Comparative Analysis of Smartwatch Exercise Evaluation Metrics : Technical Approach of Nine Brands for Algorithm Design

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ABSTRACT

INTRODUCTION Smartwatches are essential for daily exercise management, yet inconsistent nomenclature, measurement and calculation methods, and data representations across brands hinder integration. Systematic understanding of brand-specific metrics is essential for consistent evaluation in integrated platforms. This study analyzes exercise metrics from nine brands to provide information for algorithm design.

METHODS Exercise evaluation metrics were collected from official manuals and usability tests of nine brands: Apple, Coros, Garmin, Huawei, Pixel, Samsung, Suunto, Whoop, and Xiaomi. Collected metrics were classified and analyzed from five perspectives: (1) quantitative versus qualitative evaluation, (2) absolute versus relative evaluation, (3) one-time versus cumulative metrics, (4) measurement unit classification (Energy, Time, Motion, Physiology, Score, Dashboard, and Null), and (5) exercise type classification (walking, running, cycling, swimming, aerobic, and strength training). Each brand's metrics were analyzed by distinguishing common metrics from exercise-type-specific metrics.

RESULTS A total of 1,557 exercise evaluation metrics were collected from nine brands, with brand-specific counts of Garmin 469, Coros 244, Samsung 180, Huawei 159, Apple 144, Pixel 137, Suunto 124, Xiaomi 112, and Whoop 104. Quantitative metrics were most numerous in Garmin with 113, followed by Coros with 84 and Apple with 78. Garmin also led in qualitative metrics with 36, followed by Suunto with 22 and Coros with 17. For absolute evaluation metrics, Garmin provided 148, Coros 101, and Apple 92, while relative evaluation metrics were offered by only Garmin, Huawei, Pixel, and Xiaomi with one each. One-time metrics numbered 135 for Garmin, 90 for Coros, and 87 for Huawei, while cumulative metrics were relatively fewer at 14 for Garmin, 11 for Coros, and 6 for Samsung. In measurement unit analysis, Garmin provided the most metrics across all categories (Energy 18, Time 27, Motion 46, Physiology 19, Score 27, Dashboard 7, and Null 5). Across all brands, Motion unit metrics averaged 23.6, the highest, followed by Physiology 15.2, Time 14.9, Score 14.4, and Energy 9.1. By exercise type, running-related metrics were most abundant (Garmin 83, Coros 65, Huawei 56), followed by walking (Garmin 64, Coros 49, Huawei 49), cycling (Garmin 72, Coros 43, Apple 37), and strength training (Garmin 44, Coros 32, Huawei 24).

CONCLUSIONS Garmin provides the most comprehensive metric system, with clear brand-specific differences confirmed. Cumulative metrics require long-term data for refinement. This study provides fundamental information for integrated exercise evaluation algorithm development by systematic analysis of 1,557 metrics and is expected to contribute to wearable-based digital healthcare platform standardization.

INTRODUCTION & PURPOSE

- Smartwatches have become indispensable tools for daily exercise management. However, inconsistent nomenclature, measurement methods, and data representations across brands pose significant challenges for cross-platform integration. A systematic understanding of brand-specific exercise metrics is therefore essential for developing consistent evaluation frameworks in integrated digital health platforms.
- This study aimed to systematically analyze and classify exercise evaluation metrics from nine major smartwatch brands to provide foundational information for integrated exercise algorithm design.

METHODS

- We systematically collected and classified exercise evaluation metrics from 9 smartwatch brands using a five-level classification framework.

Data Collection

Official Manuals + Usability test by Conducted 7 researchers

9 Smartwatch Brands

Apple, COROS, GARMIN, HUAWEI, Pixel, SAMSUNG, SUUNTO, WHOOP, xiaomi

Metrics Collected

1,557

Exercise Evaluation Metrics

Analysis Approach

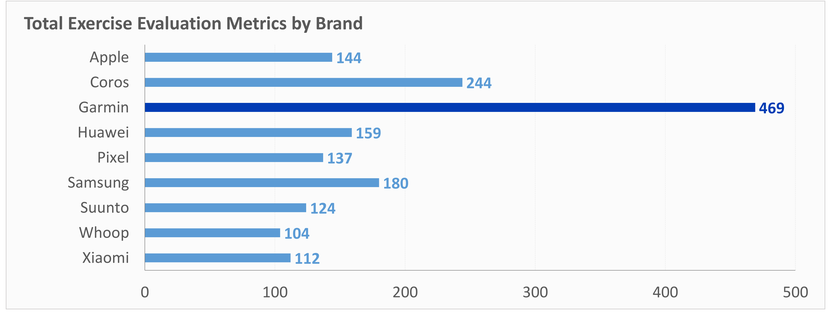
- The collected indicators are classified and analyzed from five-level classification framework.

Classification Criterion	Category
① Evaluation Type	Quantitative
	Qualitative
② Comparison Type	Absolute
	Relative
③ Duration Type	One-Time
	Cumulative

Classification Criterion	Category	Examples
④ Measurement Unit	E (Energy)	kcal, watt, METs,
	T (Time)	min/km, ms, h
	M (Motion)	km, cm, rpm
	P (Physiology)	bpm, ℃, %, hPa
	S (Score)	score, grade
	D (Dashboard)	-
	N (Null)	-

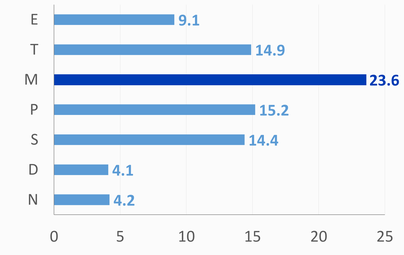
Classification Criterion	Category
⑤ Exercise Type	Running
	Walking
	Cycling
	Swimming
	Strength

RESULTS



Brand	① Evaluation Type		② Comparison Type		③ Duration Type	
	Quantitative	Qualitative	Absolute	Relative	One-Time	Cumulative
Apple	78	14	92	0	87	5
Coros	84	17	101	0	90	11
Garmin	113	36	148	1	135	14
Huawei	72	18	89	1	87	3
Pixel	44	8	51	1	51	1
Samsung	64	14	77	0	71	6
Suunto	51	22	73	0	73	2
Whoop	32	16	48	0	47	1
Xiaomi	55	16	70	1	69	2

④ Measurement Unit (Average)



⑤ Exercise Type: Brand Metric Rankings

Type	1st	2nd	3rd
Running	Garmin	Coros	Huawei
Walking	Garmin	Coros	Huawei
Cycling	Garmin	Coros	Apple
Swimming	Garmin	Xiaomi	Huawei
Strength	Garmin	Coros	Huawei

CONCLUSION

- A total of 1,557 exercise evaluation metrics were collected and analyzed across nine brands, revealing clear brand-specific differences in metric comprehensiveness and categorization.
- Garmin demonstrated the most extensive metric system across all classification perspectives.
- Notably, cumulative metrics remain limited across brands, requiring long-term data accumulation for further refinement.
- These findings provide fundamental evidence for developing integrated exercise evaluation algorithms and are expected to contribute to the standardization of wearable-based digital healthcare platforms.

ACKNOWLEDGEMENTS

- Supported by Samsung Electronics (KMU-S2025-0106).