A Cultural and Philosophical Exploration of Ergonomic Design Solutions for Obesity Management and Physical Fitness Enhancement

Safaa Ibrahim Abd El-Fattah Hanafy*
Professor, Product Design Department, Design and Art College, Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia.
Email: sihanfy@pnu.edu.sa
ORCID iD: https://orcid.org/0000-0002-4944-1806

Aysha Abduljabbar Abdullah Al Essa
Associate Professor, Product design department, Design and Art College, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia.
Email: aaalessa@pnu.edu.sa
ORCID iD: https://orcid.org/0000-0001-9708-4383

Abstract: This study addresses the global obesity epidemic with an innovative approach, focusing on the cultural and philosophical dimensions inherent in addressing physical inactivity by redesigning sports equipment for sedentary environments. Using the Design for Fun methodology, the research employed a comprehensive survey-based strategy, incorporating literature reviews and participant surveys. Insights from interviews, observations, and a questionnaire involving 52 participants revealed shortcomings in existing sports equipment and reasons for limited regular exercise, including aspects related to size and shape and reduced enjoyment. In response, the research presents a new product design, which was evaluated by 32 specialists and received high user satisfaction. Methodologically, the study emphasizes the importance of continuous user feedback for design refinement. Additionally, the study draws conclusions on the effectiveness of integrating cultural and philosophical dimensions into obesity and healthy lifestyle interventions and provides recommendations for future research and initiatives in this field. With promising results, this research contributes significantly to the fields of obesity intervention and sports product design, serving as inspiration for future impactful initiatives to promote global well-being.
Keywords: Obesity, Ergonomic Standards, Fitness, Sports Products, Physical Activity, Design for Enjoyment, Innovative Solutions, Cultural Perspectives.

1. INTRODUCTION

This study critically delves into the escalating global obesity crisis, intertwining historical trends since 1975 with an urgent call for intervention (Tashiro et al., 2023). Sedentary lifestyles, fueled by technological advancements and a prevalence of fast food, have led to a triple increase in

obesity rates (Baleilevuka-Hart et al., 2022). The severity of this issue is highlighted by the 2016 WHO report, revealing a staggering 40 million children under five classifieds as obese by 2018 (Pillar, 2023). Figure 1 illustrates obesity rates in the top ten countries, underscoring the substantial portion of these populations at risk (Hadri et al., 2022).

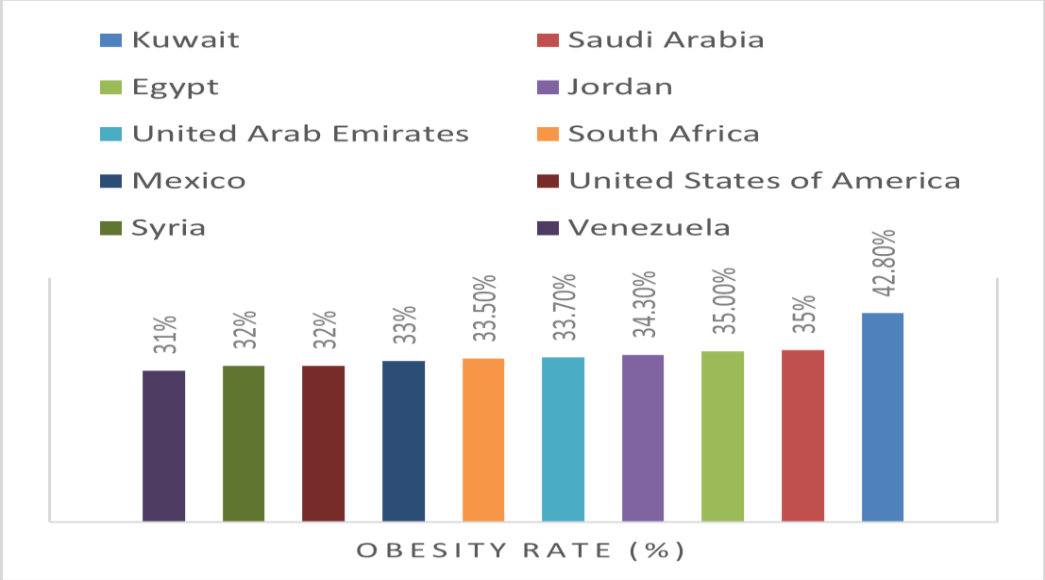

Figure 1: Graphical Analysis of the Top 10 Countries in The World with Obesity Rates.

This study places a specific emphasis on the global obesity challenge (Althumiri et al., 2021), focusing keenly on Saudi Arabia, (Albalawi et al., 2022) currently ranking second globally with an obesity rate of 35.2% (Vision 2030 Kingdom of Saudi Arabia, 2020) Recent data from the General Authority for Statistics (November 26, 2023) provides detailed indicators of obesity among adults and children in the Kingdom, as presented in Table 1.

Table 1: Presents Obesity and Overweight Tates Among Different Demographic Groups.

Indicator	Obesity rate
Obesity among Adults (15 years and over)	23.7%
Males	23.7%
Females	23.7%
Overweight among Adults (15 years and over)	30%
Males	29.5%
Females	39.6%
Obesity among Children (Under the age of 15)	7.3%

Interpretation of Table 1: provides obesity and overweight rates across various demographic groups, including adults (15 years and over) and

children (under the age of 15). It outlines the prevalence of obesity and overweight status among males and females within these age categories.

This research stands as a hopeful response to the pressing obesity crisis (Tase et al., 2022), recognizing its severe impact on health and well-being (Wooldridge et al., 2023). Advocating for innovative approaches (Canestrari et al., 2018), it proposes a shift in perspective rooted in the "design for fun" philosophy, aligning with cultural values emphasizing holistic well-being. By infusing fun and attractiveness into fitness design (Abdelkarim et al., 2020), the study goes beyond a mere examination of obesity trends, challenging conventional wisdom and offering innovative solutions grounded in cultural and philosophical ideals for a healthier future (Lee & Peterson, 2000).

1.1 Research Questions

-Main Research Question: What factors influence obesity prevalence in Saudi Arabia, particularly the impact of sedentary lifestyles and cultural norms?

- Subsidiary Research Questions:

1. How do cultural norms affect physical activity levels across different demographic groups in Saudi Arabia?
2. What factors contribute to the rise of obesity in Saudi Arabia, and how do they intersect with cultural ideals?
3. Are there regional disparities in obesity rates within Saudi Arabia, and what cultural and environmental factors contribute to these differences?
4. What is the effectiveness of culturally rooted interventions in combating obesity and promoting healthier lifestyles in Saudi Arabia?

- Exploratory Questions:

1. What are the attitudes towards physical activity, fitness, and obesity among Saudi Arabian residents?
2. How do cultural traditions influence dietary habits and physical activity patterns in Saudi Arabia?
3. What role do family, community, and religious practices play in shaping attitudes towards health and fitness in Saudi Arabia?

- Comparative Questions:

1. How do obesity rates in Saudi Arabia compare to other culturally similar countries?
2. What insights can be drawn from successful obesity intervention programs in other cultural contexts for application in Saudi Arabia?

- Longitudinal Questions:

1. How has obesity prevalence changed over time in Saudi Arabia, and

what factors have influenced these changes?

2. What are the long-term impacts of obesity on public health, societal well-being, and economic prosperity in Saudi Arabia, and how can these be addressed through culturally sensitive interventions?

1.2 Study Objectives

The study aims to address the global obesity crisis, particularly in Saudi Arabia, by exploring its cultural and philosophical dimensions. With obesity rates persistently rising despite efforts to improve quality of life, innovative interventions are crucial. Specifically, the study seeks to introduce inventive interventions in fitness product design tailored for sedentary environments, as depicted in Figure 2. These environments present unique challenges to physical activity, necessitating a nuanced understanding of cultural inclinations and philosophical ideals to develop effective solutions. Ultimately, the study aims to offer culturally sensitive insights that transcend conventional approaches.

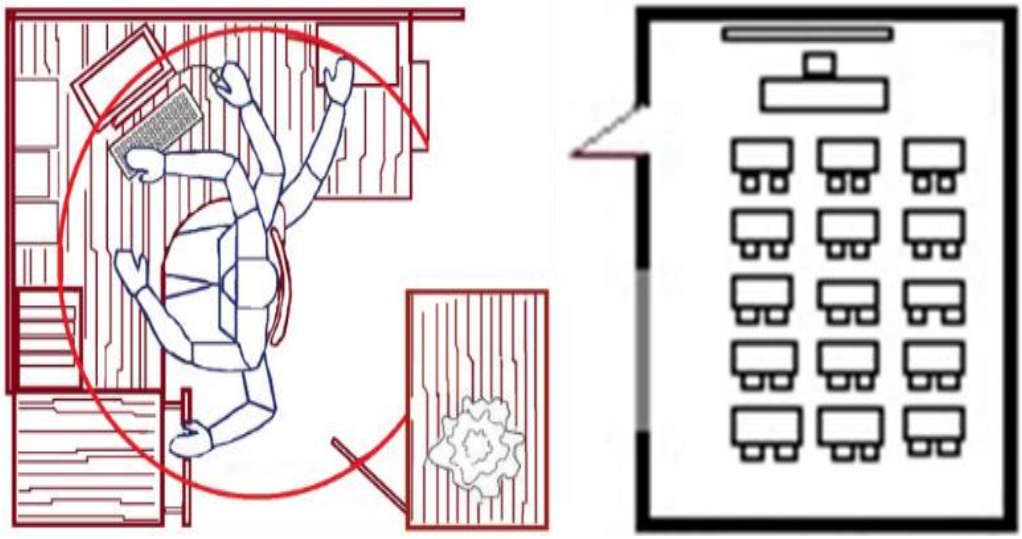

Figure 2: Displays Examples of Stable Environments, Featuring A Horizontal Orthographic View of an Office Environment and A School Classroom.

Furthermore, our objectives extend beyond combating obesity to encompass a broader cultural and philosophical context. By understanding the challenges of sedentary lifestyles in Saudi Arabia, we aim to foster innovation in fitness design aligned with cultural values. This holistic approach positions the study as a catalyst for transformative solutions deeply rooted in Saudi Arabian culture and philosophy.

1.2.1 Investigate Global and Saudi Arabian Obesity Scenarios: Cultivating Cultural and Philosophical Insights

Embarking on a cultural and philosophical exploration, this study delves

into the intricate fabric of global obesity trends, recognizing its nuanced dimensions. A focal point is Saudi Arabia, grappling with the second-highest global obesity rate at 35.2%. By intertwining cultural sensitivity and philosophical perspectives, the research aims to decipher the cultural narratives and philosophical underpinnings that contribute to the obesity landscape in Saudi Arabia.

1.2.2 Assess the Impact of Sedentary Behavior and the Built Environment on Obesity Rates: Navigating Cultural Contexts

The examination extends to the influence of sedentary lifestyles and the built environment on obesity prevalence. By scrutinizing cultural contexts, the study seeks to unravel the intricate relationship between cultural norms, philosophical values, and lifestyle choices that impact obesity rates. A profound understanding of these elements is crucial for formulating interventions that resonate with the cultural fabric of Saudi Arabia.

1.2.3 Propose Innovative Design Solutions for Sports Products in Sedentary Environments:

This objective delves into innovative design solutions for sedentary environments, blending culture and design philosophy. By understanding cultural preferences and philosophical ideals, the study aims to propose sports product designs that align with Saudi cultural norms. Emphasizing fun and attractiveness, it advocates for a design philosophy rooted in cultural resonance, catering to the aspirations of the Saudi population.

1.3 Study Problem

Rising obesity rates, particularly in Saudi Arabia, warrant thorough investigation despite ongoing efforts to improve well-being. This study addresses this issue by incorporating cultural and philosophical insights into the design of fitness products, especially in sedentary environments influenced by cultural norms.

1.4 Hypotheses: Culturally Grounded Innovations for Healthier Futures

Fitness product designs emphasizing enjoyment and attractiveness are anticipated to positively impact individuals combating obesity, aligning with cultural inclinations and encouraging participation in alternative physical activities. Implementing ergonomic design interventions in sedentary settings is expected to boost physical activity and reduce sedentary behavior, reflecting lifestyle choices. Integrating exercise products designed for

enjoyment and appeal is predicted to lead to significant enhancements in obesity-related health outcomes. This approach, rooted in culture and philosophy, aims to decrease inactivity levels and foster ongoing engagement in physical activities, aligning with Saudi values for a healthier future.

2. LITERARY REVIEWS

The prolonged sedentary behavior prevalent in modern lifestyles has significant health implications, including its link to obesity and related complications (Abalkhail, 2002). This connection prompts deep cultural and philosophical considerations regarding human well-being (Abdelkarim et al., 2020). The exploration encompasses mortality rates (Tase et al., 2022), mental health impacts, and the association with depression and anxiety, particularly among college students, prompting reflections on societal values and lifestyle choices (Faulconbridge & Bechtel, 2014). This narrative further extends to metabolic health, musculoskeletal disorders, and the intricate relationship between physical activity and sedentary behavior across different demographic groups (Absil et al., 2021; Boatca & Cirjaliu, 2015).

Table 2: Provides a Concise Overview of the Relationship between Physical Activity and Different Health Outcomes.

Health Outcome	Association with Physical Activity
Spontaneous Fertility (Men and Women)	Mixed results, with some studies showing no association
Gene Expression and Epigenetic Modifications	Linked to genes related to inflammation, immune function, angiogenesis, and cardiovascular disease
Schoolchildren	Positive correlation with increased physical activity levels and reduced sedentary behavior
Alpha-1 Antitrypsin Deficiency (AATD)	Limited research, primarily focused on exercise capacity
Cancer Survivors	Improved outcomes with physical activity regimens, reduction in sedentary behavior enhances outcomes

Interpretation of Table 2: summarizes the link between physical activity and health outcomes. It shows mixed results for spontaneous fertility, links gene expression to inflammation and cardiovascular disease, notes a positive correlation between physical activity and reduced sedentary behavior in schoolchildren, highlights limited research on physical activity's impact on Alpha-1 Antitrypsin Deficiency, and underscores improved outcomes for cancer survivors with physical activity and reduced sedentary behavior.

2.1 Obesity and Its Health Effects: A Philosophical and Cultural Exploration

Obesity prompts a philosophical inquiry into health and cultural influences, intertwining with societal values and lifestyle choices (Tase et al., 2022). The cardiovascular impact delves into broader cultural and philosophical reflections on body image and societal norms.

2.1.1 Cardiovascular Effects

Obesity's impact on heart health reflects societal attitudes toward physical well-being (Wooldridge et al., 2023), urging examination of lifestyle choices and body image perceptions.

2.1.2 Obesity and Cancer Risk

The link between obesity and cancer underscores the need to shift cultural beauty standards and philosophical health considerations (Boatca & Cirjaliu, 2015), particularly in public health discourse (Al Dossary et al., 2010).

2.1.3 Obesity and Mental Health

The correlation between obesity and mental illness sparks a cultural and philosophical discourse on holistic well-being (Staiano & Katzmarzyk, 2012), challenging societal stigmas and reevaluating beauty norms and the mind-body relationship (Riemann et al., 2021) Figure 3.

Figure 3: Illustrates the Detrimental Effects of Prolonged Sitting in A Fixed Position, Which Can Contribute to Obesity, Consequently Increasing the Risk of Various Chronic Diseases.

2.2 Ergonomic Interventions in Educational Settings: Cultivating Well-being through Philosophy and Design.

2.2.1 Philosophical Commitment to Holistic Well-being:

Ergonomic interventions in educational environments represent a profound philosophical commitment to the holistic well-being of students and educators, transcending the mere physical realm to encompass the psychological dimensions. Rooted in the philosophy of optimizing human potential, these interventions seek to harmonize cultural considerations with the design of furniture, equipment, and learning spaces, aiming to minimize the risk of musculoskeletal disorders, and fostering a symbiotic relationship between form and function.

2.2.2 Philosophical Foundation of Ergonomics

The introduction of adjustable furniture and supplementary tools is not merely a practical measure; it is a philosophical underscore of empowering students through customization. By incorporating adjustable desks and chairs, students gain agency in shaping their learning environment, fostering a sense of responsibility and autonomy. This aligns with a philosophical perspective viewing education as a collaborative endeavor, where the physical space becomes a canvas for the co-creation of knowledge (Rasouli et al., 2013).

2.2.3 Cultural Relevance of Ergonomic Design

Supplementary tools, such as manual trays and footrests, extend beyond ergonomic functionality to become cultural artifacts symbolizing the importance of support systems within a learning community (Chiu et al., 2016). In diverse cultural contexts, the act of providing additional tools echoes the cultural value of communal support, emphasizing the philosophy that education is not an isolated journey but a collective experience.

2.2.4 Ergonomics and Pedagogical Philosophy

The incorporation of ergonomic computing equipment and the design of adaptable learning environments align with pedagogical philosophies recognizing the diversity of learning styles. The provision of stability balls, standing desks, and collaborative spaces reflects a cultural shift in the perception of education. It acknowledges that learning is a dynamic, fluid process, and the environment should adapt to accommodate various pedagogical approaches (Yoshioka et al., 2019).

2.2.5 Philosophical Evaluation of Effectiveness

The efficacy of these ergonomic interventions requires a philosophical

evaluation. Studies, such as the one published in the Journal of School Health, become not just scientific endeavors but cultural narratives affirming that adaptability in learning spaces leads to increased student commitment. The Applied Ergonomics study echoes a philosophy that values student satisfaction alongside the reduction of musculoskeletal symptoms (Li, 2020).

2.2.6 Cultural Recognition of Ergonomic Guidelines

Table 3, summarizing the impact of ergonomic interventions, becomes a cultural manifesto emphasizing the need for comprehensive ergonomic guidelines (Wang et al., 2022). This aligns with the philosophy that educational environments should be guided by principles prioritizing knowledge, awareness, and positioning, fostering a culture of well-being and inclusivity.

Interpretation of Table 3: This table outlines various ergonomic interventions aimed at improving comfort and reducing physical strain in educational settings. It includes adjustable desks and chairs, ergonomic accessories, ergonomic computing equipment, and flexible learning environments. These interventions are designed to promote better posture and enhance the overall learning experience.

Table 3: Presents Various Ergonomic Interventions.

Ergonomic Intervention	**Description**	**Figure**
Adjustable Desks and Chairs	Students can customize seating and working positions for better posture and reduced physical strain.	
Ergonomic Accessories	Ergonomic Accessories	
Ergonomic Computing Equipment	Ergonomic Computing Equipment	
Flexible Learning Environments	Flexible Learning Environments	

-Mitigating Sedentary Behavior in Various Environments: Mitigating the harmful effects of sedentary behavior requires a bridge between health philosophy and physical reality, particularly in workplaces and public spaces (Pugliese et al., 2022). Figures 4 and 5 symbolize not just stable and flexible work environments but embody a philosophical and cultural shift towards acknowledging the importance of movement in our daily lives.

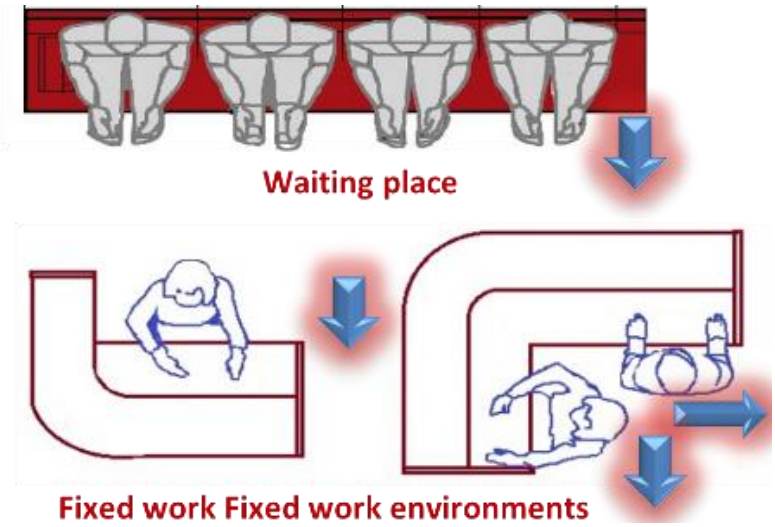

Figure 4: Illustrates The Movement-Limited Paths That Static Environments Impose on Users.

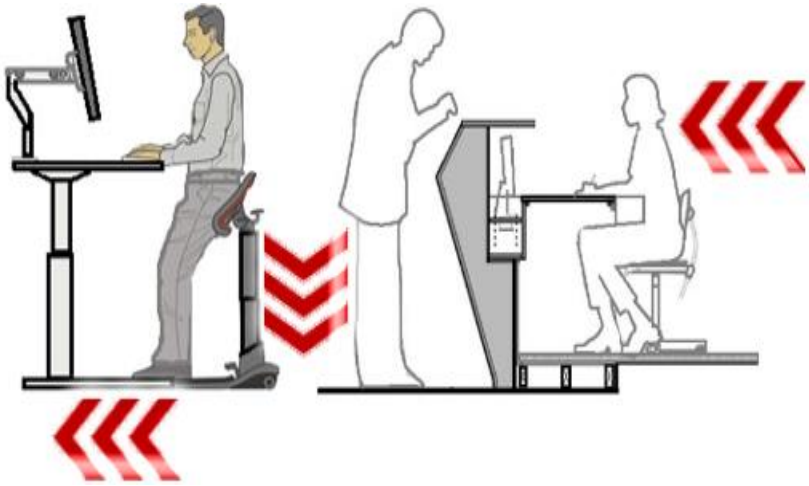

Figure 5: Illustrates The Multiple Paths of Movement That Flexible Environments Impose on Users.

2.2.7 Integrating Physical Activity Opportunities in Healthcare Facilities: A Philosophical Approach

The incorporation of physical activity opportunities within healthcare facilities represents a proactive strategy grounded in a profound philosophical commitment to improving patient outcomes and nurturing comprehensive well-being in the healthcare ecosystem (O'Connor et al., 2021). This approach goes beyond traditional healthcare practices, acknowledging the interconnection of physical, mental, and emotional well-being. The deliberate design of fitness centers within healthcare facilities signifies a philosophical comprehension of the diverse exercise needs of individuals with varying fitness levels (Malm et al., 2019). By

providing a range of exercise equipment and personalized programs, healthcare institutions acknowledge the distinctiveness of each patient's physical condition, offering avenues for tailored well-being enhancement.

Table 4: Advantages of Integrating Physical Activity in Healthcare Facilities.

Physical Activity Opportunities in Healthcare Facilities	**Benefits**
Meticulously designed fitness centers	Varied exercise options for diverse fitness levels
Tailored programs for individuals with medical conditions	Effective prevention and control of chronic ailments
Readily available walking paths and open-air areas	Stress reduction and enhanced psychological well-being
Healthcare professionals' encouragement for physical activity	Positive impact on patient recovery and overall health

Interpretation of Table 4: This table outlines the advantages of integrating physical activity into healthcare facilities. It includes meticulously designed fitness centers offering varied exercise options, tailored programs for individuals with medical conditions for effective ailment prevention, readily available walking paths and open-air areas for stress reduction, and healthcare professionals' encouragement for physical activity, positively impacting patient recovery and overall health.

3. MATERIALS AND METHODS

3.1 Materials: Exploring the Philosophical Dimensions of Physical Activity

3.1.1 The Impact of Exercise on Physical and Mental Well-being: A Philosophical Inquiry

Physical activity, often hailed as the "wonder pill" for addressing obesity (O'Connor et al., 2021), extends beyond its physiological effects to encompass profound implications for mental well-being. This exploration delves into the philosophical underpinnings of exercise (Wang et al., 2022), recognizing (Jola et al., 2017) its role not only in preventing and alleviating physical health conditions but also in shaping mental and emotional resilience. Exercise, as a philosophical intervention, is crucial for adolescents' holistic development, impacting emotions, cognition, and social adjustment (Pugliese et al., 2022). It embodies a commitment to self-care and mental well-being, serving as a preventive measure against mental health issues like depression and anxiety. Exercise is viewed as a philosophy dedicated to enhancing life quality through the interconnectedness of

physical and mental health (Liu et al., 2023). Moreover, the philosophical aspects of exercise extend to its influence on cognitive functions, such as concentration and memory. Beyond physical movement, exercise is seen as a cognitive stimulant, contributing to intellectual capacities, particularly in college students. The philosophy emphasizes exercise not just as a physical routine but as a holistic approach promoting mental health and vitality.

3.1.2 Impact of Physical Activity on Mood: A Cultural and Philosophical Perspective

The impact of physical activity on mood, driven by neurotransmitter release (Konduru et al., 2022), holds cultural and philosophical significance. This section delves into this relationship, considering cultural context and philosophical influences (Jola et al., 2017). Endorphin release during exercise is culturally framed as a reward mechanism, tying physical exertion to emotional well-being. Neurotransmitters like GABA promote tranquility (Faulconbridge & Bechtel, 2014), aligning with philosophical ideals of mental balance through physical practices.

Various contextual factors (Colleluori et al., 2022), including location and social interaction, shape the mental health benefits of physical activity (Cho & Park, 2021), forming a cultural tapestry (Hills et al., 2013). Different cultural contexts yield different benefits (Quiroga Murcia et al., 2010), emphasizing the need for culturally sensitive exercise recommendations. Viewing exercise culturally and philosophically reveals its broader societal impact on relaxation (Abalkhail, 2002), vitality, happiness, and self-esteem (Cho & Park, 2021).

Table 5(a): Summary of the Impact of Obesity on Mental Health and Well-being Strategies

Aspect	Description
Obesity and Psychological Impact	Obesity markedly raises the likelihood of psychological disorders, focusing on depression and anxiety. The risk emanates from factors affecting quality of life, shame culture, and diminished self-confidence
Impact on Quality of Life	Impact on Quality-of-Life d restricts movement, limiting outdoor activities and travel. Reduced social participation can result in feelings of loneliness and isolation, significantly affecting mental health.
Shame Culture Associated with Obesity	Obesity leads to social stigma, causing shame, bullying, discrimination, and increased mental health risks, especially in children and adolescents, leading to reduced self-confidence and depression.
Lack of Self-Confidence	Excess weight alters self-perception, leading to dissatisfaction with body image. This dissatisfaction generates anxiety and fear of judgment, contributing to social embarrassment.

Table 5(b): Summary of the Impact of Obesity on Mental Health and Well-being Strategies

Aspect	Description
Psychological Disorders Associated with Obesity	Obesity heightens the risk of psychological issues, particularly depression and anxiety, due to factors like inflammatory substances, social bullying, and a reciprocal link between depression and obesity.
Strategies to Promote Health and Mental Well-being	In dealing with the connection between mental health and obesity, adopting crucial strategies for weight management is essential. This involves making dietary changes and increasing physical activity, with recommendations for a nutrient-rich diet and regular exercise.

Interpretation of Table 5: This table summarizes the cultural and philosophical aspects of strategies addressing the impact of obesity on mental health. It emphasizes the necessity for a comprehensive and culturally sensitive approach in developing well-being strategies.

3.1.3 Integrating Dance into Sports Products: A Cultural Revolution in Physical Activity

Proposing a cultural revolution in addressing obesity and sedentary lifestyles (Quiroga Murcia et al., 2010), the integration of dance into sports products signifies a paradigm shift in the philosophy of exercise (Faulconbridge & Bechtel, 2014). Dance, traditionally a cultural and social expression, emerges as a transformative tool for health promotion (Malm et al., 2019).

This section aims to unravel the cultural and philosophical dimensions of dance. positioning it as a holistic and enjoyable form of exercise. Recognizing dance as a cultural expression underscores its significance beyond physical activity. It becomes a means of cultural preservation and identity, enriching the philosophical landscape of exercise (Wang et al., 2022). Leveraging dance-associated benefits, such as enhanced happiness, increased self-confidence, and mitigation of depression, the study positions dance as a powerful avenue for holistic well-being (Liu et al., 2023).

The philosophy here is to redefine the conventional exercise experience (Konduru et al., 2022), infusing it with cultural richness, dynamism, and joy (O'Connor et al., 2021).

3.1.4 Sports Products for Weight Loss

The research focused on gyms specializing in obesity treatment to compile a comprehensive list of sports equipment facilitating weight loss.

Emphasis was placed on overall fat burning, particularly in the abdominal area, and involving comprehensive body movement, with insights gathered from discussions with training personnel. Various products meeting these criteria were identified, Table 6.

Table 6: Shows The Most Used Sports Products.

Product Name	Product Description	Product Shape
Stationary Bike	Ideal for those with limitations hindering running activities, suitable for individuals with heart conditions.	
Home Bike	Compact and lightweight, catering to home use.	
Ergonomic Bike	Medium-weight bike with adjustable resistance.	
E-Bike	Utilizes electromagnetic resistive technology, offering customizable resistance.	
Treadmills	Electric and automatic types catering to walking, running, and jogging.	
Fixed Rowing Machine	Mimics kayaking, targeting major arm and leg muscles.	
Air Skating	Simulates skiing, engaging upper and lower body muscles.	
Ladder Device (Step)	Simulates stair climbing, offering resistance control.	

Interpretation of Table 6: This table presents a summary of commonly used sports products along with their descriptions and shapes. Each product is described briefly, highlighting its intended use and features.

3.2 Method: Innovative Design Solutions for Promoting Physical Activity and Well-being

In response to the pressing challenges of physical inactivity and rising obesity rates, particularly in sedentary environments, this research endeavors to pioneer inventive design solutions for sports products. Beyond merely promoting physical activity, the primary thrust is to contribute to the holistic well-being of individuals, with a specific focus on addressing the obesity issue prevalent in Saudi Arabia.

3.2.1 Experimental Design: Unveiling Causal Relationships and Intervention Effectiveness

The experimental design chosen is effective in exploring cause-and-effect

relationships and assessing intervention impact.It allows for manipulation of variables, scrutinizing ergonomic interventions, and studying design elements influencing user engagement and physical activity. The study uses a carefully crafted experimental approach to design and evaluate exercise equipment, involving a diverse group of participants with varying demographics, age, and fitness levels. Stratification based on BMI creates two main groups: those considered obese (BMI > 30) and those within the normal or overweight BMI range.

3.2.2 Comprehensive Data1 Collection: Insights from Various Perspectives

Various methods, including surveys, questionnaires, interviews, and observations, were used to collect data on ergonomic design solutions. Surveys and questionnaires had Likert scale and multiple-choice questions, exploring exercise habits and preferences. Interviews provided qualitative insights, while observations focused on user behavior and engagement during exercise.

3.3 Research Instruments: Ensuring Transparency and Replicability

In this study, two questionnaires were used to collect data from participants, ensuring transparency and replicability of the research process. The first questionnaire aimed to gather information on participants' demographics, obesity status, exercise habits, use of sports equipment, problems encountered with sports equipment, and overall evaluation of sports equipment.

The second questionnaire measured user satisfaction with the proposed design, including aspects such as appearance, expected pleasure during use, ease of use, size fit, aesthetic values, ergonomics, and novelty. By clearly detailing the research tools used, the study enhances transparency, facilitating future replication and understanding of the methodology.

4. DATA ANALYSIS

Merging Quantitative and Qualitative Approaches: The amassed data underwent rigorous analysis, seamlessly blending quantitative and qualitative methodologies. Statistical software was harnessed for quantitative analysis, enabling the extraction of descriptive statistics, frequency distributions, and correlations.

Concurrently, qualitative data from interviews and open-ended inquiries underwent thematic analysis, unraveling valuable insights concerning exercise equipment design and user experiences Table 7.

Table 7: Overview of The Research Methodology Components.

Section	Content
Experimental Design	Choosing an experimental design to examine the impact of fitness product designs on physical activity and health in sedentary environments.
Participant Selection	Selecting diverse participants in terms of age and fitness levels, categorizing them into two groups: (a) Individuals suffering from obesity and (b) non-obese individuals.
Data Collection	- Using surveys to explore participants' opinions and preferences. - Conducting interviews to understand experiences and barriers related to exercise practices. - Observing participants' behavior while using exercise equipment in controlled environments.
Data Analysis	- Quantitative analysis using statistical software to extract statistics, frequencies, and correlations from quantitative data. - Qualitative analysis using thematic analysis to uncover meaningful insights from qualitative data.
Exercise Equipment Design	The researchers designed a product that includes several functions to help users participate in physical activity, which enhances the enjoyment and attractiveness factor.
Results and Discussion	Presenting key findings and discussing them in detail, including comparisons with current literature and the impact of results on the field of fitness equipment design and obesity.

Interpretation of Table 7: This table outlines the research methodology employed, encompassing the experimental design chosen to investigate the effects of fitness product designs on physical activity and health in sedentary environments. It highlights participant selection criteria, data collection methods including surveys, interviews, and observations, and details the quantitative and qualitative data analysis techniques utilized. Additionally, it summarizes the development of an exercise equipment prototype aimed at enhancing physical activity enjoyment and attractiveness and discusses the presentation and discussion of key findings within the context of existing literature and implications for fitness equipment design and obesity intervention strategies.

4.1 Holistic Exercise Equipment Design: Fusing Philosophy and User-Centric Innovation

After analyzing data from observations, interviews, and an initial questionnaire (Table No. 8), researchers identified significant flaws in current sports products regarding dimensions, design paradigms, and aesthetics. This insight prompted the development of designs surpassing these limitations, tailored for diverse users, including those with obesity. Guided by a user-centered design philosophy, the formulation of these

designs was meticulous, ensuring comprehensive effectiveness. The chosen design, adaptable to various demographics and environments, serves as a functional archetype.

Table 8(a): Analyzing User Perspectives on Sports Equipment.

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
Age	10-18	15	28.8	28.8	28.8
	19-60	37	71.2	71.2	100.0
	Total	52	100.0	100.0	-
Gender	male	15	28.8	28.8	28.8
	Female	37	71.2	71.2	100.0
	Total	52	100.0	100.0	-
Do you or any of your relatives suffer from obesity?	Yes	40	76.9	76.9	76.9
	No	6	11.5	11.5	88.5
	Maybe	6	11.5	11.5	100.0
	Total	52	100.0	100.0	
Have you resorted to obesity treatment?	Yes	38	73.1	74.5	74.5
	No	6	11.5	11.8	86.3
	Maybe	7	13.5	13.7	100.0
	Total	51	98.1	100.0	-
Missing	System	1	1.9	-	-
Total		52	100.0	-	-
Do you practice sport?	Yes	35	67.3	74.5	74.5
	No	12	23.1	25.5	100.0
	Total	47	90.4	100.0	-
Missing	System	5	9.6	-	-
Total		52	100.0	-	-
Do you use sports equipment?	Yes	39	75.0	76.5	76.5
	NO	12	23.1	23.5	100.0
	Total	51	98.1	100.0	-
Missing	System	1	1.9	-	-
Total		52	100.0	3.8	-
Do you prefer to use sports equipment and devices in exercising?	0	2	3.8	67.3	3.8
	YES	35	67.3	28.8	71.2
	NO	15	28.8	100.0	100.0
	Total	52	100.0	-	-
Are you having problems using sports equipment?	0	9	17.3	17.3	17.3
	Yes	30	57.7	57.7	75.0
	NO	13	25.0	25.0	100.0
	Total	52	100.0	100.0	-
If the answer is yes, what problems do you face in sports equipment?	0	1	1.9	1.9	1.9
	the shape	31	59.6	59.6	61.5
	the price	7	13.5	13.5	75.0
	the size	13	25.0	25.0	100.0
	Total	52	100.0	100.0	-
What is your assessment of sports equipment and devices in general?	Excellent	3	5.8	5.8	5.8
	Good	27	51.9	51.9	57.7
	acceptable	10	19.2	19.2	76.9
	bad	9	17.3	17.3	94.2

Table 8(b): Analyzing User Perspectives on Sports Equipment.

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
Do you feel pleasure while using sports equipment?	Total	52	100.0	100.0	-
	certainly	13	25.0	25.0	25.0
	Yes	21	40.4	40.4	65.4
	sometimes	13	25.0	25.0	90.4
	maybe	5	9.6	9.6	100.0
	Total	52	100.0	100.0	-

Interpretation of Table 8: provides an analysis of user perspectives on sports equipment. It includes data on age groups, gender distribution, obesity status, usage of sports equipment, preferences for exercising with sports equipment, issues faced while using sports equipment, and overall assessment of sports equipment. The table highlights frequencies and percentages for each category, offering insights into users' experiences, preferences, and challenges related to sports equipment usage. This tabulated representation encapsulates the findings from an in-depth survey analyzing users' opinions regarding sports equipment. It serves as a cultural lens through which the collective preferences and perceptions of users are distilled, enriching the overall narrative of the study. The amalgamation of philosophy and user-centric innovation in the design process aligns with the cultural ethos, envisioning exercise not just as a physical activity but as a holistic and culturally embedded experience. In advancing our methodology, we delve into the pivotal stage of newly designed product specifications. Rooted in a holistic understanding of cultural and philosophical dimensions, our approach aims to transcend the conventional boundaries of sports product design. This section is a culmination of insights derived from user opinions, steering clear of redundancy, and embracing a coherent narrative.

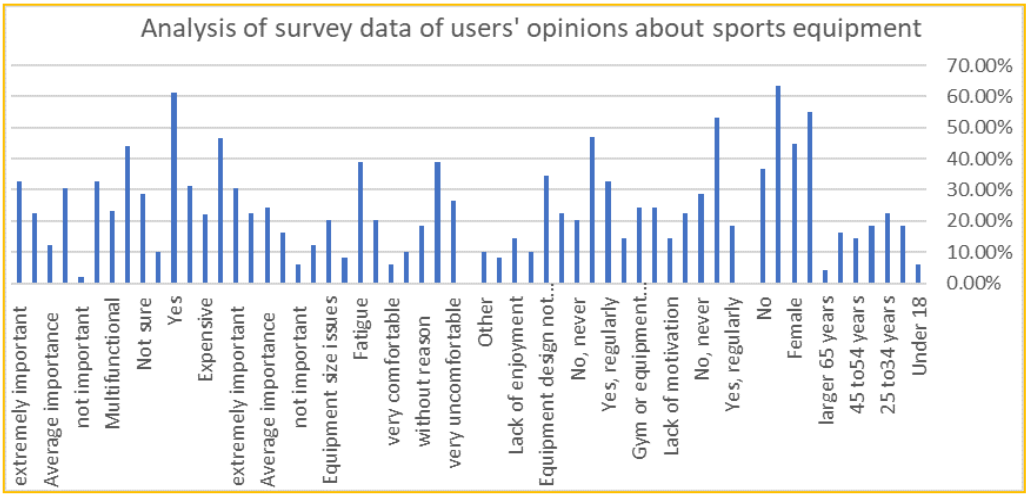

Figure 6: Statistical Analysis of Users' Opinions on Sports Products.

4.2 Innovative Product Development: A Fusion of Culture and Design Philosophy

This section marks the culmination of the research journey, introducing a unique sports product designed to surpass traditional exercise boundaries by incorporating cultural richness and philosophical underpinnings. The product stands out in the realm of sports equipment through the integration of cultural elements and adherence to philosophical principles.

4.3 Design Specifications Formulation

The study aimed to create a culturally embedded sports product to combat obesity and enhance physical activity enjoyment. Design specifications were carefully crafted to ensure ease of use, adaptability, interactivity, aesthetics, and user enjoyment, among other factors. Grounded in a philosophical belief in transcending mundane exercise, the product embodies cultural diversity and user expectations.Innovative design implementation resulted in an interactive sports product integrating various activities to address psychological challenges associated with obesity.

Figure 7 visually depicts the proposed design's cultural journey, featuring scenarios like wheelchair movement with a fat-burning belt, user movement to generated music, interactive screens, and foot movement scenarios.

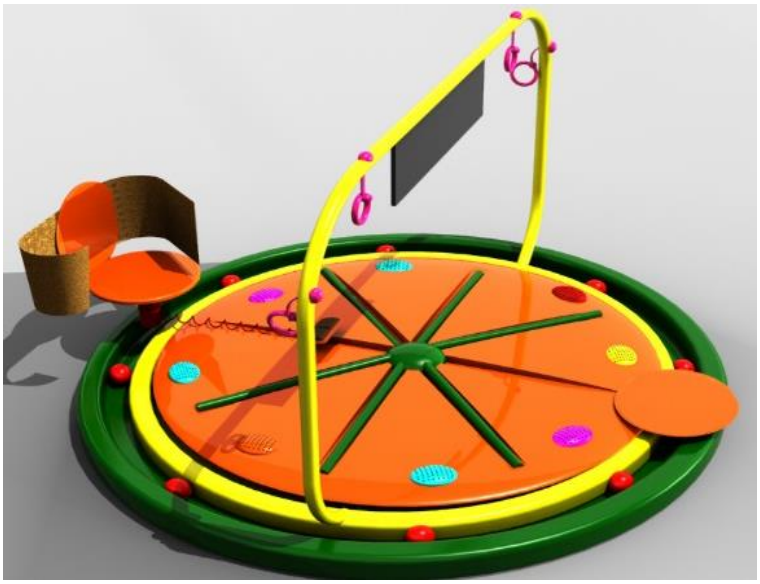

Figure 7: Illustrates The Proposed Design, A Versatile Product Capable of Accommodating Various Sports Exercises. It Features a Movable Chair and Headphones That Emit Music Tones Synchronized with The User's Movements. For Instance, When Performing Dance Exercises, The Product's Screen Provides Guidance to The User.

Figure 8: The User's Posture Is Illustrated During Exercises That Focus on Leg and Foot Movements. The Chair Is Adjustable and Retractable, With Particular Emphasis on Targeting the Abdominal Area to Burn Fat. This Abdominal Component Serves as A Vibrating Belt Intended for Fat Burning, Seamlessly Integrated into The Chair for Convenient Storage When Not in Use.

Figure 9: Illustrates The User's Posture During Dance-Like Exercises, Accompanied by Music Emitted from The Device. Music Adjusts Its Frequency and Changes in Response to The User's Movements on The Product, Providing an Interactive Experience. User Guidance Is Facilitated Through the Screen Integrated into The Product.

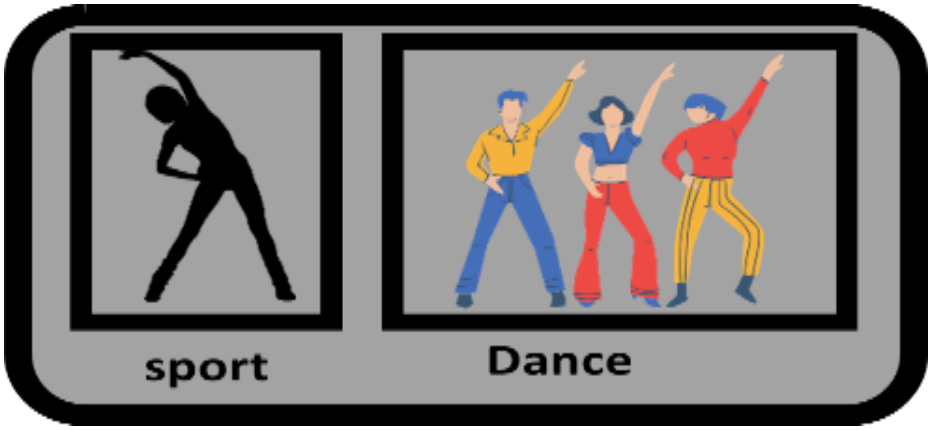

Figure 10: Showcases the Interactive Screen Designed to Guide Users Through Simulated Dance Exercises.

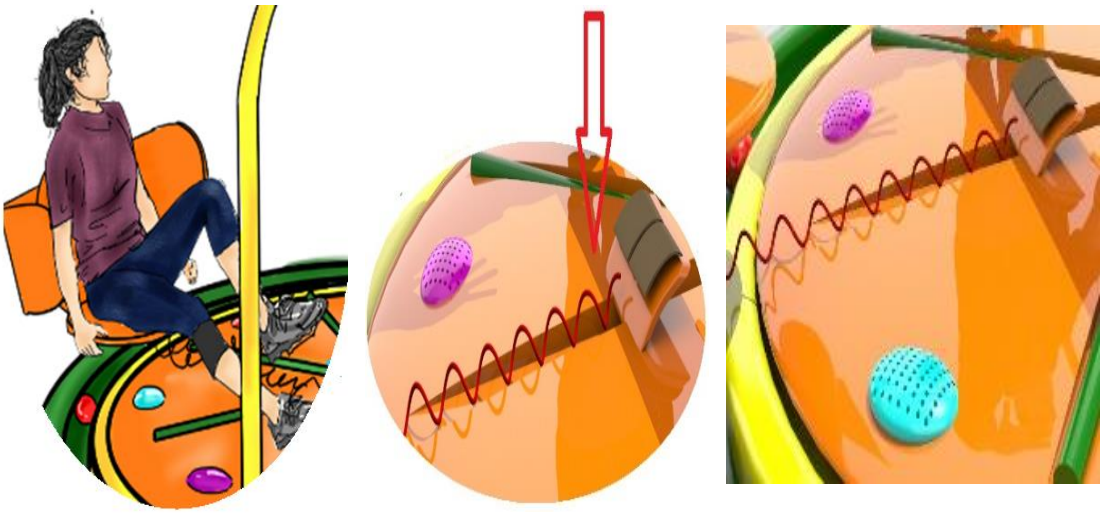

Figure 11: Illustrates The Mechanism for Flexible and Effortless Foot Movement, Enhancing User Enjoyment.

4.4 Aesthetic and Cultural Evaluation

To gauge the effectiveness of our innovative design, a questionnaire was designed and administered to specialists. The results, presented in Table 9, reflect an affirmative acknowledgment of the cultural and philosophical infusion into our sports product, paving the way for a transformative approach to exercise that goes beyond physical fitness, encompassing cultural enrichment and overall well-being.

Interpretation of Table 9: provides insights into user perspectives on sports product design. It includes data on the specialization of designers, user satisfaction with design aspects, expectations regarding user experience, evaluations of equipment replacement, usability, size suitability, aesthetic values achieved, ergonomic compatibility, and novelty of the proposed product.

The table presents frequencies and percentages for each question, offering a comprehensive understanding of users' opinions and preferences regarding various design features and functionalities of sports equipment.

-Statistical Analysis: Users' Opinions on the New Product: The results show high satisfaction levels with our design, with 92.5% finding it attractive and acceptable, indicating strong market potential. Ease of use scored 95%, meeting top-quality standards and study objectives. Arbitrator judgments favored the design's aesthetics by 96%, influencing user preferences.

Additionally, 83.3% expect the product to meet comfort standards, fulfilling our primary goal. A notable 86.7% appreciate the product's novelty, underscoring its innovation.

Table 9(a): Interprets User Perspectives on Sports Product Design.

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
Specialization	product design	17	30.4	30.4	30.4
	Industrial design	15	26.8	26.8	57.1
	Medical specialty	14	25.0	25.0	82.1
	physical therapy	10	17.9	17.9	100.0
	Total	56	100.0	100.0	
How satisfied are you with the shape of the design?	excellent	19	33.9	33.9	33.9
	very good	17	30.4	30.4	64.3
	good	11	19.6	19.6	83.9
	acceptable	7	12.5	12.5	96.4
	bad	2	3.6	3.6	100.0
	Total	56	100.0	100.0	
Do you expect the design to achieve pleasure for the user during use?	excellent	25	44.6	44.6	44.6
	very good	13	23.2	23.2	67.9
	good	8	14.3	14.3	82.1
	acceptable	6	10.7	10.7	92.9
	bad	4	7.1	7.1	100.0
	Total	56	100.0	100.0	
How do you evaluate the replacement of sports equipment for the proposed product?	0	1	1.8	1.8	1.8
	excellent	23	41.1	41.1	42.9
	very good	14	25.0	25.0	67.9
	good	6	10.7	10.7	78.6
	acceptable	7	12.5	12.5	91.1
	bad	5	8.9	8.9	100.0
	Total	56	100.0	100.0	
Is the proposed product easy to use?	0	2	3.6	3.6	3.6
	excellent	23	41.1	41.1	44.6
	very good	14	25.0	25.0	69.6
	good	7	12.5	12.5	82.1
	acceptable	6	10.7	10.7	92.9
	bad	4	7.1	7.1	100.0
	Total	56	100.0	100.0	
Is the size of the product suitable for use in a variety of places?	excellent	24	42.9	42.9	42.9
	very good	13	23.2	23.2	66.1
	good	8	14.3	14.3	80.4
	acceptable	9	16.1	16.1	96.4
	bad	2	3.6	3.6	100.0
	Total	56	100.0	100.0	
What is the percentage of achieving aesthetic values in the design?	0	1	1.8	1.8	1.8
	excellent	28	50.0	50.0	51.8
	very good	11	19.6	19.6	71.4
	good	6	10.7	10.7	82.1
	acceptable	6	10.7	10.7	92.9
	bad	4	7.1	7.1	100.0

Table 9(b): Interprets User Perspectives on Sports Product Design.

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
Is the product ergonomically compatible with the user?	Total	56	100.0	100.0	
	0	13	23.2	23.2	23.2
	Yes	29	51.8	51.8	75.0
	No	9	16.1	16.1	91.1
	To some extent	5	8.9	8.9	100.0
Is the product characterized by novelty (innovation)	Total	56	100.0	100.0	
	0	13	23.2	23.2	23.2
	Yes	31	55.4	55.4	78.6
	No	8	14.3	14.3	92.9
	To some extent	4	7.1	7.1	100.0
	Total	56	100.0	100.0	

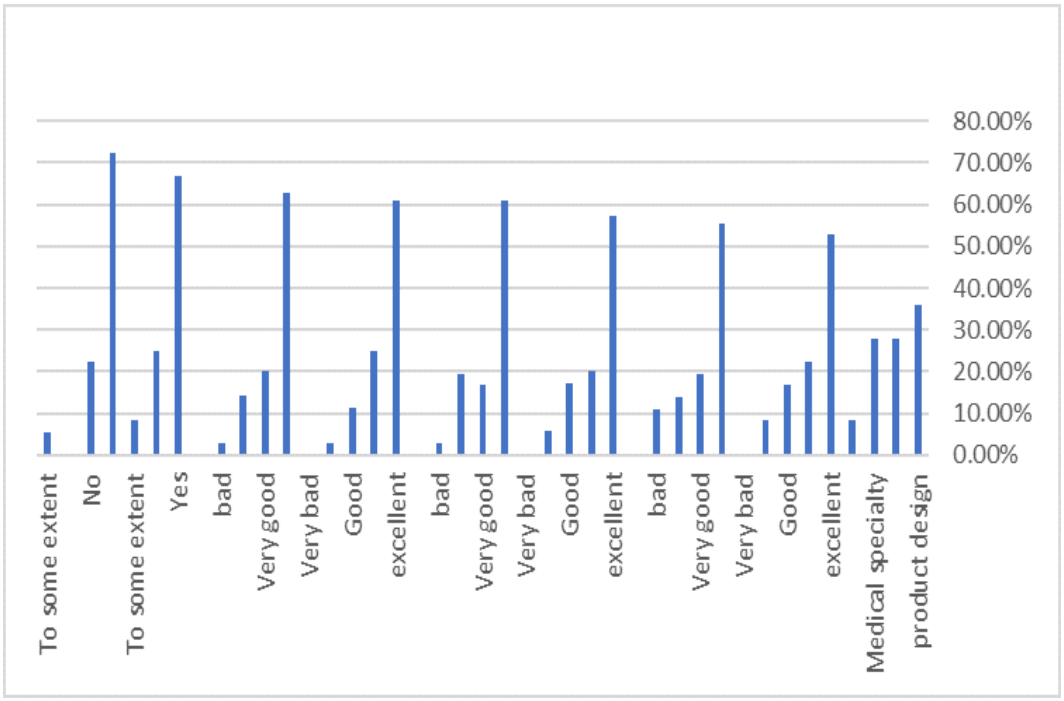

Figure 8: Expert Evaluation of the New Design.

Figure 8 presents a chart illustrating the expert evaluation of the new design, further supporting the positive reception and potential success of our culturally embedded sports product.

5. RESULTS

5.1 Gender Disparities in Interest

- Women show a 71.20% higher interest in fitness and obesity compared to men.

5.2. Prevalence of Obesity:
- 76.90% of respondents are either obese or have obese relatives.

5.3. Cultural Awareness and Therapy Engagement:
- 74.50% of respondents engage in obesity therapy.
- 74.50% report regular exercise.

5.4. Significance of Sports Equipment:
- 76.50% actively use sports equipment.
- 82.60% of households possess sporting goods.
- 69.80% report issues, with shape (60.8%) and size (25.5%) being predominant concerns.

5.5. User Satisfaction and Enjoyment:
- 25% reported low satisfaction about the user's feeling of pleasure using traditional sports products.
- The proposed design receives a 92.5% satisfaction rate and anticipates a 95% user enjoyment rate.

5.6. Competitiveness and Ease of Use:
- The proposed design competes favorably with traditional sports equipment (94% agreement).
- A 95% endorsement for ease of use.

5.7. Aesthetic Values and User Comfort:
- Aesthetic values receive a 96% favorable opinion.
- 83.3% expect user comfort.

5.8. Innovation and Novelty:
- 86.7% appreciate the novelty of the proposed product.

These results highlight significant gender differences, the prevalence of obesity, societal engagement with therapy and exercise, challenges in sports equipment, user satisfaction with the proposed design, and cultural considerations in aesthetics, comfort, and innovation.

6. JUSTIFICATION OF RESEARCH OBJECTIVES

The research objectives are justified based on previous data and analyses, highlighting the critical importance of addressing health and cultural

challenges linked to obesity and physical inactivity. By enhancing cultural and philosophical saturation in design and sports equipment use, the study aims to improve public health and well-being. Modern design standards, cultural analysis, and philosophical considerations drive the design of sports equipment, offering a comprehensive solution to promote physical activity and combat obesity. Innovative sports equipment fosters positive engagement with exercise and promotes active participation, challenging traditional methods. The research underscores the necessity for innovative design aligned with cultural and philosophical values to achieve specific objectives. Overall, justifying research objectives underscores the significance of cultural and philosophical aspects in developing sports equipment that addresses public health challenges and encourages an active lifestyle.

7. DISCUSSIONS

7.1 Gender Disparities in Interest

- The significant gender difference in fitness and obesity interest, with women exhibiting a 71.20% higher engagement, reflects a cultural nuance. This suggests that addressing obesity, especially among women, is of societal importance, underlining the need for gender-specific health interventions.

7.2 Prevalence of Obesity

- The high prevalence of obesity (76.90%) within the sample indicates a pressing societal issue. This familial dimension emphasizes the need for comprehensive strategies to address obesity on both individual and familial levels.

7.3 Cultural Awareness and Therapy Engagement:

- The substantial engagement (74.50%) in obesity therapy showcases cultural acknowledgment and an active stance towards combating obesity. This cultural understanding emphasizes the importance of therapeutic interventions and indicates a proactive societal approach.

7.4 Significance of Sports Equipment

- The cultural significance of sports equipment, as evidenced by 76.50% actively using such equipment, reveals its integral role in society. The reported issues (69.80%), especially concerns about shape (60.8%) and size (25.5%), underscore the need for designers to align sports products with

cultural expectations.

7.5 User Satisfaction and Enjoyment

- The low satisfaction level (25%) regarding the user's sense of pleasure highlights a cultural expectation for sports products to offer a more engaging and enjoyable experience. The proposed design's high satisfaction rate (92.5%) and anticipated user enjoyment (95%) indicate its potential cultural impact and acceptance.

7.6 Competitiveness and Ease of Use

- The proposed design's competitiveness with traditional sports equipment (94% agreement) and the high endorsement for ease of use (95%) align with cultural values emphasizing efficiency and functionality in products.

7.7 Aesthetic Values and User Comfort

- Favorable opinions on aesthetic values (96%) and the expectation for user comfort (83.3%) affirm the cultural importance of these aspects. This aligns with cultural values prioritizing user well-being and the adaptability of designs to diverse preferences.

7.8 Innovation and Novelty

- The appreciation for the proposed product's novelty (86.7%) reflects cultural openness to innovative ideas. This underscores the importance of considering cultural values and preferences in introducing novel products to the market. In summary, the discussion emphasizes the cultural nuances in fitness and obesity interest, the prevalence of obesity as a societal concern, cultural awareness and engagement in therapy, the importance of sports equipment in society, cultural expectations for user satisfaction, and the proposed design's alignment with cultural values and preferences.

8. CONCLUSION

In conclusion, this research underscores the transformative potential of sports as a pivotal tool in combating the pervasive issue of obesity. The urgent call for novel ideas and innovations in sports product design and exercise methodologies is illuminated, emphasizing the imperative need for a cultural and philosophical shift in the fitness landscape. By extending beyond traditional fitness approaches, this study advocates for a

reimagining of sports products, encompassing not only their physical form but also their cultural and philosophical essence.

The prevalence of obesity in Saudi society, with a notable emphasis on the higher proportion among women, accentuates the necessity for tailored and inclusive sports products. Acknowledging diverse preferences, encompassing color, size, and shape, particularly specific to women, is fundamental to fostering a culture of sports participation for a healthier society. This inclusive approach aligns with the broader vision of promoting overall well-being and dismantling gender-specific barriers to physical activity.

The cultural integration of sports products into diverse settings, including homes, schools, and public spaces, emerges as a key strategy for instilling a culture of physical activity. Recognizing locations with extended wait times, such as airports and institutions, as potential hubs for sports engagement, emphasizes the pivotal role that well-designed sports equipment can play in enhancing users' well-being. The study posits that strategically placed sports products have the potential to elevate happiness, foster optimism, and mitigate obesity-related health issues.

Addressing the objectives of the research, the study not only identifies prevalent challenges in current sports equipment but also proposes design solutions aligned with ergonomic c standards. By scrutinizing the obesity landscape in Saudi society, with a gender-specific lens on women, the research unveils barriers hindering widespread physical exercise. Moreover, the study extends its purview to the intersection of sports equipment and work environments, providing criteria for alternative design selections to cultivate a pervasive culture of physical activity.

A noteworthy outcome of this research is the development of a versatile device designed to motivate individuals of all ages and genders to embrace exercise. This paradigm shift in the perception of exercise signifies a departure from traditional notions of exhaustion and effort, ushering in an era where pleasure, enjoyment, and fun take center stage in the fitness narrative. In essence, this research lays the foundation for a holistic and culturally enriched approach to exercise, promising enduring benefits for societal health and well-being.

ACKNOWLEDGMENT

The authors extend their appreciation to the Deputyship for Research & Innovation, Ministry of Education in Saudi Arabia for funding this research work through the project number PNU-DRI-RI-20-034.

References

Abalkhail, B. (2002). Overweight and obesity among Saudi Arabian children and adolescents between 1994 and 2000. *Eastern Mediterranean Health Journal*, *8*(4-5), 470-479. https://doi.org/https://iris.who.int/handle/10665/119188

Abdelkarim, O., Ammar, A., Trabelsi, K., Cthourou, H., Jekauc, D., Irandoust, K., Taheri, M., Bös, K., Woll, A., & Bragazzi, N. L. (2020). Prevalence of underweight and overweight and its association with physical fitness in Egyptian schoolchildren. *International Journal of Environmental Research and Public Health*, *17*(1), 75. https://doi.org/https://doi.org/10.3390/ijerph17010075

Absil, P.-A., Diao, O., & Diallo, M. (2021). Assessment of COVID-19 hospitalization forecasts from a simplified SIR model. *Letters in Biomathematics*. https://doi.org/10.30707/LiB8.1.1682013528.154572

Al Dossary, S., Sarkis, P., Hassan, A., Ezz El Regal, M., & Fouda, A. (2010). Obesity in Saudi children: a dangerous reality. *Eastern Mediterranean Health Journal*, *16*(9), 1003-1008. https://doi.org/10.26719/2010.16.9.1003

Albalawi, O., Almubark, R., Almarshad, A., & Alqahtani, A. S. (2022). The Prevalence of Vitamin and Mineral Deficiencies and High Levels of Non-Essential Heavy Metals in Saudi Arabian Adults. In *Healthcare* (Vol. 10, pp. 2415). MDPI. https://doi.org/https://doi.org/10.3390/healthcare10122415

Althumiri, N. A., Basyouni, M. H., AlMousa, N., AlJuwaysim, M. F., Almubark, R. A., BinDhim, N. F., Alkhamaali, Z., & Alqahtani, S. A. (2021). Obesity in Saudi Arabia in 2020: prevalence, distribution, and its current association with various health conditions. In *Healthcare* (Vol. 9, pp. 311). MDPI. https://doi.org/https://doi.org/10.3390/healthcare9030311

Baleilevuka-Hart, M. E., Khader, A., De Alba, C. E. G., Holmes, K. W., & Huang, J. H. (2022). Sports participation, activity, and obesity in children who have undergone the Fontan procedure. *Cardiology in the Young*, *32*(7), 1027-1031. https://doi.org/10.1017/S1047951121003541

Boatca, M. E., & Cirjaliu, B. (2015). A proposed approach for an efficient ergonomics intervention in organizations. *Procedia Economics and Finance*, *23*, 54-62. https://doi.org/https://doi.org/10.1016/S2212-5671(15)00411-6

Canestrari, C., Branchini, E., Bianchi, I., Savardi, U., & Burro, R. (2018). Pleasures of the mind: What makes jokes and insight problems enjoyable. *Frontiers in Psychology*, *8*, 302800. https://doi.org/https://doi.org/10.3389/fpsyg.2017.02297

Chiu, W., Lee, Y.-j., & Won, D. (2016). Bifactor analysis of motivation for charity sport event participation. *International Review on Public and Nonprofit Marketing*, *13*, 1-13. https://doi.org/https://doi.org/10.1007/s12208-015-0141-8

Cho, J. T., & Park, J. (2021). Exploring the effects of various types of stressors on the physical and mental health symptoms of police officers in South Korea. *International Journal of Law, Crime and Justice*, *67*, 100494. https://doi.org/https://doi.org/10.1016/j.ijlcj.2021.100494

Colleluori, G., Galli, C., Severi, I., Perugini, J., & Giordano, A. (2022). Early life stress, brain development, and obesity risk: is oxytocin the missing link? *Cells*, *11*(4), 623. https://doi.org/https://doi.org/10.3390/cells11040623

Faulconbridge, L. F., & Bechtel, C. F. (2014). Depression and disordered eating in the obese person. *Current obesity reports*, *3*, 127-136. https://doi.org/https://doi.org/10.1007/s13679-013-0080-9

Hadri, Z., Benada, M. h., Djellouli, M., Boudalia, S., Rahali, A., & Araf, A. (2022). Prevalence of obesity and effect of sport activity on university students in Algeria. *Scientific African*, *17*, e01319. https://doi.org/https://doi.org/10.1016/j.sciaf.2022.e01319

Hills, A. P., Byrne, N. M., Lindstrom, R., & Hill, J. O. (2013). 'Small Changes' to Diet and Physical Activity Behaviors for Weight Management. *Obesity facts*, *6*(3), 228-238. https://doi.org/https://doi.org/10.1159/000345030

Jola, C., Calmeiro, L., Karkou, V., Oliver, S., & Lycouris, S. (2017). *The Oxford Handbook of Dance and Wellbeing*. https://doi.org/https://doi.org/10.1093/oxfordhb/9780199949298.001.0001

Konduru, L., Das, N., Kothari-Speakman, G., & Behura, A. K. (2022). Experiencing the COVID-19 pandemic as a healthcare provider in rural Dhanbad, India: An interpretative phenomenological analysis. *PLoS one*, *17*(8), e0273573. https://doi.org/https://doi.org/10.1371/journal.pone.0273573

Lee, S. M., & Peterson, S. J. (2000). Culture, entrepreneurial orientation, and global competitiveness. *Journal of world business*, *35*(4), 401-416. https://doi.org/https://doi.org/10.1016/S1090-9516(00)00045-6

Li, G. (2020). From Society to Shehui: The Early Configuration of a Basic Concept in Modern China. *Cultura*, *17*(2), 11-28.

Liu, T., Wu, B., Yao, Y., Chen, Y., Xu, K., Wang, N., & Fu, C. (2023). Associations between depression and the incident risk of obesity in southwest China: A community population prospective cohort study. *Frontiers in Public Health*, *11*, 1103953. https://doi.org/https://doi.org/10.3389/fpubh.2023.1103953

Malm, C., Jakobsson, J., & Isaksson, A. (2019). Physical activity and sports—real health benefits: a review with insight into the public health of Sweden. *Sports*, *7*(5), 127. https://doi.org/https://doi.org/10.3390/sports7050127

O'Connor, D. B., Thayer, J. F., & Vedhara, K. (2021). Stress and health: A review of psychobiological processes. *Annual review of psychology*, *72*, 663-688. https://doi.org/https://doi.org/10.1146/annurev-psych-062520-122331

Pillar, G. (2023). Cardiorespiratory Changes as They Relate to Sleep in Transition from Pediatric to Adulthood. In *Sleep Medicine: A Comprehensive Guide for Transitioning Pediatric to Adult Care* (pp. 25-44). Springer. https://doi.org/https://doi.org/10.1007/978-3-031-30010-3_3

Pugliese, G., Liccardi, A., Graziadio, C., Barrea, L., Muscogiuri, G., & Colao, A. (2022). Obesity and infectious diseases: pathophysiology and epidemiology of a double pandemic condition. *International journal of obesity*, *46*(3), 449-465. https://doi.org/https://doi.org/10.1038/s41366-021-01035-6

Quiroga Murcia, C., Kreutz, G., Clift, S., & Bongard, S. (2010). Shall we dance? An exploration of the perceived benefits of dancing on well-being. *Arts & Health*, *2*(2), 149-163. https://doi.org/https://doi.org/10.1080/17533010903488582

Rasouli, B., Grill, V., Midthjell, K., Ahlbom, A., Andersson, T., & Carlsson, S. (2013). Smoking is associated with reduced risk of autoimmune diabetes in adults

contrasting with increased risk in overweight men with type 2 diabetes: a 22-year follow-up of the HUNT study. *Diabetes care*, *36*(3), 604-610. https://doi.org/https://doi.org/10.2337/dc12-0913

Riemann, L., Lubasch, J. S., Heep, A., & Ansmann, L. (2021). The role of health literacy in health behavior, health service use, health outcomes, and empowerment in pediatric patients with chronic disease: a systematic review. *International Journal of Environmental Research and Public Health*, *18*(23), 12464. https://doi.org/https://doi.org/10.3390/ijerph182312464

Staiano, A., & Katzmarzyk, P. (2012). Ethnic and sex differences in body fat and visceral and subcutaneous adiposity in children and adolescents. *International journal of obesity*, *36*(10), 1261-1269. https://doi.org/https://doi.org/10.1038/ijo.2012.95

Tase, A., Vadhwana, B., Buckle, P., & Hanna, G. B. (2022). Usability challenges in the use of medical devices in the home environment: a systematic review of literature. *Applied Ergonomics*, *103*, 103769. https://doi.org/https://doi.org/10.1016/j.apergo.2022.103769

Tashiro, H., Takahashi, K., Uchida, M., Kurihara, Y., Sadamatsu, H., Takamori, A., Kimura, S., & Sueoka-Aragane, N. (2023). Effect of azithromycin on exacerbations in asthma patients with obesity: protocol for a multi-center, prospective, single-arm intervention study. *International Journal of Environmental Research and Public Health*, *20*(3), 1861. https://doi.org/https://doi.org/10.3390/ijerph20031861

Wang, Y., Lin, S., He, C., Zhang, M., Li, J., Chen, L., Qi, B., Wen, J., Yang, J., & Liu, D. (2022). Novel insights into the consequences of obesity: a phenotype-wide Mendelian randomization study. *European Journal of Human Genetics*, *30*(5), 540-546. https://doi.org/https://doi.org/10.1038/s41431-021-00978-8

Wooldridge, J. S., Tynan, M., Rossi, F. S., Gasperi, M., McLean, C. L., Bosch, J., Trivedi, R. B., Herbert, M. S., & Afari, N. (2023). Patterns of adverse childhood experiences and cardiovascular risk factors in US adults. *Stress and Health*, *39*(1), 48-58. https://doi.org/https://doi.org/10.1002/smi.3167

Yoshioka, H., Yaegashi, Y., Yoshioka, Y., & Tsugihashi, K. (2019). A short note on analysis and application of a stochastic open-ended logistic growth model. *Letters in Biomathematics*, *6*(1), 67-77. https://doi.org/https://doi.org/10.30707/LiB6.1Yoshioka