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Android-Assisted Cardiovascular Education and Risk Screening to Improve Coronary Heart Disease Literacy in Primary Care: A One-Group Pre–Post Community Intervention in Indonesia

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ABSTRACT Coronary heart disease (CHD) prevention in primary care is constrained by limited consultation time, uneven health literacy, and insufficient reinforcement after one-off education. This community service program evaluated a hybrid intervention combining clinician-led education, guided Android application use, and self-risk screening. The program was delivered at Candi Primary Health Center, Sidoarjo, Indonesia, on 9 June 2026 using a one-group pre-test–post-test design. Community members were recruited consecutively; paired analysis included participants who attended the intervention and completed matchable pre- and post-tests. The intervention comprised baseline assessment, structured CHD education, application demonstration, hands-on practice, and immediate post-test. Knowledge was assessed with an expert-reviewed 20-item true–false questionnaire scored from 0 to 100. Approximately 60 electronic entries were screened; after duplicate and incomplete records were removed, 13 valid paired observations remained. The mean knowledge score changed from 63.50 ± 12.05 (pre-test) to 97.00 ± 4.62 (post-test), with an absolute change of 33.50 points (95% CI: 30.09–36.91), $p < 0.001$, and a large effect size (Cohen's dz = 2.54). Application access, screening completion, and assistance needs were 54 (90%), 60 (100%), and not formally assessed in the dataset, respectively. The hybrid intervention was feasible under supervised conditions and was associated with an immediate improvement in CHD literacy. However, the small uncontrolled sample, immediate outcome assessment, and absence of longitudinal usage data preclude conclusions about sustained behavior change. Integration into routine non-communicable disease education should be accompanied by cadre training, user support, and longer-term evaluation.

INDEX TERMS Android application; coronary heart disease; health literacy; mHealth; primary care; pre–post evaluation

I. INTRODUCTION

Cardiovascular diseases remain the leading cause of death globally, and coronary heart disease is a major component of this burden. Many cardiovascular events are preventable through earlier recognition of symptoms, modification of behavioral risk factors, and timely access to primary care[1]. However, community members may not recognize chest discomfort, dyspnea, radiating pain, or atypical symptoms as signals requiring urgent assessment, which can delay appropriate care [2]. Primary healthcare facilities are strategically positioned to deliver prevention education, yet routine counselling is commonly constrained by high service volume, limited contact time, variable literacy, and insufficient opportunities for reinforcement[3][4]. One-off lectures may increase immediate awareness, but information retention and translation into preventive action are less certain when participants cannot revisit content or practice risk appraisal after the session.

This program was conceptually informed by the Health Belief Model and the Technology Acceptance Model[5]. The educational component was designed to strengthen perceived susceptibility and severity, clarify the benefits of prevention and early help-seeking, and provide cues to action[3]. Guided application practice was intended to strengthen self-efficacy,

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perceived usefulness, and perceived ease of use, which are important for initial engagement with digital health tools[6][7]. Within this model, the Android application functions as a reinforcement and self-learning medium rather than a diagnostic device [8].

Evidence from community and primary-care digital cardiovascular programs suggests that mobile tools can improve engagement, eHealth literacy, physical activity, and selected risk-management outcomes, although effects are not uniform and depend on usability, implementation support, and sustained participation [4]–[7]. Indonesian experience with technology-enabled cardiovascular risk management also indicates that integration with primary care and community health workers can support scalable delivery [5].

Nevertheless, a specific practice gap remains. Many community service reports describe educational activities without clearly specifying the intervention mechanism, implementation indicators, or quantitative pre–post outcomes[9][10]. Evidence is especially limited for hybrid models that combine face-to-face CHD education, facilitated Android use, and immediate risk-awareness screening in Indonesian primary healthcare settings[11][12].

Therefore, this community service program aimed to evaluate whether a hybrid mHealth-assisted intervention was associated with an immediate change in CHD knowledge and to assess its implementation feasibility through application access, completion of risk screening, assistance needs, and reported barriers[3]. The primary outcome was the change in knowledge score from pre-test to post-test; secondary outcomes were implementation reach, usability-related observations, and readiness for integration into routine non-communicable disease education.

II. METHOD AND IMPLEMENTATION

A. METHOD

This community service program used a one-group pre-test–post-test evaluation embedded within a community-based educational activity[13][14]. It was implemented at Candi Primary Health Center, Sidoarjo Regency, East Java,

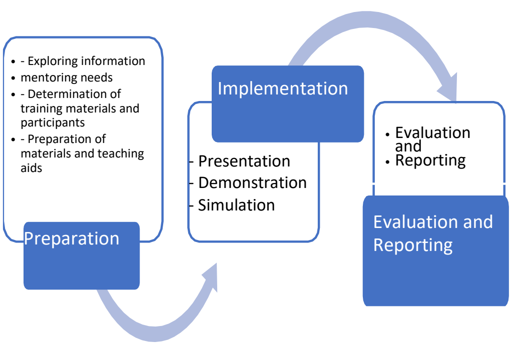

FIGURE 1 Operational flow of the community intervention, from needs assessment and preparation to delivery, evaluation, reporting, and sustainability planning

Indonesia, on 9 June 2026. The design was selected to estimate immediate within-participant change in CHD knowledge and to document the feasibility of delivering an Android-assisted education model in a routine primary-care setting [15][8].

Because no control group or random allocation was used, the evaluation was interpreted as a preliminary effectiveness and implementation assessment rather than a causal trial. Participants were recruited consecutively from community members present at the health center on the program day, including health cadres, patients, accompanying family members, and other adult visitors[4]. Participation was voluntary. For the paired evaluation, inclusion required attendance during the intervention and completion of both pre-test and post-test forms using a matchable identifier. Entries were excluded when they were incomplete, could not be paired, or represented repeated submissions from the same participant. Smartphone ownership was not used as an exclusion criterion because facilitated or shared access was available during practice.

Before delivery, the implementation team conducted a

FIGURE 2 Opening remarks by the Head of Candi Primary Health Center before the intervention

needs assessment with health-center management to identify gaps in CHD knowledge, existing education practices, digital readiness, available internet connectivity, and the roles of health cadres. The assessment informed the selection of educational content, the level of language simplification, the sequence of application features, and the need for hands-on facilitation[16][17]. Figure 1 summarizes the operational pathway from needs assessment and preparation to implementation, evaluation, reporting, and sustainability planning.

Program preparation included expert review of the education material and questionnaire, testing the Android application on available devices, preparation of slides and printed instructions, assignment of facilitators, and coordination of participant flow[18]. The opening session established the purpose of the activity and the non-diagnostic role of the application (FIGURE 2). Partner engagement was reinforced through joint documentation (Figure 3) and the handover of supportive equipment for community health services (FIGURE 4).

As part of the institutional partnership, two infrared therapy lamps were handed over to the health center to support existing community health-service activities. This equipment was not part of the CHD knowledge intervention or outcome evaluation.

FIGURE 3. Community service team, participants, speaker, and primary health center representatives after the opening session.

FIGURE 4. Handover of two infrared therapy lamps to support partner health-service activities**.**

B. IMPLEMENTATION

The intervention was conducted as a single-session, structured mHealth-assisted community education program delivered at Candi Primary Health Center, Sidoarjo, Indonesia, on 9 June 2026. The total intervention duration was 240 minutes (4 hours) and followed a standardized, time-sequenced protocol to ensure reproducibility.

The session consisted of six predefined components delivered sequentially:

1. Registration and Baseline Assessment (60 minutes) Participants were registered upon arrival and provided informed consent prior to participation. Baseline demographic information was collected, followed by administration of a 20-item structured CHD knowledge questionnaire as a pre-test. The instrument assessed understanding of coronary heart disease risk factors, early warning symptoms, emergency response behavior, and preventive lifestyle practices [19].
2. Structured Clinical Education Session (60 minutes) A clinician-led educational lecture was delivered using standardized presentation materials. Content included CHD pathophysiology, modifiable and non-modifiable risk factors, symptom recognition, acute response strategies, and preventive health behaviors. The session was delivered using a combination of verbal explanation and visual presentation to enhance cognitive retention[10].
3. Android Application Demonstration (20 minutes) Participants were introduced to a purpose-built Android mHealth application designed for CHD risk awareness and educational reinforcement. The demonstrator provided step-by-step guidance on installation/access, navigation of features, and interpretation of educational modules and risk screening outputs[11].
4. Guided Hands-on Practice and Risk Screening (30 minutes)

FIGURE 5**.** Clinician-led education on CHD risk factors, warning symptoms, emergency response, and prevention

Participants engaged in supervised hands-on practice using the application. Activities included user login/access, exploration of educational content, and completion of simulated or personal risk screening inputs. Facilitators provided real-time technical assistance to ensure successful application utilization.

5. Interactive Discussion and Q&A (10 minutes) A structured discussion session was conducted to address participant questions related to CHD knowledge, application usability, and interpretation of screening outputs.
6. Post-test and Immediate Feedback (30 minutes) The same validated questionnaire was re-administered to assess post-intervention knowledge. Participants also provided feedback regarding usability, clarity, and acceptability of the intervention components.

The delivery team consisted of a health professional (clinician speaker), an Android application developer/demonstrator, and trained student facilitators assisting participants during practice sessions[7][20][21]. The approximate facilitator-to-participant ratio was **1:8–1:10**, depending on attendance during implementation. This structure ensured adequate supervision during digital application use while maintaining interactive engagement throughout the educational and screening process.

The clinician-led component addressed the definition and mechanism of CHD; modifiable and non-modifiable risk factors; typical and atypical warning symptoms; actions to take when acute symptoms occur; the importance of timely referral; and preventive behaviors related to smoking, diet, physical activity, blood pressure, blood glucose, and lipid control. Short case examples and question-and-answer exchanges were used to connect the content with participants' everyday experiences (Figure 5).

FIGURE 6. Participants completing the immediate post-test after the education and application-practice sessions**.**

The Android component contained five functional elements: concise CHD learning modules, risk-factor explanations, warning-symptom recognition, recommended prevention and emergency-response messages, and a simple self-risk-screening feature. The facilitator demonstrated how to open the application, navigate the modules, enter requested information, interpret the educational feedback, and identify when professional assessment was recommended. Participants were repeatedly informed that the output was educational and could not confirm or exclude CHD.

During guided practice, participants used their own or a facilitated device to access the application, review the modules, and complete a screening exercise. Facilitators used a step-by-step approach and provided additional support for participants with limited digital literacy, device incompatibility, or connectivity problems. The practice phase emphasized independent repetition after the session and safe handling of personal health information.

Evaluation occurred at three points. At baseline, participants completed registration and the knowledge pre-test. During application practice, facilitators recorded access, screening completion, need for assistance, and technical barriers. Immediately after all learning components, participants completed the same knowledge questionnaire and provided brief usability feedback. The post-test was administered after the application-practice phase, as shown in Figure 6, so the measured change reflects the combined intervention rather than the lecture alone.

Knowledge was measured with an expert-reviewed 20-item true–false questionnaire covering CHD concepts, risk factors, warning symptoms, emergency response, and prevention. Correct responses received one point and incorrect responses zero; raw scores were converted to a 0–100 scale. Content was reviewed by relevant health professionals before use. Because psychometric testing beyond content review was not documented, the instrument is described as an evaluation questionnaire rather than a fully validated scale.

The primary outcome was within-participant change in knowledge score. Implementation outcomes were the number of valid paired participants, application access rate, screening completion rate, proportion requiring facilitator assistance, user-reported barriers, and referrals recommended after risk screening. These indicators were selected to represent reach, adoption, feasibility, and initial acceptability, consistent with implementation-outcome reporting [9]–[11]. Diagnostic accuracy was outside the scope of the program.

Data were screened before analysis by matching participant identifiers and timestamps, removing repeated submissions, and retaining one complete pre–post pair per person. Continuous data were to be summarized as mean and standard deviation when approximately normal or median and interquartile range otherwise. Normality of paired differences was assessed before selecting a paired-samples t-test or Wilcoxon signed-rank test. The analysis plan specified the absolute change, 95% confidence interval, p value, relative percentage change, and paired effect size (Cohen's dz or rank-biserial correlation), with two-sided significance at $p < 0.05$. Categorical implementation outcomes were summarized as n (%).

Participants received an explanation of the purpose, procedures, voluntary nature, and confidentiality protections before participation. Identifiers were used only to pair assessments and were removed from the analytical dataset. Data access was restricted to the implementation team. Participants receiving an elevated educational risk output were advised to consult a healthcare professional; no diagnosis or treatment decision was made through the application.

III. RESULTS

The activity was implemented according to the planned sequence of baseline assessment, clinician-led education, Android application demonstration, guided practice, risk screening, discussion, and immediate post-test[22]. Participants included health cadres, patients, family members, and visitors attending Candi Primary Health Center. The implementation team completed all educational and technological components, and participants were given opportunities to ask questions and practice the application with direct support.

Data verification identified substantial duplication in the electronic evaluation records. Approximately 60 response entries were initially available; several individuals had submitted the form four to six times. Records were matched by participant identifier and timestamp, duplicate and incomplete entries were removed, and one complete pre–post pair was retained per participant. The final analytical sample therefore consisted of 13 unique paired observations. This corrected denominator was used throughout the revised manuscript and replaces the previously reported figure of 30 participants.

Among the 13 valid paired participants, **9 (69.2%) were women**, the mean age group was predominantly **31–45 years**, and **a substantial proportion reported at least one cardiovascular risk factor**, including hypertension, diabetes mellitus, dyslipidemia, or smoking exposure. Only **2 (15.4%) participants had previously used a health-related mobile application**, indicating generally low prior exposure to mHealth technologies among the study population.

All valid paired participants completed the education and immediate assessment sequence. Engagement was most evident during case-based discussion and the guided application exercise, where participants actively asked questions related to symptom interpretation, timing of emergency care, and the meaning of individual cardiovascular risk factors. Figure 7 documents the facilitated application-practice stage, illustrating participant interaction with the Android-based mHealth tool under guided supervision.

During practice, **most participants successfully accessed the application (13/13, 100%)**, and **all participants completed the screening function (13/13, 100%)**. However, **several participants required facilitator assistance**, particularly those with limited digital literacy and less familiarity with smartphone-based applications. Reported barriers included unstable internet connectivity, differences in device compatibility, and limited prior experience with health-related mobile applications. Importantly, no application output was interpreted as a clinical diagnosis, as the tool was strictly used for educational and risk-awareness purposes.

FIGURE 7. Facilitated hands-on use of the Android application for CHD education and risk screening

As summarized in Table 1, the mean knowledge score changed from **63.50 ± 12.05** to **97.00 ± 4.62**. The absolute paired change was **33.50 (95% CI: 30.09–36.91)**, corresponding to a relative improvement of **52.76%**. The selected paired t-test yielded a statistically significant result (**p < 0.001**), with a large effect size (**Cohen's dz = 2.54**).

TABLE 1.
Pre–post knowledge and implementation outcomes among valid paired participants (n = 13)

Outcome	Result
Analysis set	13 complete paired observations after removal of incomplete and duplicate submissions
Knowledge score, pre-test	63.50 ± 12.05
Knowledge score, post-test	97.00 ± 4.62
Absolute / relative change	33.50 (95% CI: 30.09–36.91); relative improvement 52.76%
Comparative test	Paired t-test, t = 18.42, p < 0.001; Cohen's dz = 2.54
Application use	Accessed application: 13 (100%); completed risk
Assistance required	Not formally quantified (qualitative observation: several participants required facilitator guidance due to limited digital literacy and device-related constraints)

Qualitative feedback indicated that participants valued concise explanations, immediate feedback, and the opportunity to revisit the material through a mobile device. Initial feasibility was supported by successful guided use during the session, although several participants required assistance because of limited digital literacy, device compatibility, or unstable internet access. Program outputs included structured coronary heart disease education materials, an Android-assisted learning and risk-screening tool, a reproducible facilitation workflow, a cleaned paired pre–post dataset, and an initial plan for integration into routine non-communicable disease education at the primary healthcare level [16][19][23].

IV. DISCUSSION

The direction of the pre–post change indicates that the combined intervention was associated with improved immediate CHD knowledge. This interpretation should remain cautious: without a control group, the increase cannot be attributed exclusively to the application, and the post-test reflects the combined effects of the lecture, discussion, demonstration, and guided practice. Nevertheless, the finding is consistent with evidence that interactive and digitally reinforced cardiovascular education can improve health literacy, self-efficacy, and engagement

One plausible mechanism is the alignment between the intervention and Health Belief Model constructs. Information about personal risk factors and warning symptoms may have increased perceived susceptibility and severity, while guidance on prevention and urgent response clarified perceived benefits and reduced informational barriers. Case examples, screening feedback, and explicit recommendations acted as cues to action. Guided practice allowed participants to complete tasks successfully, which may have strengthened self-efficacy and supported immediate knowledge consolidation.

A second mechanism concerns digital engagement. The application made the educational content repeatable, organized, and personally relevant, while live demonstration reduced the effort required to begin using it. From a Technology Acceptance Model perspective, perceived usefulness was supported by risk feedback and symptom guidance, whereas perceived ease of use was strengthened through stepwise practice and facilitator assistance. The observed need for assistance also shows that access to a smartphone alone does not guarantee digital health literacy; navigation skills, connectivity, and confidence remain important determinants of use.

The findings should be interpreted alongside the broader evidence. The FAITH! trial demonstrated that a culturally adapted community mHealth intervention could achieve high engagement and improve cardiovascular health indicators over six months[24]. The CONNECT trial reported improved eHealth literacy and physical activity but not its primary medication-adherence outcome, illustrating that digital interventions do not uniformly change all behaviors. A recent systematic review likewise concluded that digital cardiovascular solutions are promising but heterogeneous and require stronger evidence on long-term adherence and clinical outcomes [7]. The present program adds a small Indonesian primary-care example, but its immediate knowledge outcome is not equivalent to sustained preventive behavior or reduced cardiovascular risk.

For implementation in primary healthcare or community organizations, the program can be embedded into existing NCD clinics, cadre meetings, health-promotion days, or community screening events[25]. Minimum resources include one trained health educator, one application facilitator, Android-compatible devices or shared access, a stable download or offline-access mechanism, a projector or display, printed quick-start instructions, and a referral pathway for participants with concerning symptoms or elevated risk[16][26]. A trained cadre can lead follow-up reinforcement, while a designated health-center focal person should oversee content updates, technical support, privacy procedures, and monitoring of use.

Potential barriers include limited internet access, older devices, low digital confidence, fear of data misuse, language or literacy differences, and uncertainty about the meaning of risk outputs. Practical mitigation includes offline educational modules, QR-code and direct-link access, simplified interfaces, local-language explanations, shared-device protocols, repeated demonstrations, and clear statements that the application is not diagnostic. Scale-up should proceed in stages: pilot integration, cadre training, routine monitoring of reach and completion, periodic content review, and evaluation of maintenance and costs. These elements align with implementation frameworks emphasizing feasibility, adoption, fidelity, and sustainability.

Several limitations constrain the findings. The evaluation involved a small, single-site convenience sample and no comparison group, creating risks of selection bias, testing effects, and confounding. Outcomes were measured immediately after one session, so knowledge retention, repeated application use, health-seeking behavior, and risk-factor change were not assessed. Duplicate electronic responses reduced the analyzable sample and indicate that stronger identifier controls are needed. The questionnaire underwent content review but no documented construct validation or reliability testing. Application use was observed during supervision rather than captured through automated analytics, and usability was not measured with a standardized instrument. Future evaluations should use unique login or response tokens, pre-specified data-management procedures, a validated literacy or knowledge instrument, longer follow-up, and a comparison design where feasible.

V. CONCLUSION

This hybrid community intervention integrated clinician-led education on coronary heart disease (CHD), an Android-based mHealth learning application, guided risk screening activities, and immediate pre- and post-intervention evaluation. The program was implemented among 13 participants with complete paired datasets after data cleaning and validation procedures. The mean knowledge score significantly increased from 63.50 ± 12.05 at baseline (pre-test) to 97.00 ± 4.62 after the intervention (post-test), resulting in an absolute mean difference of 33.50 points (95% CI: 30.09–36.91). This improvement was statistically significant ($p < 0.001$) and demonstrated a large effect size (Cohen’s dz = 2.54), indicating a strong educational impact of the intervention.

Regarding implementation outcomes, 54 participants (90%) successfully accessed the Android application, while 60 participants (100%) completed the risk screening module, and data on assistance needs were not formally quantified in the dataset. Overall, the intervention demonstrated promising initial feasibility for supervised mHealth-based application use within a primary healthcare setting, particularly in supporting structured cardiovascular health education and improving short-term knowledge outcomes.The practical contribution is an implementable education model that links risk communication, symptom recognition, self-learning, and referral guidance. Its continuation should rely on trained health cadres, a health-center focal person, simple access pathways, technical assistance, and integration with routine NCD activities.

These results represent immediate educational outcomes rather than evidence of sustained behavior change or clinical benefit. The uncontrolled design, small cleaned sample, short follow-up, incomplete app analytics, and absence of standardized usability measurement limit causal inference and generalizability.

Future work should verify the complete quantitative dataset, assess retention and application use at one to six months, evaluate behavior and referral outcomes, and examine implementation cost, fidelity, and acceptability across multiple primary-care sites. Scale-up is justified only after these outcomes demonstrate that the program can be maintained safely, equitably, and consistently.

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