R$ (η)
5) ե$_R$ (ς ∪ η) = ե$_R$ (ς) ∪ ե$_R$ (η)
6) ե$_R$ (ςη) = ե$_R$ (ς)ե$_R$ (η)
7) ե$_R$ (ς) ⊆ ե$_R$ (η) and Џ$_R$ (ς) ⊆ Џ$_R$ (η) whenever ς ⊆ η
8) Џ$_R$ (ςc) = [ե$_R$ (ς)]^c and ե$_R$ (ςc) = [U$_R$ (ς)]^c
9) Џ$_R$ (Џ$_R$ (ς)) = ե$_R$ (Џ$_R$ (ς)) = Џ$_R$ (ς)
10) ե$_R$ (ե$_R$ (ς)) = Џ$_R$ (ե R (ς)) = ե$_R$ (ς)

Definition 1.3 (17)**.** Let H be the universe, R be an equivalence relation on H and $\mathcal{I}_R$ (ς) = { H, φ, ե$_R$ (ς), Џ$_R$ (ς), B$_R$ (ς) } where ς ∈ H. Then by Property 1.2 $\mathcal{I}_R$ (ς) satisfies the following axioms

1) H and φ belongs to $\mathcal{I}_R$ (ς)
2) The union of the member of any sub-collection of $\mathcal{I}_R$ (ς) is in $\mathcal{I}_R$ (ς)
3) The intersection of the member of any finite sub-collection of $\mathcal{I}_R$ (ς) is in $\mathcal{I}_R$ (ς). That is $\mathcal{I}_R$ (ς) is a topology on H called the NT on H with respect to ς. Then (H, $\mathcal{I}_R$ (ς)) is a NTS. The member of $\mathcal{I}_R$ (ς) are termed as Nano-open (NO) sets.

Remark 1.4 (17)**.** If $\mathcal{I}$ R (ς) is the NT on H with respect to ς then the set B = {H, ե R (ς), Џ R (ς)} is the basis for $\mathcal{I}$ R (ς).

Definition 1.5 (17)**.** If (H, $\mathcal{I}_R$ (ς)) is a NTS concerning ς where ς ⊆ H and if $\mathcal{A}$ ⊆ H, then the Nano interior of $\mathcal{A}$ is defined as the union of all NO subsets contained in $\mathcal{A}$ and it is denoted by Na Int($\mathcal{A}$).The Nano Closure of A is defines as the intersection of all NC sets containing A and it is denoted by NaCl($\mathcal{A}$).

Definition 1.6 (6)**.** Let H be a non empty set and $\mathcal{I}_1, \mathcal{I}_2, \mathcal{I}_3, \mathcal{I}_4, \mathcal{I}_5, \mathcal{I}_6$ are general topology on H. Then a subset $\mathcal{A}$ of space H is said to be is called to be hexa - closed set (referred to as h-closed). The set H together with h-Topology τ_h is called hexa topological space (referred to as hTS) and is denoted by (H, $\mathcal{I}_h$) where τ_h = (H, ϕ, $\mathcal{I}_1, \mathcal{I}_2, \mathcal{I}_3, \mathcal{I}_4, \mathcal{I}_5, \mathcal{I}_6$)

Definition 1.7 (6)**.** If (H, $\mathcal{I}_h$) is a HTS and $\mathcal{A}$ ⊆ H. Then

1) The h-interior of $\mathcal{A}$ is the union of all h-open subset containedin $\mathcal{A}$ and is denoted by h int($\mathcal{A}$)
2) The h-closure of $\mathcal{A}$ is the intersection of all h-closed subset con taining $\mathcal{A}$ and is denoted by hcl($\mathcal{A}$)

A NEW FORM OF NANO HEXA TOPOLOGICAL SPACE

Definition 2.1. Let H be a non-empty universe set $\mathcal{I}_{R1}$(ς), $\mathcal{I}_{R2}$(ς), $\mathcal{I}_{R3}$(ς), $\mathcal{I}_{R4}$(ς), $\mathcal{I}_{R5}$(ς) and $\mathcal{I}_{R6}$(ς) are NT on H with respect to X. Then a subset A is said to be Nano Hexa open (referred to as NhO) if $\mathcal{A} \in (\mathcal{I}_{R1}(\varsigma) \cup \mathcal{I}_{R2}(\varsigma)) \cup \mathcal{I}_{R3}(\varsigma)) \cup \mathcal{I}_{R4}(\varsigma)) \cup \mathcal{I}_{R5}(\varsigma)) \cup \mathcal{I}_{R6}(\varsigma))$ and its complement is said to be Nano Hexa closed (referred to as NhC) and the set with six topologies called Nano Hexa Topological space denoted by N hTS for all h = 1, 2, 3, 4, 5, 6. These N h-open sets satisfies all the axioms of NhT .

Remark 2.2. Let H be an universe R be an equivalence relation on H for $\varsigma \subseteq H$ and $\mathcal{I}_{R\,h}(\varsigma) = \{H, \phi, L_{R\,h(\varsigma)}, U_{R\,h(\varsigma)}, B_{R\,h(\varsigma)}\}$. If H, $\phi \in \mathcal{I}_{R\,h}(\varsigma)$ and $L_{R\,h}(\varsigma) \subseteq U_{R\,h}(\varsigma)$

1) $L_{R\,h}(\varsigma) \cup U_{R\,h}(\varsigma) = U_{R\,h}(\varsigma) \in \mathcal{I}_{R\,h}(\varsigma)$
2) $U_{R\,h}(\varsigma) \cup B_{R\,h}(\varsigma) = U_{R\,h}(\varsigma) \in \mathcal{I}_{R\,h}(\varsigma)$
3) $L_{R\,h}(\varsigma) \cup B_{R\,h}(\varsigma) = U_{R\,h}(\varsigma) \in \mathcal{I}_{R\,h}(\varsigma)$
4) $L_{R\,h}(\varsigma) \cap U_{R\,h}(\varsigma) = L_{R\,h}(\varsigma) \in \mathcal{I}_{R\,h}(v)$
5) $U_{R\,h}(\varsigma) \cap B_{R\,h}(\varsigma) = B_{R\,h}(\varsigma) \in \mathcal{I}_{R\,h}(\varsigma)$
6) $L_{R\,h}(\varsigma) \cap B_{R\,h}(\varsigma) = \varphi \in \mathcal{I}_{R\,h}(\varsigma))$

Definition 2.3. Let H be the universe set R be an equivalence relationon H and $\mathcal{I}_{Rh}(\varsigma) = \mathcal{I}_{R1}(\varsigma) \cup \mathcal{I}_{R2}(\varsigma) \cup \mathcal{I}_{R3}(\varsigma) \cup \mathcal{I}_{R4}(\varsigma) \cup \mathcal{I}_{R5}(\varsigma) \cup \mathcal{I}_{R6}(\varsigma)$.

Let $\varsigma \subseteq H$, $\mathcal{I}$ Rh(ς) satisfies the following axioms

1) H and $\varphi \in \mathcal{I}_{Rh}(\varsigma)$, where h = 1, 2, 3, 4, 5, 6
2) The union of the member of any finite sub-collection of $\mathcal{I}_{Rh}(\varsigma)$ is in $\mathcal{I}_{Rh}(\varsigma)$
3) The intersection of the member of any finite sub-collection of $\mathcal{I}_{Rh}(\varsigma)$ is in $\mathcal{I}_{Rh}(\varsigma)$.

That is $\mathcal{I}_{Rh}(\varsigma)$ is a topology on H is called the N hT on H then (H, $\mathcal{I}_{Rh}(\varsigma)$)is called the N hTS. Member of the N hT are called Nano hexa open sets (referred to as NhO 's) in H.

Proposition 2.4. If $\mathcal{I}_{Rh}(\varsigma)$ is the N hT on H with respect to H thenthe set B = {H,$L_{Rh}(\varsigma)$, $B_{Rh}(\varsigma)$} is the basis for $\mathcal{I}_{Rh}(\varsigma)$.

Definition 2.5. A space (H, $\mathcal{I}_{Rh}(\varsigma)$) is NhT- with concern to ς whereς ⊆ H and F ⊆ H then the N h-interior of F is the union of all N h-open subset contained in F and is denoted by N hint(F) thus Nhint(F)is the largest N hO subset contained in F. The N h-closure of F is the intersection of all Nh-closed sets containing F and is denoted by Nhcl(F) thus Nhcl(F) is the smallest NhC set containing F.

Properties 2.6. Let (H, $\mathcal{I}_{Rh}(\varsigma)$ be a NhT with respect to ς where ς ⊆ H. Let F, E ⊆ H. Then

1) Nh int(φ) = φ, Nhcl(φ) = φ
2) Nhint(H) = H, Nhcl(H) = H
3) Nhint(F) ⊆ F ⊆ Nhcl(F)
4) F ⊆ E implies N hint(F) ⊆ N hint(E) and N hcl(F) ⊆ N hcl(E)
5) F is NhO if and only if Nh int(F) = F
6) F is NhC if and only if Nhcl(F) = F
7) N hcl(N hcl(F)) = N hcl(F) and N hint(N hint(F)) = N hint(F)
8) N hcl(F∪E) = N hcl(F)∪N hcl(E) and N h int(F∪E) = N hint(F)∪Nhint(E)
9) N hcl(F∩E) ⊆ N hcl(F)∩N hcl(E) and N hint(F∩E) = N hint(F)∩Nhint(E)

Now we are discussing the following three cases

Case (i) Let H/ R be the equivalence relation defined on a universeset and six subsets of M.

Example 2.7. Let H = {ψi, ψ j, ψ k, ψ l, ψ m} and H/ R = {{ψ i}, {ψ j, ψl}, {ψ k}, {ψ m}}.

Let ς_1 = {ψ i} ⊆ H ⇒ $\mathcal{I}_{R\,1}(\varsigma)$ = {H, φ, {ψ i}},

ς_2 = {ψ k, ψ m} ⊆ H ⇒ $\mathcal{I}_{R\,2}(\varsigma)$ = {H, φ, {ψk, ψ m}},

ς_3 = {ψ i, ψ k, ψ m} ⊆ H ⇒ $\mathcal{I}_{R\,3}(\varsigma)$ = {H, φ, {ψ i, ψk, ψ m}},

ς_4 = {ψ i, ψm} ⊆ H ⇒ $\mathcal{I}_{R\,4}(\varsigma)$ = {H, φ, {ψ i, ψ m}},

ς_5 = {ψ m} ⊆ H ⇒ $\mathcal{I}_{R5}(\varsigma)$ = {H, φ, {ψ m}},

ς_6 = {v k} ⊆ H ⇒ $\mathcal{I}_{R\,6}(\varsigma)$ = {H, φ, {ψ k}}

Then N*h*O(H) = {H, φ, {ψ i}, {ψ k}, {ψ m}, {ψ i, ψ m}, {ψ k, ψm}, {ψ i, ψk, ψ m}},

NhC(H) = {H, φ, {ψ j. ψ l}, {ψ j, ψ k, ψ l}, {ψ i, ψ j, ψ l}, {ψ i, ψk, ψ l, ψ m}, {ψ i, ψ j, ψ l, ψ m}, {ψ i, ψj, ψk, ψ l}}

Case (ii) Using six equivalence relations defined on a universe set and its six subsets.

Let M = {ψ *i*, ψ *j*, ψ *k*, ψ *l*, ψ *m*} with H/ R1 = {{ψ i}, {ψ j, ψ k}, {ψ l, ψ m}}, H/ R2 = {{ψi}, {ψ m}, {ψj, ψ k, ψ l}}, H/ R3 = {{ψ i}, {ψ j}, {ψ l, ψk, ψ m}}, H/ R4 = {{ψ j}, {ψ k, ψ l}, {ψ i,

h = 1, 2, 3, 4, 5, 6	ς_h	$\mathbf{L}_{R\,h}(\varsigma)$	$\mathbf{U}_{R\,h}(\varsigma)$	$\mathbf{B}_{R\,h}(\varsigma)$	$\mathcal{I}_{R\,h}(\varsigma)$
H/ R_1	{ψ *i*, ψ*j*}	{ψ *i*}	{ψ *i*, ψ*j*, ψ *k*}	{ψ j, ψk}	{H, φ, { ψ *i*}, {ψ*j*, ψ *k*}, {ψ *i*, ψ *j*, ψ *k*}}
H/ R_2	{ψ *i*, ψ*k*}	{ψ *i*}	{ψ *i*, ψ *j*, ψ*k*, ψ *l*}	{ψ j, ψ k, ψ l}	{H, φ, {ψ *i*}, {ψ *j*, ψ *k*, ψ *l*}, {ψ *i*, ψ *j*, ψ *k*, ψ*l*}}
H/ R_3	{ψ i, ψ j, ψ m}	{ψ i, ψ j}	{ψ i, ψ j}	φ	{H, φ, {ψ i, ψ j}}
H/ R_4	{ψ j, ψ m}	{ψ j}	{ψ i, ψ j, ψm}	{ψi, ψm}	{H, φ, {ψ j}, {ψ i, ψ m}, {ψ i, ψ j, ψ m}}
H/ R_5	{ψj, , ψ k, ψm}	{ψ j, ψm}	{ψ i, ψ j, ψ k,ψ m}	{ψ i, ψ m}	{H, φ, {ψ i, ψm}, {ψ j, ψ k}, {ψi, ψ j, ψ m}}
H/ R_6	{ψ j, ψ m}	φ	H	H	{H, φ}

	H/ R_1	H/ R_2	H/ R_3	H/ R_4	H/ R_5	H/ R_6
$\mathbf{L}_{R\,h}(\varsigma)$	{ψi}	{ψi, ψ j}	{ψi}	{ψj}	{φ}	{ψi, ψj}
$\mathbf{U}_{R\,h}(\varsigma)$	{ψi, ψj, ψk}	{ψi, ψj}	{ψi, ψj, ψk, ψl}	{ψi, ψ j, ψm}	{ψi, ψj, ψk, ψm}	{ψi, ψ}
$\mathbf{B}_{R\,h}(\varsigma)$	{{ψj, ψk}	{φ}	{ψj, ψk, ψl}	{ψi, ψm}	{ψi, ψj, ψk, ψm}	{φ}

ψ m}}, H/ R5 = {{ψ l }, {ψ i, ψm}, {ψ j, ψk}}, H/ R_6 = {{ψ *i*, ψ *j*}, {ψ *l*, ψ*k*, ψ *m*}} we get

$\mathcal{I}_{R\,h}(\varsigma)$ = {H, φ, {ψi}, {ψ j}, {ψ i, ψ m}, {ψ j, ψk}, {ψ i, ψ j}, {ψ i, ψ j, ψ m}, {ψ i, ψ j, ψk}, {ψ j, ψ k, ψl},{ψi, ψ j, ψ k, ψ l},{ψ i, ψ j, ψ k, ψm}. members of $\mathcal{I}$ R *h*(X) is called N*h*O(H) sets and also the complementof N*h*O(H) is called N*h*C(H)

Case(iii) Using six equivalence relations defined in H and universeset and subsets of H

Example 2.8. *Let* H = {ψi, ψj, ψk, ψl, ψm} and ς = {ψ i, ψ j} ⊆ H with H/ $_{R1}$ ={{ψi}, {ψj, ψk}, {ψi, ψm}}, H/ $_{R\,2}$ = {{ψi}, {ψ m}, {ψj, ψk, ψl}}, H / $_{R\,3}$ = {{ψi, ψj, ψm}, {ψl, ψk}}, H / $_{R\,4}$ = {{ψj}, {ψj, ψl}, {ψi, ψm}}, H/ $_{R\,5}$ = {{ψl}, {ψi, ψm}, {ψj, ψk}}, H/ $_{R\,6}$ = {{ψi}, {ψj},{ψl, ψk, ψm}}

N*h*O(H) = {H, φ, {ψi}, {ψj}, {ψj, ψk}, {ψi, ψj}, {ψi, ψm}, {ψi, ψj, ψk}, {ψi, ψj, ψm}, {ψj, ψk, ψ l}, {ψi, ψj, ψk, ψl}, {ψi, ψj, ψk, ψm}, {ψj, ψk, ψ l, ψm}} , N*h*C(H) = {H, φ, {ψi}, {ψl}, {ψm}, {ψi, ψm}, {ψk, ψ l}, {ψl, ψm}, {ψj, ψk, ψl}, {ψk, ψl, ψm}, {ψi, ψl, ψm},{ψi, ψk, ψl, ψ}}

Result: We note that these cases are independent of each other interms of structural formation of the N*h*TS.

REDUCING CHILDHOOD OBESITY VIA NEW FORM OF N*H*TS

Obesity is characterized by an excessive accumulation of fat under the skin and around body tissues, exceeding the curb limits. The diagnosis of obesity is typically situated on the Body Mass Index (BMI), which is calculated using the following formula:

BMI = Body weight in kilograms / (Height in meters)²

The WHO has established specific classifications for obesity situated on BMI, which are used to assess the degree of obesity. These categories help identify individuals who may be at risk for fat -related health issues and can guide intervention strategies.

Table 1. Table of information on obesity measures

S. No	Obesity indicators	
1	Overweight	29, 99 – 25Kg
2	Low obesity	Kg34, 99–30
3	Medium obesity	Kg39, 99 – 35
4	Severe obesity	Kg 40 ≤

Here we apply the N *h*T to find the most critical factors that are used to reduce obesity in children from the age of 5 years to 14 yearsold that revealed the presence of six key areas of action.

Example 3.1. A sample of 8 male children, aged 8 years, identified as overweight or obese, was examined in a study by Asmaa et al. (2021). Additionally, a report by the World Health Organization (WHO) Commission on Reducing Childhood Obesity identified six key factors to reduce childhood obesity.

First Factor: {Promote Healthy Habits - Q_1}

The variables of the first factor are represented by { take nutritionfood, avoid fast food, avoid sugar-sweetened beverages }

Second Factor: { Promote Physical Activity- Q_2}

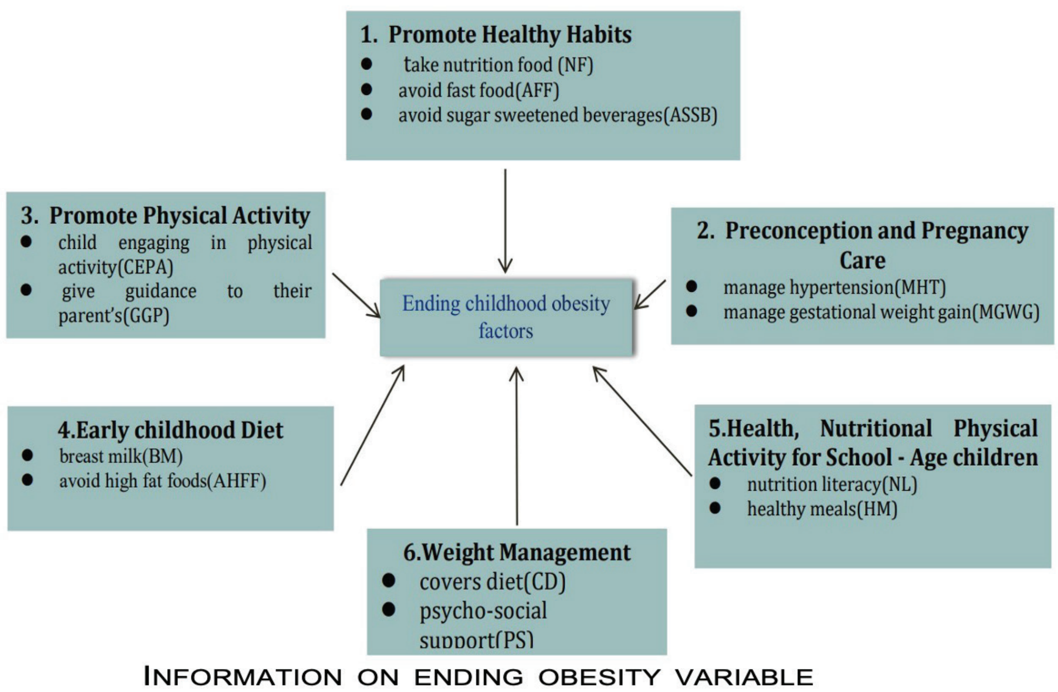

Figure 1. Six key areas of action.

Table 2. Table of information on obesity measures

Children	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Result
ꞥ	{*NF, AFF, ASSB*}	{*CEPA*}	{*MHT, MGWG*}	{*BM, AHFF* }	{*NL, HM*}	{*CD*}	Yes
ᶁ	{*NF, AFF, ASSB*}	{*CEPA*}	{*MHT, MGWG*}	{*BM, AHFF* }	{*NL, HM*}	{*CD*}	Yes
ᶒ	{*AFF, ASSB*}	{*GGP*}	{*MHT, MGWG*}	{*BM*}	{*NL, HM*}	{*PS*}	Yes
ᶓ	{*NF* }	{*GGP*}	{*MHT, MGWG*}	{*BM*}	{*NL, HM*}	{*PS*}	No
η	{*NF, AFF, ASSB*}	{*CEPA*}	{*MHT, MGWG*}	{*BM, AHFF* }	{*NL, HM*}	{*CD*}	Yes
β	{*NF, ASSB*}	{*GGP*}	{*MHT, MGWG*}	{*BM*}	{*NL, HM*}	{*PS*}	No
γ	{*NF, AFF* }	{*CEPA*}	{*MHT, MGWG*}	{*BM*}	{*NL, HM*}	{*CD*}	Yes
δ	{*NF, AFF* }	{*GGP*}	{*MHT, MGWG*}	{*AHFF* }	{*NL, HM*}	{*PS*}	No

The variables of the second factor are {child engaging in physical activity, give guidance to their parent's }

Third Factor: {Preconception and Pregnancy Care- Q_3}

The variables of the third factor are { manage hypertension, managegestational weight gain}

Forth Factor: { Early childhood Diet- Q_4}

The variables of the fourth factor is {breast milk, avoid high fat foods }

Fifth Factor: { Health, Nutritional Physical Activity for School - Age Children- Q_5}

The variables of the fifth factor is {nutrition literacy, healthy meals}

Sixth factor: { Weight Management- Q_6 }

The variables of the sixth factor cover diet, and psychosocial supportHere Q_1, Q_2, Q_3, Q_4, Q_5, Q_6 will stand for Promote Healthy Habits, Promote Physical Activity, Preconception and Pregnancy Care, Early childhood Diet, Health, Nutritional Physical Activity for School-Agechildren, Weight Management .

The domains are as follows

KQ1 ={take nutrition food (NF), avoid fast food(AFF), avoid sugar-sweetened beverages(ASSB)

K_Q2 = {child engaging in physical activity(CEPA), give guidance totheir parent's (GGP) }

K_Q3 = { manage hypertension(MHT), manage gestational weight gain(MGWG)}

K_Q4 = { breast milk(BM), avoid high fat foods(AHFF)}

K_Q5 = { nutrition literacy(NL), healthy meals(HM)}

K_Q6 = { covers diet(CD), psycho-social support(PS) }

Case 1: Let H = {ꞥ, ᶁ, ᶒ, ᶓ, η, β, γ, δ} be the set of children and Q_1 ={*NF, AFF, ASSB*} be the set of domains. Let H/Q_1 = {{ꞥ, ᶁ, γ}, {ᶒ}, {ᶓ}, {β }, {γ, δ}}

Case 1.1: Children with reducing Obesity with respect to Q_1. Then the corresponding upper, lower approximation and the boundary region of ς

Then $\mathcal{I}_{Q1h}$(ς) = {H, φ, {ꞥ, ᶁ}, {γ, δ}, {ꞥ, ᶁ, γ}, {ꞥ, ᶁ, γ, η }}, B_{Q1h}(ς) ={H, φ, {ꞥ, ᶁ, γ, η, δ}}

Case 1.1.1: When nutrition food (NF) was removed from Q_1

H/ (Q_1 – NF) = {{ꞥ, ᶁ, ᶒ, γ}, {ᶓ}, {β }, {γ, δ}} we obtain $\mathcal{I}_{(Q1-NT)h}$(ς) ={H, φ, {γ, δ}, {ꞥ, ᶁ, ᶒ , γ}, {ꞥ, ᶁ, ᶒ, γ, η, δ}}, $B_{(Q1-NT)h}$ (ς) = {H, φ, {ꞥ, ᶁ, ᶒ, γ, η, δ}} ≠ $B_{(Q1h)}$ (ς)

Case 1.1.2: When avoid fast food (AFF) was removed fromQ1

H/Q_1	L_{Q1} ($ς_i$) (i = 1,*v*2, 3, 4, 5, 6}	U_{Q1} ($ς_i$)	B_{Q1} ($ς_i$)	$\mathcal{I}_{Q1}$ ($ς_i$)
$ς_1$ = {ꞥ, ᶁ}	φ	{ꞥ, ᶁ}	{*a, b*}	{H, φ, {*a, b*}}
$ς_2$ = {ꞥ, γ}	φ	{ꞥ, ᶁ, γ}	{*a, b, e*}	{H, φ, {*a, b, e*}}
$ς_3$ = {ᶁ, γ}	φ	{ꞥ, ᶁ, γ}	{*a, b, e*}	{H, φ, {*a, b, e*}}
$ς_4$ = {ᶁ, γ, η }	φ	{ꞥ, ᶁ, γ, η }	{ {ꞥ, ᶁ, γ, η }	H, φ, {ꞥ, ᶁ, γ, η }}
$ς_5$ = {ꞥ, ᶁ, γ}	{ꞥ, ᶁ, γ}	{ꞥ, ᶁ, γ}	φ	{H, φ, {ꞥ, ᶁ, γ}}
$ς_6$ = {γ}	φ	{γ, δ}	{γ, δ}	{H, φ, {γ, δ}}

H/Q_1	L_{Q1} ($ς_i$)	U_{Q1} ($ς_i$)	B_{Q1} ($ς_i$)	$\mathcal{I}_{Q1}$ ($ς_i$)
$ς_1$ = { ᶒ}	{ ᶒ}	{ ᶒ}	φ	{H, φ, { ᶒ}}
$ς_2$ = {ᶓ, β }	{ᶓ, *f*}	{ᶓ, β }	φ	{H, φ, {ᶓ, β }}
$ς_3$ = {β, δ}	{β }	{β, γ, δ}	{γ, δ}	{H, φ, {β }, {γ, δ}, {β, γ, δ}
$ς_4$= { ᶒ, ᶓ, β}	{ ᶒ, ᶓ, β }	{ ᶒ, ᶓ, β	φ	{H, φ, { ᶒ, ᶓ, β }}
$ς_5$ = {ᶓ, β, δ}	{ᶓ, β }	{ᶓ, β, γ, δ}	{γ, δ}	{H, φ, {ᶓ, β}, {γ, δ}, { ᶒ, β, γ, δ}
$ς_6$ = { ᶒ, *γ*, δ}	{ ᶒ, β}	{ ᶒ, β, γ, δ}	{γ, δ}	{H, φ, { ᶒ, β}, {γ, δ}, { ᶒ, β, γ, δ}}

H/ (Q_1 – AFF) = {{ɦ, ȡ, γ, β}, { ҽ}, {ɛ},{γ, δ}} we obtain $\mathcal{I}_{(Q1-AFF)h}(\varsigma)$= {H, φ, {γ, δ}, {ɦ, ȡ, γ, β },

Case 1.2: Children with not reducing Obesity with respect to Q_1**.** Then the corresponding upper, lower approximation and the boundary region of ς

Then $\mathcal{I}_{Q1h}(\varsigma)$ = {H, φ, { ҽ}, {β }, {ɛ, β }, {γ, δ}, { ҽ, ɛ, γ }, {β, γ, δ}, {ɛ, β, γ, δ}, { ҽ, β, γ, δ}}, $B_Q 1h(\varsigma)$ = {H, φ, {γ, δ}, { ҽ, ɛ, β }}

Case 1.2.1: When nutrition food (NF) was removed from Q_1

H/ (Q_1 – NF) = {{ɦ, ȡ, ҽ, γ}, {ɛ}, {β }, {γ, δ}} we obtain $\mathcal{I}_{(Q1-NF)h}(\varsigma)$= {H, φ, {β}, {ɛ, β}, {γ, δ}, {γ, δ, β}, {ɦ, ȡ, ҽ, γ}, {γ, δ, ɛ, β}, {ɦ, ȡ, ҽ, γ, ɛ, β}}, $B_{(Q1-NF)h}(\varsigma)$ = {H, φ, {ɛ, β }, {ɦ, ȡ, ҽ, γ, η, δ}} = $B_{Q1h}(\varsigma)$

Case 1.2.2: When avoiding fast food (AFF) was removedfrom Q_1

H/ (Q_1 – AFF) = {{ɦ, ȡ, γ, β }, { ҽ}, {ɛ}, {γ, δ}} we obtain $\mathcal{I}_{(Q1-AFF)h}(\varsigma)$ = {H, φ, { ҽ}, {ɛ}, { ҽ, ɛ}, {ɦ, ȡ, γ, β }, {ɦ, ȡ, ɛ, γ, β }, {ɦ, ȡ, ҽ, ɛ, γ, β }, {ɦ, ȡ, γ, β, γ, δ}, {ɦ, ȡ, ҽ, γ, β, γ, δ}}, $B_{(Q1-AFF)h}(\varsigma)$ = {H, φ, { ҽ, ɛ}, {ɦ, ȡ, γ, β, γ, δ}}$\neq B_{(Q1h)}(\varsigma)$

Case 1.2.3: When avoid sugar sweetened beverages(ASSB)was removed fromQ_1

H/ (Q_1 – ASSB) = {{ɦ, ȡ, γ, γ, δ}, { ҽ}, {ɛ, β }} we obtain $\mathcal{I}_{(Q1-ASSB)h}(\varsigma)$ ={H, φ, { ҽ}, {ɛ, β }, { ҽ, ɛ, β}, {ɦ, ȡ, γ, γ, δ}, {ɦ, ȡ, ɛ, γ, β, γ, δ}},$B_{(Q1_{-ASSB})h}(\varsigma)$ = {H, φ, {ɦ, ȡ, ɛ, γ, β, γ, δ}, { ҽ, ɛ, β }} = $B_{Q1h}(\varsigma)$

Therefore CORE = { nutrition food, avoid fast food } (2)

Note: From (1) and (2), we get CORE 1 = { nutrition food, avoidfast food }

Case 2: Let H = {ɦ, ȡ, ҽ, ɛ, γ, β, γ, δ} be the set of children and Q_2 ={ AEPA, GGP } be the set of domains. Let H/ Q_2 = {{ɦ, ȡ, γ, γ}, { ҽ, ɛ, β, δ}}

Case 2.1: Children with reducing Obesity concerning Q_2.

Then the corresponding upper, lower approximation and the boundary region of X Then $\mathcal{I}_{Q2h}(\varsigma)$ = {H, φ, {ɦ, ȡ, γ, γ}}, $B_{Q2h}(\varsigma)$ = {H, φ, {ɦ, ȡ, γ, γ}}

Case 2.1.1: When child engaging in physical activity(CEPA)was removed from Q_2

H/ (Q_2 – CEPA) = { ҽ, ɛ, β, δ} we obtain $\mathcal{I}_{(Q2-CEPA)h}(\varsigma)$ = {H, φ},$B_{(Q2-CEPA)h}(\varsigma)$ = {H, φ} = $B_{Q2h}(\varsigma)$

Case 2.1.2: When giving guidance to their parent's (GGP)wasremoved from Q_2

H/ (Q_2 – GGP) = {{ɦ, ȡ, γ, η } we obtain $\mathcal{I}_{(Q2-GGP)h}(\varsigma)$ = {H, φ, {ɦ, ȡ, γ, η }}, $B_{(Q2-GGP)h}(\varsigma)$ = {H, φ, {ɦ, ȡ, γ, η }} = $B_{Q2h}(\varsigma)$.

Therefore CORE =child engaging in physical activity (3)

Case 2.2: Children with not Ending Obesity with respectto Q_2. Then the corresponding upper, lower approximation and the boundaryregion of ς Then $\mathcal{I}_{Q2h}(\varsigma)$ = {H, φ, { ҽ, ɛ, β, δ}}, $B_{Q2h}(\varsigma)$ = {H, φ, { ҽ, ɛ, β, δ}}

Case 2.2.1: When child engaging in physical activity (CEPA)was removed from Q_2

H/ (Q_2 – CEPA) = {{ ҽ, ɛ, β, δ}} we obtain $\mathcal{I}_{(Q2-CEPA)h}(\varsigma)$ = {H, φ}, $B_{(Q2-CEPA)h}(\varsigma)$ = {H, φ} = $B_{Q2h}(\varsigma)$

Case 2.2.2: When giving guidance to their parent's (GGP)wasremoved from Q_2

H/ (Q_2 -GGP) = {{ɦ, ȡ, γ, η}} we obtain $\mathcal{I}_{(Q2-GGP)h}(\varsigma)$ = {H, φ, { ҽ, ɛ, β, δ}}, $B_{(Q2-GGP)h}(\varsigma)$ = {H, φ, { ҽ, ɛ, β, δ}} = $B_{Q2h}(\varsigma)$.

Therefore CORE = {child engaging in physical activity } (4)

Note: From (3) and (4), we get CORE 2 = {child engaging inphysical activity}

Case 3: Let H = {ɦ, ȡ, ҽ, ɛ, γ, β, η, δ} be the set of children and Q_3 ={ HT, MGWG } be the set of domains. Let H/ Q_3 = {{ɦ, ȡ, ҽ, ɛ, γ, β, η, δ}}

Case 3.1: Children with reducing Obesity concerning Q_3**.**

Then $\mathcal{I}_{Q3h}(\varsigma)$ = {H, φ, {ɦ, γ, δ}, {ɦ, ȡ, ɛ, γ, δ}, {ɦ, ҽ, γ, β, η, δ}, {ȡ, ҽ, ɛ, γ, β }, $B_{Q3h}(\varsigma)$ = {H, φ}

Case 3.1.1: When manage hypertension (MHT) was re-moved from Q_3

H/ (Q_3 – MHT) = {{ɦ, ȡ, ҽ, ɛ, γ, β, η, δ}} we obtain $\mathcal{I}_{(Q3-MHT)h}(\varsigma)$ ={H, φ}, $B_{(Q3-MHT)h}(\varsigma)$ = {H, φ} = $B_{Q3h}(\varsigma)$

Case 3.1.2: When to manage gestational weight gain (MGWG)was removed from **Q3**

H/ (Q_3 – MGWG) = {{ɦ, ȡ, ҽ, ɛ, γ, β, η, δ}} we obtain $\mathcal{I}_{(Q3-MGWG)h}(\varsigma)$ ={H, φ}, $B_{(Q3-MGWG)h}(\varsigma)$ = {H, φ} = $B_{Q3h}(\varsigma)$

Case 3.2: Children with not reducing Obesity concerning Q3.

Let H/Q_3 = {{ɦ, ȡ, ҽ, ɛ, γ, β, η, δ}} Then $\mathcal{I}_{Q3h}(\varsigma)$ = {H, φ}, $B_{Q3h}(\varsigma)$ ={H, φ}

Case 3.2.1: When manage hypertension (MHT) was re-moved from Q_3

H/ (Q_3– MHT)= {{ɦ, ȡ, ҽ, ɛ, γ, β, η, δ}} we obtain $\mathcal{I}_{(Q3-MHT)h}(\varsigma)$ ={H, φ}, $B_{(Q3-MHT)h}(\varsigma)$ = {H, φ} = $B_{Q3h}(\varsigma)$

Case 3.2.2: When manage gestational weight gain (MGWG)was removed from Q_3

H/Q_2	LQ_2 (ς_i) (i = 1, 2, 3, 4, 5, 6)	UQ_2 (ςi)	BQ_2 (ςi)	$\mathcal{I}Q_2$ (ςi)
X_1 = {ɦ, ȡ}	φ	{ ɦ ,ȡ, η,γ}	{ ɦ ,ȡ, η,γ}	{H, φ, { ɦ ,ȡ, η, γ} }
X_2 = {ɦ, γ}	φ	{ ɦ ,ȡ, η,γ}	{ ɦ ,ȡ, η,γ}	{H, φ, { ɦ ,ȡ, η, γ} }
X_3 = {ȡ, γ}	φ	{ ɦ ,ȡ, η,γ}	{ ɦ ,ȡ, η,γ}	{H, φ, { ɦ ,ȡ, η, γ} }
X_4 = {ȡ, γ,γ}	φ	{ ɦ ,ȡ, η,γ}	{ ɦ ,ȡ, η,γ}	{H, φ, { ɦ ,ȡ, η, γ} }
X_5 = {ɦ, ȡ, γ}	φ	{ ɦ ,ȡ, η,γ}	{ ɦ ,ȡ, η,γ}	{H, φ, { ɦ ,ȡ, η, γ} }
X_6 = {γ}	φ	{ ɦ ,ȡ, η,γ}	{ ɦ ,ȡ, η,γ}	{H, φ, { ɦ ,ȡ, η, γ} }

H/ (Q_3 – MGWG) = {{ꞧ, ȡ, ȩ, ɛ̧, γ, β, η, δ}} we obtain $\mathcal{I}_{(Q3-MGWG)h}(\varsigma)$ ={H, φ}, $B_{(Q3-MGWG)h}(\varsigma)$ = {H, φ} = $B_{Q3h}(\varsigma)$.

Therefore CORE 3 = {Nil}

Case 4: Let H = {ꞧ, ȡ, ȩ, ɛ̧, γ, β, η, δ} be the set of children and Q_4 ={BM , AHFF } be the set of domains. Let H/ Q_4 = {{ꞧ, ȡ, γ}, {ȩ, ɛ̧, β, γ}, {δ}}

Case 4.1: Children with reducing Obesity concerning Q_4

Then $\mathcal{I}_{Q4h}(\varsigma)$ = {H, φ, {ꞧ, ȡ, γ}, {ȩ, ɛ̧, β, γ}, {ꞧ, ȡ, ȩ, ɛ̧, γ, β, η }} and $B_{Q4h}(\varsigma)$ ={H, φ, {ꞧ, ȡ, ȩ, ɛ̧, γ, β, η }

Case 4.1.1: When breast milk was removed from Q_4

H/ (Q_4 – BM) = {{ꞧ, ȡ, γ, δ}} we obtain $\mathcal{I}_{(Q4-BM)h}(\varsigma)$ = {H, φ, {ꞧ, ȡ, γ, δ}},$B_{(Q4-BM)h}(\varsigma)$ = {H, φ, {ꞧ, ȡ, γ, δ}} = $B_{Q4h}(\varsigma)$

Case 4.1.2: When avoid high fat foods was removed fromQ4

H/ (Q4 – AHFF) ={{ꞧ, ȡ, ȩ, ɛ̧, γ, β, η }} we obtain $\mathcal{I}_{(Q4-AHFF)h}(\varsigma)$ ={H, φ, { ꞧ, ȡ, ȩ, ɛ̧, γ, β }, $B_{(Q4-AHFF)h}(\varsigma)$ = { H, φ, { δ} ,{ ꞧ, ȡ,ȩ, ɛ̧, γ, β}} ≠ $q_{4h}(\varsigma)$

CORE ={breast milk, avoid high fat foods}……… (5)

Case 4.2: Children with not reducing Obesity concerningQ4.

Let H/Q_4 = {{ꞧ, ȡ, γ}, { ȩ, ɛ̧, β, γ}, {δ}} Then $\mathcal{I}_{Q4h}(\varsigma)$ = {H, φ, {δ}, { ȩ, ɛ̧, β },{ ȩ, ɛ̧, β, γ}, { ȩ, ɛ̧, β, γ, δ}}, $B_{Q4h}(\varsigma)$ = {H, φ, {δ}, { ȩ, ɛ̧, β, γ}}

Case 4.2.1: When breast milk(BM) was removed from Q_4

H/ (Q_4 – BM) = {{ꞧ, ȡ, γ, δ}} we obtain $\mathcal{I}_{(Q4-BM)h}(\varsigma)$ = {H, φ, {ꞧ, ȡ, γ, δ}}, $B_{(Q4-BM)h}(\varsigma)$ = {H, φ, {ꞧ, ȡ, γ, δ}} = $B_{Q4h}(\varsigma)$

Case 4.2.2: When avoiding high - fat foods (AHFF) wasremoved from Q_4

H/ (Q_4 – AHFF) = {{ꞧ, ȡ, ȩ, ɛ̧, γ, β, η }} we obtain $\mathcal{I}_{(Q4-AHFF\ )h}(\varsigma)$ ={H, φ}, $B_{(Q4-AHFF\ )h}(\varsigma)$ = {H, φ} = $B_{Q4h}(\varsigma)$.

CORE ={breast milk , avoidhigh fat foods} (6)

Note: From (5) and (6), we get CORE 4 ={breast milk, avoidinghigh-fat foods}

Case 5: Let H ={ ꞧ, ȡ, ȩ, ɛ̧, γ, β, η, δ} be the set of children and Q_5 = { NL, HM} be the set of domains. Let H/Q_5 ={ꞧ, ȡ, ȩ, ɛ̧, γ, β, η, δ}

Case 5.1: Children with reducing Obesity concerning Q_5. Then $\mathcal{I}_{Q5h}(\varsigma)$ = {H, φ} and $B_{Q5h}(\varsigma)$ = {H, φ}

Case 5.1.1: When nutrition literacy(NL) was removed from Q_5

H/ (Q_5 – NL) = {{ꞧ, ȡ, γ, η }} we obtain $\mathcal{I}_{(Q5-NL)h}(\varsigma)$ = {H, φ}, $B_{(Q5-NL)h}(\varsigma)$ = {H, φ} = $B_{Q5h}(\varsigma)$

Case 5.1.2: When healthy meals(HM) provided in schoolwas removed from Q5

H/ (Q_5 – HM) = {{ꞧ, ȡ, ȩ, ɛ̧, γ, β, δ}} we obtain $\mathcal{I}_{(Q5-HM)h}(\varsigma)$ = {H, φ}, $B_{(Q5-HM\ )h}(\varsigma)$ = {H, φ} = $B_{Q5h}(\varsigma)$

Case 5.2: Children with not reducing Obesity concerning Q5.

Let H/Q_5 = {{ꞧ, ȡ, ȩ, ɛ̧, γ, β, η, δ}}. Then $\mathcal{I}_{Q5h}(\varsigma)$ = {H, φ}, $B_{Q5h}(\varsigma)$ ={H, φ}

Case 5.2.1: When nutrition literacy(NL) was removed fromQ5

H/ (Q_5 – NL) = {{ꞧ, ȡ, γ, η}} we obtain $\mathcal{I}_{(Q5-NL)h}(\varsigma)$ = {H, φ},$B_{(Q5-NL)h}(\varsigma)$ = {H, φ} = $B_{Q5h}(\varsigma)$

Case 5.2.2: When healthy meals(HM) provided in schoolwas removed from Q_5

H/ (Q_5 – HM) = {{ꞧ, ȡ, ȩ, ɛ̧, γ, β, η, δ}} we obtain $\mathcal{I}_{(Q5-HM)h}(\varsigma)$ = {H, φ}, $B_{(Q5-HM)h}(\varsigma)$ = {H, φ} = $B_{Q5h}(\varsigma)$. Therefore CORE = {Nil}

Case 6: Let H = {ꞧ, ȡ, ȩ, ɛ̧, γ, β, η, δ} be the set of children and Q_6 = {CD, PS} be the set of domains. Let H/Q_6 = {{ꞧ, ȡ, γ, η}, { ȩ, ɛ̧, β, δ}}

Case 6.1: Children with reducing Obesity concerning Q_6**. Then** $\mathcal{I}_{Q6h}(\varsigma)$ = {H, φ, {ꞧ, ȡ, γ, η }} **and** $B_{Q6h}(\varsigma)$ = {H, φ, {ꞧ, ȡ, γ, η }}

Case 6.1.1: When covers diet(CD) was removed from Q_6

H/ (Q_6 – CD) ={{ ȩ, ɛ̧, β, δ}} we obtain $\mathcal{I}_{(Q6-CD)\boldsymbol{h}}(\varsigma)$ = {H, φ}, $B_{(Q6-CD)\boldsymbol{h}}(\varsigma)$ = {H, φ} = $B_{Q6h}(\varsigma)$

Case 6.1.2: When psycho-social support(PS) was removedfrom Q_6

H/ (Q_6 – PS) = {{ꞧ, ȡ, γ, η }} **we obtain** $\mathcal{I}_{(Q6-PS)h}(\varsigma)$ = {H, φ, {ꞧ, ȡ, γ, η }},$B_{(Q6-PS)h}(\varsigma)$ = {H, φ, {ꞧ, ȡ, γ, η}} = $B_{Q6\boldsymbol{h}}(\varsigma)$

Case 6.2: Children with not reducing Obesity concerning Q6.

Let H/Q_6 = {{ꞧ, ȡ, γ}, { ȩ, ɛ̧, β, γ}, {δ}}. Then $\mathcal{I}_{Q6h}(\varsigma)$ = {H, φ, { ȩ, ɛ̧, β, δ}}, $B_{Q6h}(\varsigma)$ = {H, φ, { ȩ, ɛ̧, β, δ}}

Case 6.2.1: When covers diet(CD) was removed from Q6

H/ (Q_6 – *CD*) = {{ ȩ, ɛ̧, β, δ}} we obtain $\mathcal{I}_{(Q6-CD)\boldsymbol{h}}(\varsigma)$ = {H, φ, { ȩ, ɛ̧, β, δ}}, $B_{(Q6-CD)\boldsymbol{h}}(\varsigma)$ = {H, φ, {ȩ, ɛ̧, β, δ}} = $B_{Q6\boldsymbol{h}}(\varsigma)$

Case 6.2.2: When psycho-social support(PS) was removedfrom Q_6

H/ (Q_6 – PS) = {{ꞧ, ȡ, γ, η }} we obtain $\mathcal{I}_{(Q6-PS)h}(\varsigma)$ = {H, φ}, $B_{(Q6-PS)\boldsymbol{h}}(\varsigma)$ = {H, φ} = $B_{Q6\boldsymbol{h}}(\varsigma)$

Therefore CORE = { covers diet and psycho-social supportare independent of each other }

CONCLUSION

The pervasiveness of fat among infants, children, and youngsters is rising globally, with more children who are not yet obese being overweight and on the path to obesity. Obesity can have a deep impact on a child's immediate health, educational outcomes, and overall quality of life. However, much of this can be mitigated if parents promote a healthier lifestyle at home. The habits children learn about healthy eating, physical activity, and making nutritious choices at home often translate into other areas of their lives. This paper highlights several key factors that can help reduce childhood obesity, including proper nutrition, avoiding fast food, encouraging physical activity, breastfeeding, and limiting high-fat foods. One of the most effective strategies for preventing childhood fat is to improve the eating and exercise habits of the entire family. Healthy habits lay the foundation for lifelong well-being in children and teens. Eating nutritious foods and staying physically active are essential not only for healthy growth and development but also for preventing chronic health issues. These habits can even contribute to improved academic performance. However, good health is not just about diet and exercise children also need adequate sleep and limited screen time to maintain both mental and physical well-being.

Recommendations of reduce Childhood Obesity as follows:

- **Promote Healthy Food Intake and Reduce Unhealthy Foods**

  Develop and implement programs focused on increasing the absorption of nutritious foods (like fruits, vegetables, whole grains, and lean proteins) while decreasing the consumption of unhealthy foods (such as junk food, fast food, and sugary drinks) among children and adolescents. This could involve public awareness campaigns, school-based nutrition programs, and incentives for healthy eating.
- **Promote Physical Activity and Reduce Sedentary Behaviour**

  Create initiatives that encourage children and adolescents to be more active and reduce time spent on sedentary activities (like screen time). This could include community sports programs, school physical education reforms, active transport campaigns (e.g., walking or cycling to school), and reducing the availability of sedentary activities in leisure time.
- **Integrate Non-Communicable Disease Prevention with Preconception and Antenatal Care**

  Incorporate strategies for preventing non-communicable diseases (NCDs), such as obesity, into preconception and antenatal care. By providing health education and guidance on nutrition, physical activity, and weight management to expecting parents, the aim is to diminish the risk of childhood obesity starting from birth.
- **Support Healthy Growth and Habits in Early Childhood**

  Provide clear guidelines for parents and caregivers on promoting healthy eating, physical activity, and sleep routines in early childhood to ensure proper growth and development. This could include early childhood education programs, paediatrician support, and public health campaigns focusing on the importance of balanced diets, sleep hygiene, and active play.
- **Promote Healthy School Environments and Literacy**

  Develop programs that improve the health and nutrition environment in schools, such as offering healthier meal options, promoting active breaks, and providing education on nutrition and physical activity. Schools can also serve as hubs for learning about the benefits of a healthy lifestyle through curriculum integration and extracurricular activities.
- **Family-Based, Multicomponent Weight Management Services**

  Offer family-oriented weight management programs that combine nutrition education, physical activity, behavioural counselling , and support systems. These programs should be tailored to children and adolescents who are obese and include interventions for the entire family, fostering a supportive home environment for healthy lifestyle changes.

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AUTHORSHIP CONTRIBUTIONS

Authors equally contributed to this work.

DATA AVAILABILITY STATEMENT

The authors confirm that the data that supports the findings of this study are available within the article. Raw data that support the finding of this study are available from the corresponding author, upon reasonable request.

CONFLICT OF INTEREST

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ETHICS

There are no ethical issues with the publication of this manuscript.

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