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ECG In Smartwatches and Smart Bracelets: Can They Be Trusted?

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Abstract
In recent years, wearable technologies, particularly smartwatches and smart bracelets, have become increasingly popular tools for monitoring human health. The integration of electrocardiography (ECG) functions into consumer wearable devices has significantly expanded the possibilities of digital healthcare and preventive cardiology. This article investigates the biophysical principles of ECG signal acquisition in wearable devices and analyzes the reliability of ECG measurements across different smartwatch brands, including Apple, Samsung, Huawei, Garmin, Amazfit, and Withings. The study evaluates diagnostic accuracy, signal quality, sensitivity, specificity, and clinical limitations of wearable ECG systems. The findings indicate that although modern smartwatches demonstrate high accuracy in detecting atrial fibrillation and basic rhythm disorders, substantial differences exist among brands due to sensor quality, algorithms, filtering methods, and data interpretation systems. Smartwatch ECG technologies show strong potential as auxiliary monitoring tools but cannot fully replace conventional 12-lead clinical ECG systems.
Keywords: ECG, smartwatch, smart bracelet, wearable technology, Apple Watch, Samsung Galaxy Watch, Huawei Watch, arrhythmia, digital medicine, biophysics.

Introduction

Cardiovascular diseases remain one of the leading causes of mortality worldwide. According to World Health Organization, millions of deaths annually are associated with heart-related diseases. Consequently, early diagnosis and continuous monitoring of cardiac activity have become major priorities in modern healthcare systems.

The rapid development of wearable technologies has introduced new possibilities for long-term physiological monitoring. Smartwatches and smart bracelets can continuously monitor heart rate, oxygen saturation, sleep quality, physical activity, and electrocardiographic signals. These technologies have transformed personal health monitoring from occasional hospital-based measurements into continuous real-time observation.

The integration of ECG functions into commercial devices such as Apple Watch, Samsung Galaxy Watch, Huawei Watch, Garmin, Amazfit, and Withings has significantly increased public interest in wearable cardiac monitoring.

However, despite their popularity, an important scientific and clinical question remains unresolved: can smartwatch ECG systems be trusted as reliable diagnostic tools?

This article aims to:

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- analyze the biophysical principles of ECG acquisition in wearable devices;
- compare ECG reliability among major smartwatch brands;
- evaluate clinical accuracy in arrhythmia detection;
- investigate limitations related to signal quality and motion artifacts;
- assess the future role of wearable ECG technologies in digital medicine.

Materials and Methods

The study employed methods of scientific literature review, comparative technological analysis, biophysical signal interpretation, and evaluation of wearable ECG systems.

Published studies related to smartwatch ECG validation, atrial fibrillation detection, photoplethysmography (PPG), artificial intelligence algorithms, and digital signal processing were analyzed.

Electrocardiographic signals originate from bioelectrical impulses generated by cardiac muscle depolarization and repolarization. Conventional clinical ECG systems utilize 12 leads, whereas most smartwatches rely on single-lead ECG configurations. This limitation significantly affects diagnostic capability.

The ECG signal can be represented as:

V(t)=V_0\sin(\omega t+\varphi)

where:

- (V(t)) — bioelectrical potential;
- (V_0) — signal amplitude;
- (\omega) — angular frequency;
- (\varphi) — phase shift.

The following ECG parameters were evaluated:

- RR interval;
- heart rate;
- QRS duration;
- signal-to-noise ratio;
- sensitivity and specificity for arrhythmia detection.

The study also compared the ECG performance of major smartwatch brands based on published clinical trials and meta-analyses.

Results

General Diagnostic Accuracy of Smartwatch ECG

Several systematic reviews demonstrated that smartwatch ECG systems possess high diagnostic potential for detecting atrial fibrillation (AF). A large meta-analysis involving more than 424,000 participants reported overall sensitivity of approximately 100% and specificity around 95% for arrhythmia detection. (PMC)

Another systematic review showed that most modern wearable ECG systems achieved validation measures above 90%, approaching the performance of FDA-approved portable ECG devices. (ResearchGate)

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Brand-Based Analysis of Smartwatch ECG Systems

Apple Watch

Among wearable ECG devices, Apple Watch has been the most extensively studied model in scientific research.

The Apple Heart Study conducted with approximately 420,000 participants demonstrated that Apple Watch achieved a positive predictive value (PPV) of 84% for atrial fibrillation detection. (Time)

Several studies reported that Apple Watch ECG systems showed:

- sensitivity above 90%;
- specificity near 95%;
- relatively stable signal quality under resting conditions. (MDPI)

Apple's advantage primarily comes from:

- advanced filtering algorithms;
- tight hardware-software integration;
- optimized ECG interpretation algorithms;
- large clinical datasets used for AI training.

However, Apple Watch automatically excludes low-quality measurements, which may artificially improve statistical performance. (Cinco Días)

Samsung Galaxy Watch

Samsung Galaxy Watch devices also demonstrated high ECG reliability in arrhythmia screening studies.

Clinical analyses showed:

- PPV around 95%;
- strong AF detection capability;
- high consistency during repeated measurements. (Heart)

Samsung combines:

- ECG;
- PPG sensors;
- machine learning algorithms.

This integration improves rhythm classification performance. However, signal quality may deteriorate during intensive movement and exercise.

Huawei Watch

Huawei wearable devices demonstrated relatively high ECG accuracy, especially in recent generations.

The mAFA-II clinical trial reported a PPV of approximately 91.6% for Huawei Watch devices in atrial fibrillation screening. (Heart)

Huawei smartwatches are characterized by:

- strong sensor sensitivity;
- long battery life;
- continuous monitoring capability.

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Recent Huawei devices also introduced advanced blood flow analysis and physiological monitoring systems. (TechRadar)
Nevertheless, compared to Apple and Samsung, Huawei ECG systems have fewer large-scale international validation studies.

Garmin and Amazfit
Garmin devices are widely used in sports monitoring and athlete physiology assessment. Garmin smartwatches demonstrated PPV values around 90% for AF detection. (Heart)
Amazfit devices surprisingly showed very high sensitivity and specificity in recent meta-analyses, reportedly exceeding 98% in some studies. (Cinco Días)
However, researchers noted that:

- study methodologies varied considerably;
- testing conditions were not always standardized;
- some brands excluded low-quality recordings from analysis.

Withings
Withings wearable devices demonstrated a more clinically oriented approach. Unlike some competitors, Withings systems often accepted low-quality signals rather than automatically rejecting them. (Cinco Días)
This approach may reduce apparent accuracy metrics but provides more realistic clinical performance assessment.

Comparative Analysis of Smartwatch Brands

Parameter	Apple Watch	Samsung Galaxy Watch	Huawei Watch	Garmin	Amazfit
ECG Type	Single-lead	Single-lead	Single-lead	Single-lead	Single-lead
AF Detection Accuracy	Very high	High	High	Moderate–High	Very high
Clinical Validation	Extensive	Moderate	Limited	Limited	Emerging
Signal Filtering	Advanced AI	AI-assisted	Digital filtering	Moderate	AI-assisted
Motion Artifact Resistance	High	Moderate	Moderate	Moderate	Moderate
Battery Performance	Moderate	Moderate	High	High	High
Research Support	Strong	Growing	Growing	Limited	Limited

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The comparative analysis suggests that Apple Watch currently possesses the strongest scientific validation base, whereas Samsung and Huawei demonstrate competitive technological performance. Amazfit and Garmin show promising results but require further large-scale clinical validation.

Discussion

The results indicate that smartwatch ECG technologies have achieved substantial progress in recent years. Modern wearable devices can reliably detect atrial fibrillation and basic rhythm disorders under favorable conditions.

Nevertheless, several important limitations remain:

1. Most smartwatch ECG systems are single-lead systems.
2. Signal quality decreases during motion.
3. Muscle activity introduces significant noise.
4. False-positive alerts may cause unnecessary anxiety.
5. Smartwatch ECG systems cannot diagnose all cardiac pathologies.

Studies consistently show that wearable ECG systems perform best during resting conditions. (ScienceDirect)

Artificial intelligence plays a major role in improving smartwatch ECG interpretation. Machine learning models can analyze noisy signals and improve arrhythmia detection accuracy. (arXiv)

Brand-related differences mainly depend on:

- sensor quality;
- signal filtering;
- ECG interpretation algorithms;
- dataset size used for AI training;
- hardware optimization.

Apple currently dominates scientific validation, while Samsung and Huawei continue expanding their clinical capabilities.

Future wearable ECG systems may include:

- multi-lead ECG;
- cloud-based diagnostics;
- AI-enhanced prediction systems;
- real-time telemedicine integration.

Conclusion

The study demonstrated that ECG systems integrated into smartwatches and smart bracelets possess high potential for early arrhythmia detection and long-term cardiac monitoring.

However, the reliability of smartwatch ECG significantly depends on the brand, sensor quality, filtering algorithms, and software architecture.

Among major brands, Apple Watch currently demonstrates the strongest scientific and clinical validation, while Samsung and Huawei also show high diagnostic potential. Garmin and Amazfit present promising results but require additional large-scale validation studies.

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Although smartwatch ECG systems cannot replace standard clinical 12-lead ECG devices, they represent valuable auxiliary tools in preventive cardiology, telemedicine, and personalized healthcare.
The continued development of artificial intelligence and digital signal processing technologies is expected to further improve the clinical reliability of wearable ECG systems in the future.

References

1. Biomedical Signals and Sensors. Wiley, 2015.
2. Medical Instrumentation: Application and Design. Wiley, 2018.
3. Nazarian S. Diagnostic Accuracy of Smartwatches for Detection of Cardiac Arrhythmias. Journal of Medical Internet Research, 2021. (PMC)
4. Bogár B. Detection of Arrhythmias Using Smartwatches — A Systematic Literature Review, 2024. (MDPI)
5. Zarak M.S. Systematic Review of Validation Studies for Wearable Smartwatches in AF Screening, 2024. (ija.xmlink.kr)
6. Iqhrammullah M. Accuracy and Interpretability of Smartwatch ECG for AF Detection, 2025. (Онлайн Библиотека Уайли)
7. Apple Health Research
8. Samsung Health Monitoring
9. Huawei Wearables Research
10. Malik M. Heart Rate Variability. European Heart Journal. 1996.
11. Clifford G. Advanced Methods and Tools for ECG Data Analysis. Artech House, 2006.
12. Sörnmo L., Laguna P. Bioelectrical Signal Processing in Cardiac and Neurological Applications. Elsevier, 2005.
13. Harvard Medical School. Smartwatch ECG Accuracy in Cardiac Monitoring. (Harvard Health)
14. Reuters Health. Apple Watch and AFib Monitoring Studies, 2026. (Reuters)
15. Abdelrazik A. Smartwatches for Arrhythmia Detection: A Review of Current Evidence, 2025. (Heart)