From Street to Lifesaving: CPR Training for Food Delivery Riders Using a Serious Game Approach

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Abstract

Background: The objective of this study was to design, implement, and evaluate a serious game intervention to improve CPR knowledge, chest compression quality, and willingness to act among food delivery riders,an often-overlooked group of potential first responders. Given their frequent presence in public spaces and their demographic characteristics, food delivery riders represent a promising target for gamified CPR training, which leverages interactive and motivational features to enhance learning.

Objective: This study aimed to expand the network of lay responders and contribute to public health and safety.

Methods: This study used a single-group pre–post design to evaluate a serious game-based CPR training program for food delivery riders, with 73 participants enrolled. Data were entered into a secure database by two independent researchers to ensure accuracy and minimize errors. Descriptive statistics summarized participant characteristics and outcomes. Pre- and post-intervention comparisons of attitudes, willingness, and CPR performance were analyzed using paired t-tests or Wilcoxon signed-rank tests. Analyses were performed using SPSS version 26.0.

Results: The serious game intervention significantly improved CPR knowledge and willingness to act. Participants who felt capable of performing CPR increased from 10.96% pre-intervention to 68.49% post-intervention ($p < 0.01$). Willingness to perform CPR on a stranger rose from 24.66% to 69.86% ($p = 0.02$). The average score for game engagement was 4.73/5 (SD 0.45), and participants rated the clarity of the game's task objectives at 4.67/5 (SD 0.47). CPR performance quality indicators showed promising results, with a mean compression depth of 55.7 ± 4.80 mm and a frequency of 110 ± 10.4 compressions per minute

Conclusions: This study shows that serious game-based training effectively improves CPR knowledge, performance, and willingness to act among food delivery riders. The intervention led to significant increases in confidence and CPR readiness, highlighting the potential of serious games as a scalable method for training non-medical responders.

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Abstract: Background: The objective of this study was to design, implement, and evaluate a serious game intervention to improve CPR knowledge, chest compression quality, and willingness to act among food delivery riders,an often-overlooked group of potential first responders. Given their frequent presence in public spaces and their demographic characteristics, food delivery riders represent a promising target for gamified CPR training, which leverages interactive and motivational features to enhance learning. **Objective:** This study aimed to expand the network of lay responders and contribute to public health and safety. **Methods** This study used a single-group pre–post design to evaluate a serious game-based CPR training program for food delivery riders, with 73 participants enrolled. Data were entered into a secure database by two independent researchers to ensure accuracy and minimize errors. Descriptive statistics summarized participant characteristics and outcomes. Pre- and post-intervention comparisons of attitudes, willingness, and CPR performance were analyzed using paired t-tests or Wilcoxon signed-rank tests. Analyses were performed using SPSS version 26.0.**Results:** The serious game intervention significantly improved CPR knowledge and willingness to act. Participants who felt capable of performing CPR increased from 10.96% pre-intervention to 68.49% post-intervention ($p < 0.01$). Willingness to perform CPR on a stranger rose from 24.66% to 69.86% ($p = 0.02$). The average score for game engagement was 4.73/5 (SD 0.45), and participants rated the clarity of the game's task objectives at 4.67/5 (SD 0.47). CPR performance quality indicators showed promising results, with a mean compression depth of 55.7 ± 4.80 mm and a frequency of 110 ± 10.4 compressions per minute. **Conclusions:** This study shows that serious game-based training effectively improves CPR knowledge, performance, and willingness to act among food delivery riders. The intervention led to significant increases in confidence and CPR readiness, highlighting the potential of serious games as a scalable method for training non-medical responders.

Keywords:CPR ;serious game ; food delivery rides

1. Introduction

Out-of-hospital cardiac arrest (OHCA) is a major global public health concern, with approximately 5 million cases occurring annually and a survival rate of less than 10% worldwide[1]. OHCA typically leads to

unconsciousness within 10 seconds, and without timely intervention within 4 to 6 minutes, patients face irreversible brain damage or death[2]. Survival decreases by 7% to 10% for every minute of delay in initiating CPR[3].

Despite the established effectiveness of bystander cardiopulmonary resuscitation (CPR), its implementation remains insufficient. In the United States, over 350,000 OHCA cases occur annually, but bystander CPR is provided in only 40.2% of cases[4]. Surveys indicate that 24% of individuals perceive CPR as too complex, and 16% report never receiving CPR training[5]. In China, the estimated annual OHCA incidence exceeds 550,000[6], yet bystander CPR is initiated in fewer than 20.3% of cases, and the use of automated external defibrillators (AEDs) remains extremely low (<0.1%)[7]. Notably, 16.2% of OHCAs occur in public spaces such as streets and transportation hubs[4], underscoring the importance of empowering laypersons who are frequently present in these environments.

Food delivery riders represent one such group with unique potential as first responders. The food delivery industry in China has expanded rapidly, with over 5.7 million registered riders, a number projected to surpass 10 million in the near future[8]. Riders typically work long hours with limited rest, traveling continuously within small delivery zones and maintaining constant visibility in urban neighborhoods[9]. Their mobility, geographic familiarity, and sustained presence in public spaces increase the likelihood of encountering emergencies. Evidence from related occupations, such as motorcycle taxi and ride-hailing drivers, suggests that non-medical workers with similar mobility show willingness to provide basic life support, particularly to acquaintances[10]. These findings indicate that food delivery riders may also be receptive to CPR training and could serve as an important but overlooked resource for strengthening community-based emergency response networks.

However, effective training methods must accommodate the demographic and occupational characteristics of this population. Food delivery riders are predominantly young males (mean age 30.7 years), spend long hours on the road, and have limited time for classroom-based instruction[11]. Their learning preferences may favor interactive, flexible, and visually engaging modalities over traditional lecture or video-based training[12]. Gamified learning, particularly serious games, offers an appealing solution. By integrating features such as task-based missions, feedback, scoring, and rewards, serious games promote active participation, experiential learning, and sustained motivation[13-15]. They also provide a safe environment for skill practice, enabling learners to rehearse and refine CPR performance without real-world risks. Prior research has shown that serious game–based training can enhance learner motivation, improve attitudes, and achieve compression depth and rate outcomes comparable to those of conventional methods[16,17].

In this context, a serious game–based CPR training model tailored to food delivery riders may enhance their competence and willingness to intervene during cardiac emergencies. By equipping this growing workforce with CPR skills, such an approach has the potential to expand the pool of trained lay responders and deliver meaningful public health benefits, particularly in densely populated urban settings where OHCA frequently

occurs. The objective of this study was therefore to design, implement, and evaluate a serious game intervention aimed at improving both CPR performance and psychological readiness among food delivery riders.

2. Methods

2.1 Study Design

This study adopted a single-group pre–post design to evaluate the effectiveness of a serious game–based CPR training program for food delivery riders. The intervention was delivered on-site at food delivery stations and followed the process illustrated in Figure 1. Upon arrival, participants first received a brief session on CPR theory and hands-on practice. They were then divided into small groups and introduced to the rules of the serious game. The game consisted of sequential tasks simulating CPR response, and participants were scored based on their performance. At the end of the session, scores were announced and small prizes were awarded to enhance engagement. After completing the game, participants filled out the Game Design Evaluation Questionnaire as well as the Self-reported Attitude and Willingness to Perform CPR scale. The training concluded following questionnaire completion.

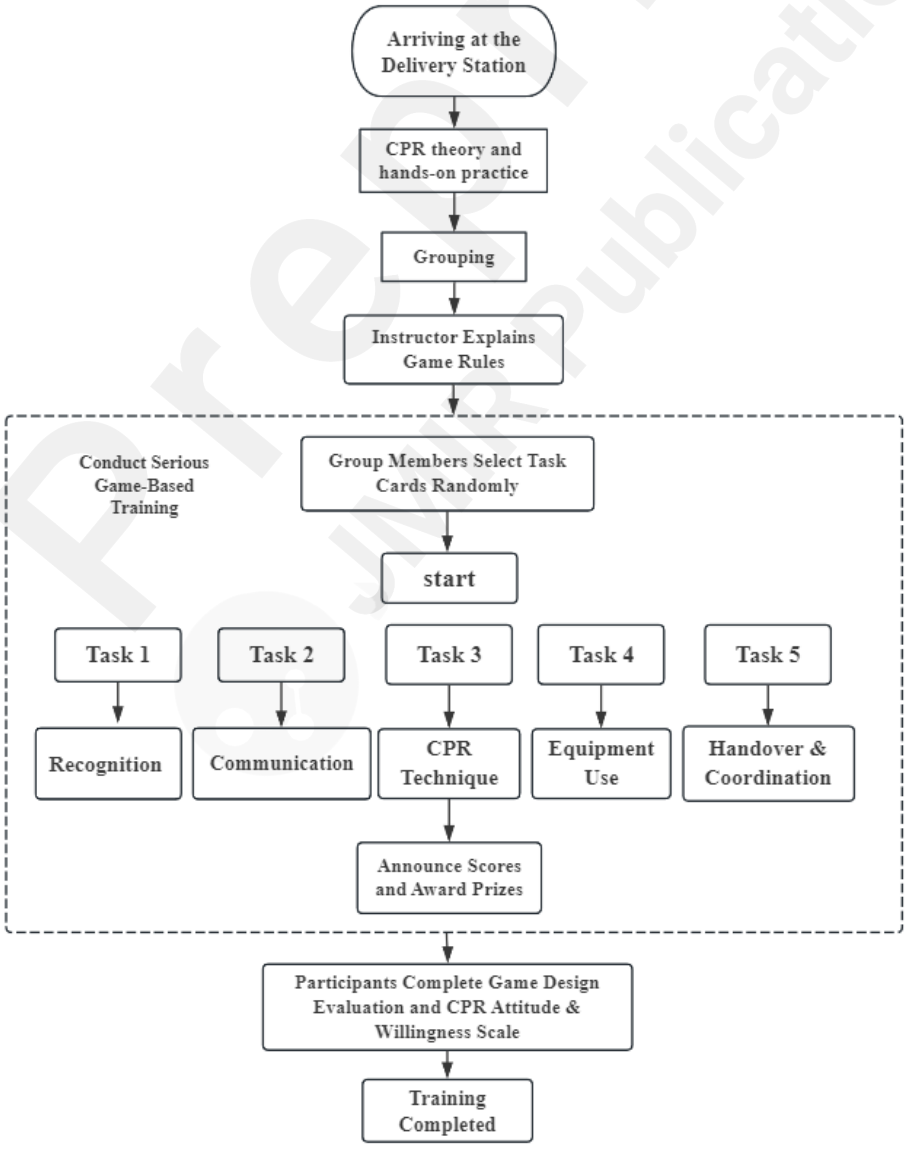

Figure 1. Implementation process of the game

2.2 Study participants and recruitment

Participants in this study were recruited from a pool of active food delivery riders in Wuhan. Inclusion criteria included: (1) over 18 years old; (2) currently employed as a food delivery rider; (3) having no prior formal CPR training within the past one years. Exclusion criteria included any physical or cognitive conditions that would prevent safe participation in CPR training activities. Recruitment was conducted through coordination with local delivery platforms. After obtaining ethical approval from the Centre Hospital of Wuhan Ethics Committee (Approval No. WHZXKYL2024-201), all participants provided written informed consent before participating in the study. Participation was entirely voluntary, and individuals could withdraw at any time without consequence. A total of 73 participants were enrolled for the pilot implementation and evaluation of the serious game.

2.3 Intervention Procedures

2.3.1 CPR Theory Instruction and Demonstration

Each session began with a concise lecture covering the core elements of cardiopulmonary resuscitation (CPR), including recognition of cardiac arrest, activation of emergency medical services, chest compressions, and use of an automated external defibrillator (AED). The theoretical content and practical demonstration were based on the latest Basic Life Support (BLS) training curriculum. Demonstrations were performed on manikins by emergency nursing staff certified in Basic Life Support (BLS). This ensured participants received standardized and evidence-based instruction before proceeding to the game phase.

2.3.2 Gameplay Design and Implementation

Training was conducted on-site at food delivery stations using a simulated street environment that included sidewalks and storefronts to mirror typical urban settings. Participants were randomly assigned to small teams of 3–5 members to encourage collaboration and to model real-world division of labor. Each session lasted approximately 30 minutes, and individual tasks were time limited. Required materials included CPR manikins, AED trainers, the Palm CPR feedback device, task cards, alphabet puzzle cards, prop cards, scoring sheets, and badge stickers. Instructors provided real-time verbal feedback and recorded performance using a standardized scoring system.

The game comprised five mission-based CPR tasks embedded in the simulated street scenario. Task 1 focused on scene assessment and cardiac arrest recognition and was required to unlock subsequent tasks. Tasks 2–5 could be attempted in any order according to team strategy, and teams were allowed to run tasks in parallel to simulate efficient on-site coordination. Each participant was required to complete at least one task, and chest compressions were mandatory for all team members.Each task card contained concealed operational hints; teams could use up to three scratch-off hints per task with corresponding score deductions. Completing a task without hints unlocked additional achievements. Detailed wording of task cards, scoring rules, and operational prompts is provided in Appendix 1.

2.3.3 Task Structure

The game simulation consisted of five designed tasks, each reflecting a real-world step in the CPR response process:

Task 1: What Happened to Him? (Start Task) Participants assessed the emergency scene, ensured safety, and determined whether the patient was unconscious, not breathing, or pulseless. Only upon confirming cardiac arrest could subsequent tasks be unlocked.

Task 2: Call for Help! Participants dialed the emergency hotline, reported the location, described the patient's condition, and maintained communication with dispatchers.

Task 3: Life-saving Chest Compressions (Mandatory for All) Each team member performed at least 30 chest compressions on a manikin following CPR guidelines. Compression quality was monitored with the Palm CPR feedback device, which provided real-time prompts such as "press harder" or "press faster." Each incorrect action reduced the task score by one point until the minimum score was reached. Participants were required to correct errors before advancing.

Task 4: Activate AED, Restart the Heart Teams located and operated an AED marked with the red "+" symbol. They performed power-on, pad placement, rhythm analysis, and shock delivery while coordinating with ongoing compressions. An optional bonus challenge asked participants to name common AED locations. Two correct answers earned 5 points; three or more earned 10 points.

Task 5: Handover Emergency! Participants communicated patient status and the interventions performed to arriving emergency medical services. signaling successful training completion.

The Task Card, Bonus Challenge Card, and the 'Phone' Prop Card are depicted in Figure 2 At the end of each session, team scores were announced. Badge stickers and small rewards were distributed to recognize high-performing teams and maintain motivation.

Figure 2 Task Cards overviews

2.4 Outcome Measures

This study employed a combination of self-reported and objective measures to evaluate the effectiveness of the serious game intervention on CPR knowledge, skills, and behavioral intentions.

2.4.1 Palm CPR Feedback Device

Chest compression performance was measured using the Palm CPR feedback device (Figure 3), which captures real-time data on compression depth, rate, recoil, and release via a wireless connection. The device provides immediate visual and auditory feedback aligned with established CPR quality standards, allowing

participants to adjust their technique. All performance data, including interruptions due to defibrillation or ventilation, were recorded and uploaded to the CPR Data Cloud for analysis. The system supports both global and segmental analyses and generates compression trend charts to facilitate continuous monitoring and improvement of CPR training quality.

2.4.2 Self-reported Attitude and Willingness Questionnaire

Participants' attitudes and willingness to perform CPR were assessed using a self-developed scale. The questionnaire evaluates confidence in performing CPR, willingness to act in emergencies, and related emotional responses. Participants completed the scale before and after the intervention to measure changes. Internal consistency of the scale was tested during the pilot phase, yielding a Cronbach's α of 0.85.

2.4.3 Game Design Evaluation Questionnaire

Participants' perceptions of the serious game were assessed after training using a self-developed Game Design Evaluation Questionnaire. The instrument evaluates game complexity, engagement, immersion, feedback, self-efficacy, and motivation. Internal consistency was confirmed with a Cronbach's α of 0.89, indicating excellent reliability.

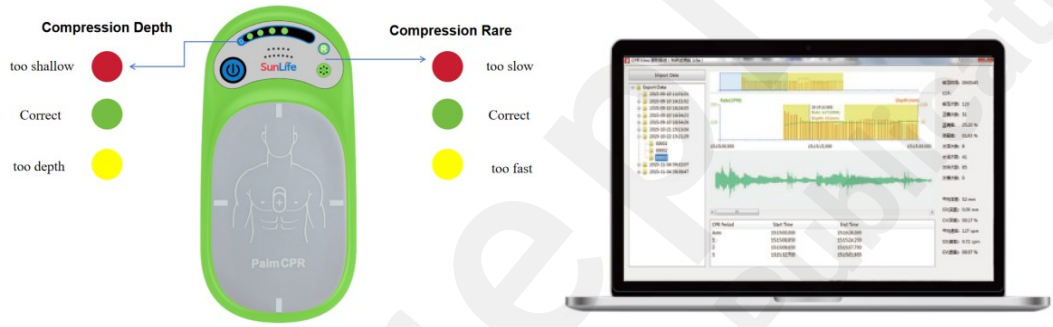

Figure 3. the Palm CPR feedback device

2.5 Data Collection and Analysis

All collected data were entered into a secure database by two independent researchers to ensure accuracy and minimize entry errors. Data management procedures included verification and cross-checking of all entries. Statistical analyses were performed using SPSS version 26.0. Descriptive statistics, including means, standard deviations, and frequencies, were used to summarize participant characteristics and outcome measures. Pre- and post-intervention comparisons of self-reported attitudes, willingness, and CPR performance indicators were conducted using paired t-tests or Wilcoxon signed-rank tests, depending on data distribution. A two-sided p-value < 0.05 was considered statistically significant.

3. Results

3.1 Participant Characteristics

All participants completed the study protocol without any adverse events or negative outcomes during the intervention period. Demographic characteristics of the participants are presented in Table 1. The majority were men (87.67%). The predominant age group was 31–40 years (56.16%). Regarding education level, 43.84% had completed high school or secondary school, and 46.58% had a college degree or higher. In terms

of marital status, 42.47% were married. Monthly income was mainly between 6000 and 8000 RMB (43.84%), followed by ≥8000 RMB (31.51%). Work experience varied, with 38.36% having 1 to 3 years of experience.

Table 1. Demographic characteristics of participants (n=73)

Variable	N (%)
Gender	
Male	64 (87.67)
Female	9 (12.33)
Age (Years)	
21~30	22 (30.14)
31~40	41 (56.16)
41~50	10 (13.70)
Education Level	
Junior High	7 (9.59)
High School	32 (43.84)
College and above	34 (46.58)
Marital Status	
Married	31 (42.47)
Single	32 (43.84)
Divorced	10 (13.70)
Monthly Income (RMB)	
2000~4000	3 (4.11)
4000~6000	15 (20.55)
6000~8000	32 (43.84)
≥8000	23 (31.51)
Years of Work Experience (years)	
≤1	11 (15.07)
1~3	28 (38.36)
3~5	12 (16.44)
≥5	22 (30.14)

3.2 Evaluation of the Game Performance

In Table 2, the descriptive statistics of participants responses to the game-related questions are presented. Overall, the feedback was generally positive. The highest mean score was given to the statement “The game is interesting and attracts my attention” (4.73±0.45). Participants also rated the difficulty level as appropriate, with a mean score of 4.01 ± 0.79.Although some scores related to immersion were lower, such as “The games audio and visual effects enhance the immersion” (3.56 ±1.32) and “The game makes me feel immersed in the task, as if I were in a real-life emergency situation”(3.78±1.17), they still indicate a moderate level of engagement.

Table 2. Descriptive statistics of the answers to the questions related to the game

Question	Mean ± SD
The task objectives are easy to understand	4.67 ± 0.47
The difficulty level of the game is appropriate	4.01 ± 0.79
The game is interesting and attracts my attention	4.73 ± 0.45
The game’s audio and visual effects enhance the immersion	3.56 ± 1.32
The game makes me feel immersed in the task, as if I were in a real-life emergency situation	3.78 ± 1.17
The game provides clear and timely feedback, helping to correct errors	4.67 ± 0.58
The feedback from the game helps me improve my actions	3.81 ± 0.87
The game increases my confidence in performing emergency operations in real-life situations	3.55 ± 0.93
The game sparks my interest in learning emergency response skills	3.77 ± 0.79

3.3 Post-Intervention CPR Quality and

Participant Attitudes

Table 3 presents the descriptive statistics of the key performance variables. The mean compression depth was 55.7 ± 4.80 mm, and the average compression frequency was 110 ± 10.4 compressions per minute. Regarding hand position accuracy, participants achieved a mean of 85.2% ± 8.66%. The rebound ratio, reflecting chest recoil quality, was 86.8% ± 5.44%. These results indicate generally good performance across the measured CPR quality indicators.

Table 3. Pressing Quality Statistics

Variable	Mean ± SD
Depth□mm)	55.7 ± 4.80
Frequency(times/min)	110 ± 10.4
Hand Position(□□	85.2 ± 8.66
Rebound Ratio(□□	86.8 ± 5.44

Table 4 shows participants' self-reported attitudes and willingness related to CPR before and after the intervention. Significant improvements were observed across multiple indicators. The proportion of participants who felt capable of performing CPR increased markedly from 10.96% pre-intervention to 68.49% post-intervention (P< 0.01, t=15.227). Correspondingly, those who did not feel ready dropped from 83.56% to 5.48%. When asked about willingness to perform CPR on an unknown person experiencing cardiac arrest, "Yes" responses rose from 24.66% before to 69.86% after the intervention (P=0.02, t=11.809). Willingness to perform CPR on a family member or friend increased from 73.97% to 94.52% (P< 0.01, t=22.66). Participants' confidence in their ability to help someone during cardiac arrest significantly improved, with mean scores increasing from 2.48 to 3.88 points (P<0.01, F=17.007). Fear of performing CPR decreased significantly, with mean scores dropping from 3.68 pre-intervention to 2.45 post-intervention (P< 0.01, F=14.305).

Table 4. CPR Self-reported Attitude and Willingness

Questions	Pre-Intervention (%/□±sd)	Post-Intervention (%/□±sd)	p-value	Effect size
Do you feel capable to perform CPR after study participation□			<0.01	15.227
Yes, because I have learned the relevant knowledge and skills through this study	8 (10.96)	50 (68.49)		
No, I do not feel ready to perform CPR yet	61 (83.56)	4 (5.48)		
I am unsure whether I am capable of performing CPR yet	4 (5.48)	19 (26.03)		
If you were to witness a cardiac arrest of an unknown person, would you start CPR?			0.02	11.809
Yes	18 (24.66)	51 (69.86)		
No	23 (31.51)	5 (6.85)		
Do not know	32 (43.84)	17 (23.29)		
If you were to witness a cardiac arrest of a family member or friend, would you start CPR?			<0.01	22.66
Yes	54 (73.97)	69 (94.52)		
No	7 (9.59)	0		

Do not know	12 (16.44)	4 (5.48)		
I have the feeling that I am capable of helping somebody experiencing cardiac arrest	2.48 ± 1.16	3.88 ± 1.08	<0.01	17.007
I would be scared to perform CPR	3.68 ± 1.20	2.45 ± 1.11	<0.01	14.305

4. Discussion

4.1 CPR Skill Acquisition and Performance

The serious game intervention led to meaningful improvements in participants' CPR skills, reflected in correct compression depth, frequency, and chest recoil. These findings indicate that task-based, gamified learning effectively conveyed procedural knowledge and reinforced correct motor execution, enabling participants without prior formal training to reach competency levels comparable to laypersons and healthcare trainees in prior studies[18,19]. The compulsory inclusion of chest compressions for all team members, coupled with real-time feedback from the Palm CPR device, facilitated a "learn by doing" approach, allowing immediate error correction and consolidation of psychomotor skills. These elements exemplify how structured, scenario-based gamification can support rapid acquisition of essential lifesaving skills[20].

4.2 Psychological Outcomes and Attitudinal Shifts

Post-training evaluations indicated enhanced confidence, increased willingness to act in emergencies, and decreased fear of performing CPR. These changes reflect improved self-efficacy and reduced performance anxiety, likely mediated by the safe, immersive, and interactive nature of the game[21,22]. Task cards, score incentives, and immediate corrective feedback collectively reinforced a sense of mastery while minimizing psychological barriers to action. The "trial-and-error in a controlled environment" mechanism may have been particularly effective for younger participants familiar with gamified learning, allowing them to rehearse decision-making and motor responses without real-world consequences. This aligns with social cognitive theory, wherein experiential learning and feedback loops strengthen behavioral readiness and self-confidence in emergency scenarios[23]. The intervention also highlights the potential of serious games to reduce affective barriers—such as fear and hesitation,which are often significant obstacles for non-medical bystanders, thereby complementing skill acquisition with attitudinal and emotional readiness[24,25].

4.3 Game Design Considerations and Optimization

Participant feedback suggested that the game successfully engaged attention and clarified objectives, though immersion and audiovisual realism were moderate (3.56–3.78/5). Enhancing sensory fidelity,through realistic street noises, dynamic environmental cues, or integration of virtual reality (VR) and augmented reality (AR) components could further replicate the emotional intensity of real emergencies and improve skill retention[26,27]. Incorporating high-fidelity simulation techniques, commonly applied in SBE, may allow for more authentic scenario variability, time pressure, and environmental distractions, bridging the gap between gamified practice and real-life application[28]. Future iterations could systematically examine task sequencing, hint utilization, and difficulty calibration as variables influencing cognitive load, motivation, and learning efficiency. The existing dynamic scoring and hidden achievement mechanisms effectively sustained attention and promoted autonomous problem-solving, highlighting the value of gamification elements in non-medical

CPR training. Coupling serious games with SBE principles may provide a hybrid approach that leverages interactive gameplay and evidence-based simulation pedagogy to maximize learner competence and confidence.

4.4 Public Health Implications

Targeting food delivery riders as a high-mobility, public-facing group expands the network of potential first responders. Equipping these individuals with CPR skills enhances the probability of timely intervention during out-of-hospital cardiac arrests, potentially reducing response times and improving survival outcomes[29]. Beyond individual skill gains, the intervention demonstrates how non-traditional populations can be strategically engaged in community-based health promotion, serving as cost-effective agents to strengthen societal resilience. This approach aligns with broader public health strategies that aim to cultivate a culture of first aid awareness, empower lay responders, and extend emergency preparedness to densely populated urban environments[30,31].

4.5 Limitations and Future Directions

This study still has several limitations that should be mentioned. First, it relied on self-reported data to measure participants' attitudes, willingness, and perceived abilities regarding CPR. Although self-reports provide valuable insights into subjective experiences, they are prone to social desirability bias, which may compromise accuracy. Second, the short duration of the study limited the assessment to immediate improvements, without evaluating long-term retention of CPR knowledge and skills; longitudinal studies are needed to determine whether the acquired competencies persist over time and translate into real-life emergency responses. Finally, the influence of specific game design elements (e.g., audio-visual quality, mechanics, and features) on learning outcomes was not examined. Future research could investigate how different design components shape training effectiveness, enabling more targeted and optimized serious game development.

5. Conclusion

In summary, the serious game successfully enhanced both CPR skills and psychological readiness among food delivery riders, providing a scalable, engaging, and evidence-based model for non-medical bystander training. The intervention's dual impact on technical performance and attitudinal shifts underscores the value of gamified, experiential approaches for extending community emergency response capacity.

Declarations:

Ethics approval and consent to participate: The present study was approved by the **Ethics Committee of The Central Hospital of Wuhan (Ethics approval number: WHZXKYL2024-201).** All methods were carried out in accordance with relevant guidelines and regulations, including the Declaration of Helsinki. Written informed consent was obtained from all participants or their legal guardians prior to their inclusion in the study.

Clinical trial number: Not applicable

Consent for publication: Not applicable

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests

Funding: None

Authors' contributions: L.Y. and L.L. conceptualized the study. H.K. and L.O. curated the data and designed the methodology. L.O. and L.L. performed the data analysis. Y.L., L.L., and L.O. wrote the original draft of the manuscript. D.L. reviewed and edited the manuscript and supervised the whole research.

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Supplementary Files