A Survey on the Usage and Evaluation of Exercise mhAPP among Urban Residents and Opinions of Relative Industry Experts over mhAPP Service in China

-Residents and Experts in Guangzhou, Foshan and Changchun as Survey Respondents

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Abstract: *Exercise mobile health application (mhAPP) is the integration hub of exercise and medical care, and a new health management tool. It can monitor the key physiological health indicators of the human body in exercise/quiet state, provide fitness courses, fitness/diet planning, and latest fitness consultation, etc., and has great potential value for the promotion of "Healthy China". In order to examine the current status of mhAPP services and the possible future application of mhAPP in big health services, this study investigated the acceptance, usage rate, brand selection and quality evaluation of mhAPP among Chinese urban residents, and the views of industry experts (doctors, fitness trainers, insurance managers and mhAPP developers) on the participation of mhAPP in industry services, aiming to provide a theoretical basis for mhAPP-mediated big health services in China.*

Keywords: *Mobile Health Application, Integration Hub of Exercise and Medical Care, Big Health Service, Survey*

1. Introduction

"Health China" is an important component of the "Great Revival Dream" of the Chinese nation, and improving the physical health of the nation is the key to "Health China". The obvious imbalance of medical resources in China is a huge obstacle to the implementation of the "Healthy China" strategy. The growing demand for health management and the unbalanced medical resources have created a sharp contradiction. Mobile health has emerged, allowing users to complete basic health management without leaving home, saving patients' time and relieving pressure on hospitals. During the global coronary outbreak, the advantages of mobile health across time and space were highlighted as never before, and played a significant role in the fight against the epidemic.

Mobile health is managed through small programs that run on smart mobile devices, called mobile health application (mhAPP). Unlike the medical mhAPPs (such as "Medical Deer" and "Dr. Chunyu") that can provide online diagnosis by doctors, exercise mhAPPs have the function of monitoring physiological indicators of exercise/basic status, fitness and diet planning, and fitness courses, etc. Its personal monitoring of human The convenience of its personal health monitoring surpasses that of any traditional medical institutions, and is an integration hub of exercise and medical care   and a good assistant for "scientific exercise".

The emergence of mhAPP (unless otherwise stated, mhAPP in the study refers to exercise mhAPP only) is disruptive to the traditional hospital-centered health management. Although the physiological items it can monitor are limited, it involves the health most closely associated with cardiorespiratory function, such as blood pressure, ECG, and oxygen saturation, for exercise or basic status, but also includes sleep quality, fall risk and energy consumption, and its scientific fitness/diet planning, fitness

courses and other functions make fitness twice as effective. Using mhAPP not only allows for better management of personal health, but in the future, the data it collects can also be accessed by third-party service providers (e.g. hospitals, gyms, insurance companies), making it useful in the larger health services of society. In order to examine the feasibility of mhAPP big health services in Chinese cities, it is necessary to understand the current residents' acceptance, usage rate (popularity), quality evaluation and expectation of mhAPP, and industry experts' (doctors, fitness trainers, insurance managers and mhAPP production faculties) views on mhAPP participation in various industry services.

Due to constraints, this survey only covered residents and industry experts in three Chinese cities (Guangzhou, Foshan, and Changchun). These three cities are distributed in the south and north of China, and economically, Guangzhou is a first-tier city, while Foshan and Changchun are second-tier cities, which are representative

2. Methods

2.1. Questionnaire survey and interviews

Questionnaire survey: conducted in June-July 2021, the link to the online questionnaire was disseminated in local WeChat groups by investigators who were in Guangzhou, Foshan, and Changchun, China, and data collection lasted 4 weeks. A total of 800 questionnaires were received (400 for each gender limit), with 636 valid questionnaires.

Expert interviews (telephone exchanges or face-to-face interviews): Interviews were conducted from September to December 2021. Including 30 doctors (from 1 Guangzhou 1 Changchun and 3 Foshan City tertiary hospitals, specifically 8 internal medicine, 4 general surgery, 5 Orthopedics, 5 pediatrics, 4 contagion section, 4 obstetrics and gynecology) and 30 professional fitness trainers (from 5 gyms in Foshan City), 6 insurance managers (all from Guangzhou and Foshan branches of a domestic insurance company), 6 mhAPP developers (all from the Guangzhou R&D group of a domestic mhAPP)

2.2. Reliability and validity

Reliability and validity of the questionnaire: The questionnaire body is non-scale type, so the reliability and validity of the Cronbach α and KMO cannot be tested in the conventional scale format, and this study ensures the reliability and validity of the questionnaire from the following aspects: In terms of reliability, in order to improve the stability of the results, 70% of the same option is considered invalid sample, and the minimum time to submit the questionnaire is 300 seconds. Regarding validity, the content of this questionnaire was referred to the Fifth National Health Service Survey 2013[1] and was reviewed by five experts in exercise and two in education, with two revisions to ensure its validity.

The reliability and validity of the expert interviews were guaranteed: the reliability was improved in two ways——the interviewees had been practicing for more than three years and the interviews were at least 8 minutes long. To ensure its validity, the content of the interview outline was reviewed by five experts in exercise and two experts in education, and the content were revised twice.

2.3. Processing of questionnaire and interview results

The results of the questionnaires were processed by descriptive statistics, rank sum test, chi-square test, and multi-factor logistic regression by SPSS 22. The significance level was set at 0.05.

The interview results were processed by summary and induction methods.

3. Research results and discussion

### 3.1. Basic information of survey respondents (urban residents)

Table 1: Basic information of survey respondents(n=636)

Sample Characteristics	Category	Number	Percentage	Cumulative Percentage
Gender	Male	284	44.7	44.7
	Female	352	55.3	100
Age	24 and below	159	25	25
	25-34	156	24.5	49.5
	35-44	127	20	69.5
	45-54	119	18.7	88.2
	55 years old and above	75	11.8	100
Education background	Junior high school and below	146	23	23
	High school/Secondary vocational school	283	44.5	67.5
	Bachelor's degree/higher vocational school	112	17.6	85.1
	Graduate student and above	95	14.9	100
Job	Student	171	26.9	26.9
	In the system	141	22.2	49.1
	Private enterprise	180	28.3	77.4
	Freelance	85	13.4	90.7
	Retired	40	6.3	97
	Other	19	3	100
Monthly income	<1500¥	254	39.9	39.9
	1501-5000¥	213	33.5	73.4
	5001-10000¥	98	15.4	88.8
	10001-20000¥	48	7.5	96.4
	>20,000¥	23	3.6	100
Health status	Health	217	34.1	34.1
	Sub-healthy	276	43.4	77.5
	patient	143	22.5	100
Household medical expenditure per capita (the latest year)	<1000¥	243	38.2	38.2
	1000-3000¥	199	31.3	69.5
	3001-6000¥	107	16.8	86.3
	6001-9999¥	61	9.6	95.9
	>10000¥	26	4.1	100
The first medical payment method	Self-funded	96	15.1	15.1
	Urban employee medical insurance	297	46.7	61.8
	Urban residents' medical insurance	144	22.6	84.4
	New Agricultural Cooperative Medical Insurance	28	4.4	88.8
	Commercial Insurance	31	4.9	93.7
	Other	40	6.3	100
Medical examination habit	No regular medical checkups	403	63.4	63.4
	regular medical checkups	233	36.6	100
Frequency of medical checkups	Never	26	4.1	4.1
	Every six months	57	9	13.1
	Every year	294	46.2	59.3
	Every two years	32	5	64.3
	> 2 years	20	3.1	67.5
	No fixed pattern	207	32.5	100

The results suggest that the distribution of people will not be overly concentrated in a certain category of people, and the data is somewhat representative.

### 3.2. Acceptance of mhAPP in each category and comparison between groups

In this study, the acceptability, from inactive to positive, was divided into 5 levels (1 unacceptable, 2 less willing to accept, 3 indifferent, 4 more willing to accept, 5 original intention to accept). The findings are presented in the left panel and the comparison between groups is presented in the right panel, see fig1-10. Significance ($p<0.05$) and differences between groups were investigated by rank sum test of Independent sample Mann-Whitney U test (two groups) or Kruskal-Wallis one-way ANOVA (multiple groups).
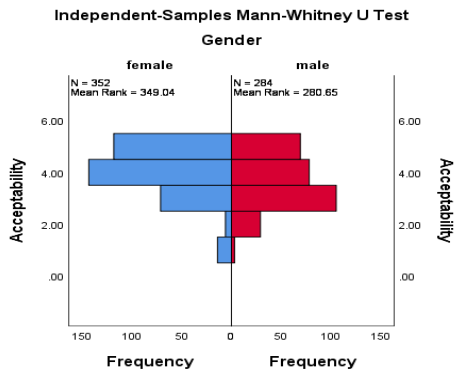
| Independent-Samples Mann-Whitney U Test Summary	
Total N	636
Mann-Whitney U	60734.500
Wilcoxon W	122862.500
Test Statistic	60734.500
Standard Error	2199.015
Standardized Test Statistic	4.889
Asymptotic Sig.(2-sided test)	.000

Figure 1: Gender group and acceptability
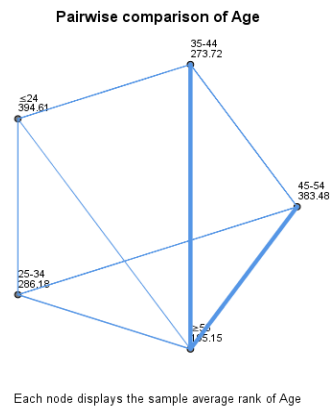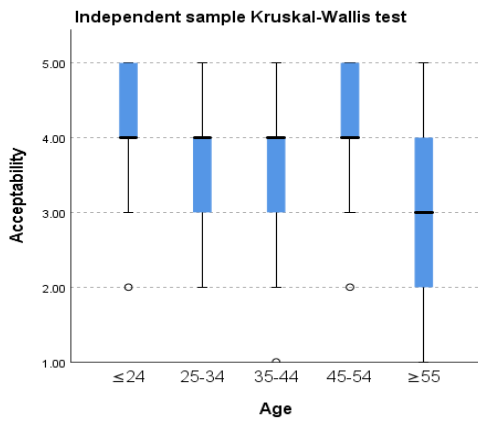
Total N	636
Test Statistic	96.805a
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	.000

Figure 2B: Comparison of acceptability in different age groups

Figure 2A: Age and acceptability

Note: There is a connecting line means there is a significant difference, and the value under the grouping node represents the mean rank, the same below
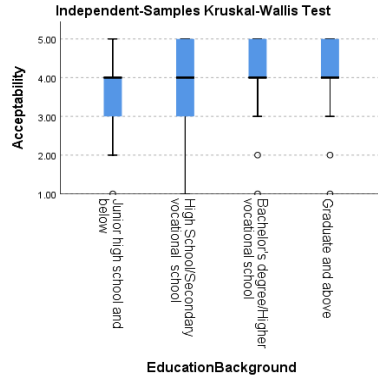
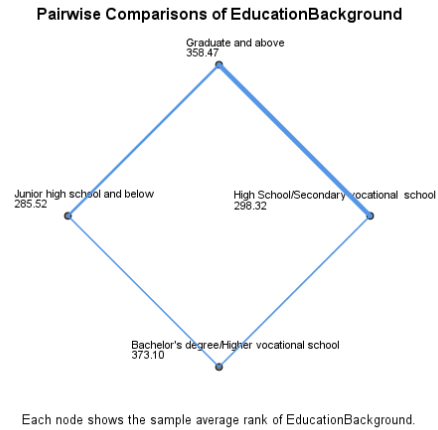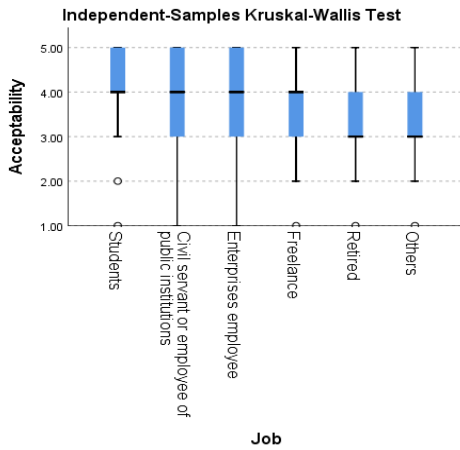| Total N | 636 |
Test Statistic	24.685[a]
Degree Of Freedom	3
Asymptotic Sig.(2-sided test)	.000

Figure 3A: Education background and acceptability

Figure 3B: Comparison of acceptability in groups with different education background

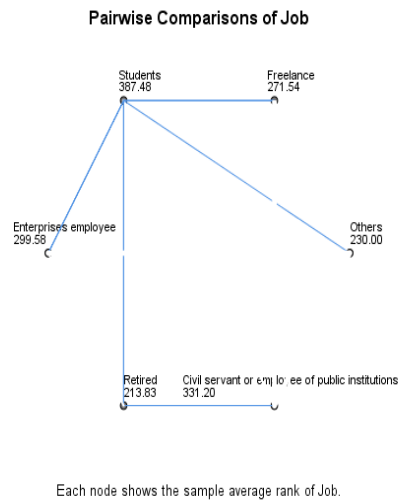| Total N | 636 |
Test Statistic	54.146[a]
Degree Of Freedom	5
Asymptotic Sig.(2-sided test)	.000

Figure 4A: Job and acceptability

Figure 4B: Comparison of acceptability in groups with different jobs
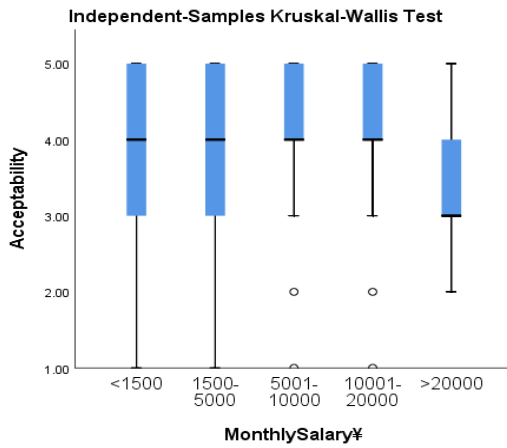
Total N	636
Test Statistic	28.827[a]
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	.000

Figure 5A: Monthly salary(¥) and acceptability
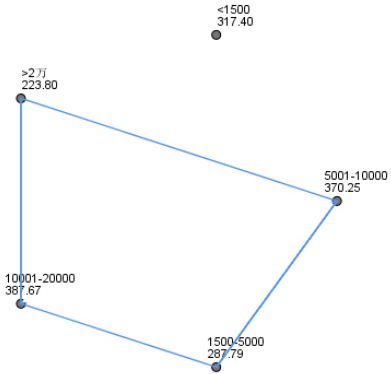
Figure 5B: Comparison of acceptability in groups with different monthly salary
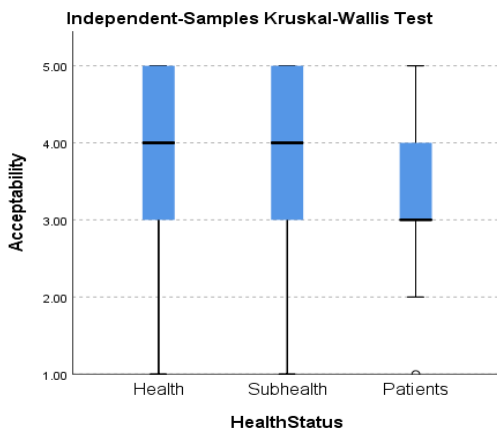
Total N	636
Test Statistic	77.898[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	.000

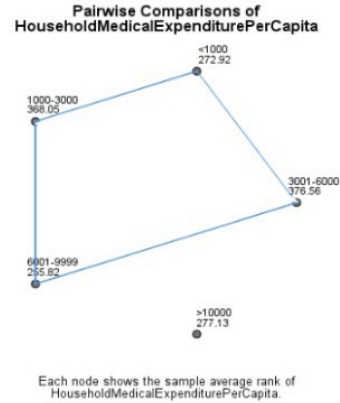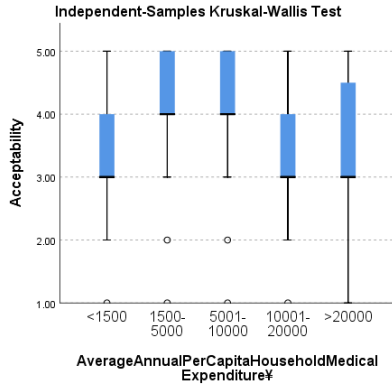*Figure 6A: Health status and acceptability*
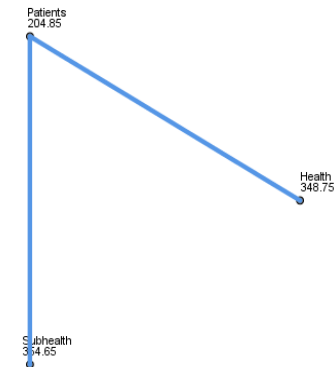
Figure 6B: Comparison of acceptability in groups with different health status

Total N	636
Test Statistic	53.145[a]
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	.000

Figure 7A: Average annual per capita household medical expenditure (in the most recent year, ¥) and acceptability

Figure 7B: Comparison of acceptability in groups with average annual per capita household medical expenditure
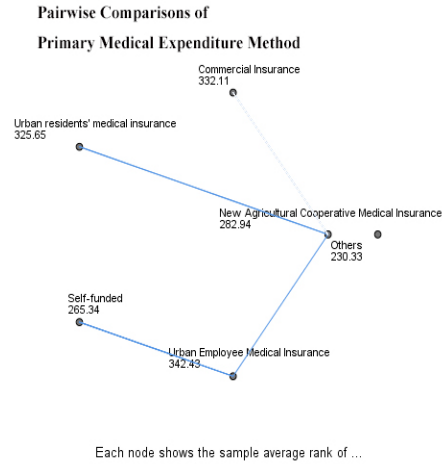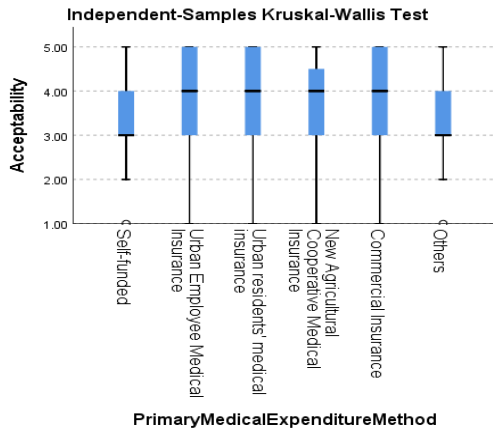
Total N	636
Test Statistic	25.914[a]
Degree Of Freedom	5
Asymptotic Sig.(2-sided test)	.000

Figure 8A: The first medical expenditure method and acceptability

Figure 8B: Comparison of acceptability in groups with different first medical expenditure methods
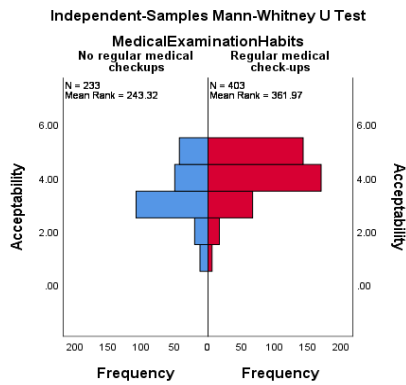
Total N	636
Mann-Whitney U	29432.500
Wilcoxon W	56693.500
Test Statistic	29432.500
Standard Error	2132.736
Standardized Test Statistic	-8.213
Asymptotic Sig.(2-sided test)	.000

Figure 9: Medical examination habit (with or without regular medical examination) and acceptability

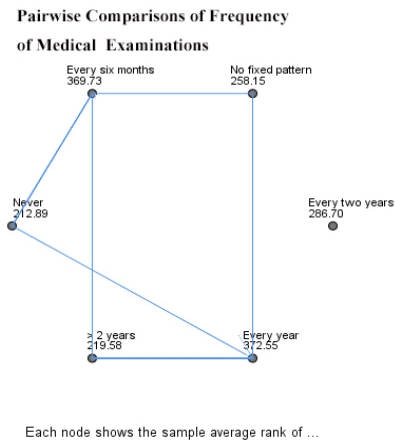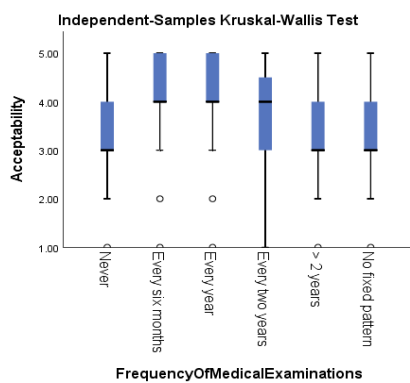|	
Total N	636
Test Statistic	74.058ª
Degree Of Freedom	5
Asymptotic Sig.(2-sided test)	.000

Figure 10A: Frequency of medical examination and acceptability

Figure 10B: Comparison of acceptability in groups with different frequency of medical examinations

Acceptability showed a skewed normal distribution for most groups, while individual groups were non-normal, for example, the highest percentage of those younger than 24 years old and those with a bachelor's degree chose " original intention to accept ". The trend of acceptability was analyzed for each group: women had higher acceptability than men. In terms of age group, 45-54 years old and ≤24 years old were higher than other groups, followed by 25-34 and 35-44 years old groups, and ≥55 years old group was the lowest. In terms of educational background, both groups, bachelor/college and master and above, had higher acceptability than the other two groups with lower educational background. The acceptance of the two groups of students and civil servants and institution employees were close to each other and higher than that of corporate employees, freelancers, other occupations and retirees. In terms of monthly salary (¥), 5001-10,000 and 10,001-20,000 (two groups are close) have the highest acceptability, higher than the 1,500-5,000 and 10,001-20,000 groups (two groups are close in terms of indicators). In terms of health status, the healthy and subhealthy groups were close in acceptance and both were higher than the patient group. In terms of average annual household medical expenditure (¥) in the most recent year, the 1000-3000 and 3001-6000 groups were close in acceptance to the <1000 and 6001-9999 groups. In terms of the first medical payment method, the acceptance of urban employees' medical insurance and urban residents' medical insurance was close to and higher than that of self-payment and others, and there was no significant difference between the new rural cooperative and all other groups. In terms of medical checkup habits, the acceptance of regular medical checkups was higher than that of irregular medical checkups. Regarding the frequency of medical checkups, the acceptance of

the semi-annual checkup group and the annual checkup group was higher than that of the three groups that never had medical checkups, irregular medical checkups and every two years (there was no significant difference between the latter three groups), and the acceptance of the every two years checkup group was second only to the semi-annual and annual groups.

3.3. Survey on the penetration rate of mhAPP among various groups of people and its influencing factors

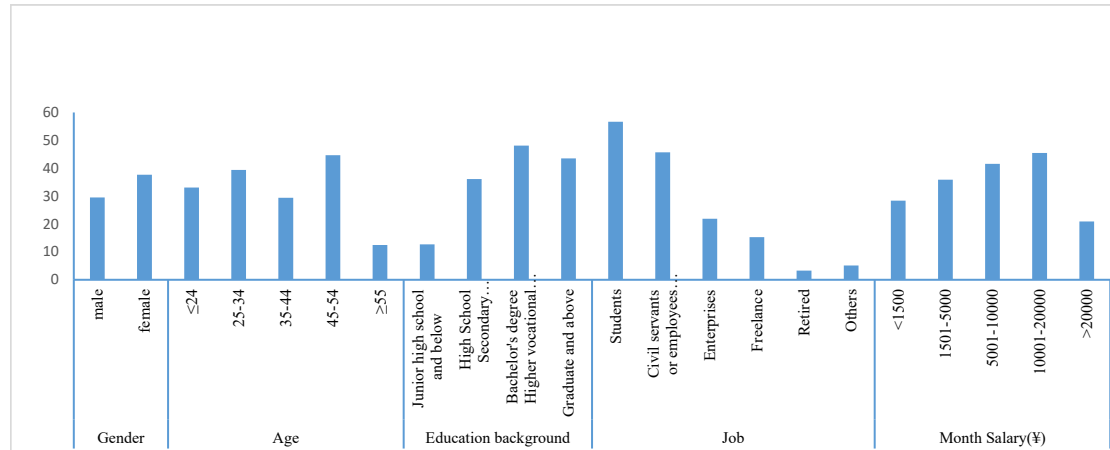### 3.3.1. Prevalence rate (percentage of those who have used mhAPP)

Figure11A: Percentage of those who have used mhAPP (%)(n=636)
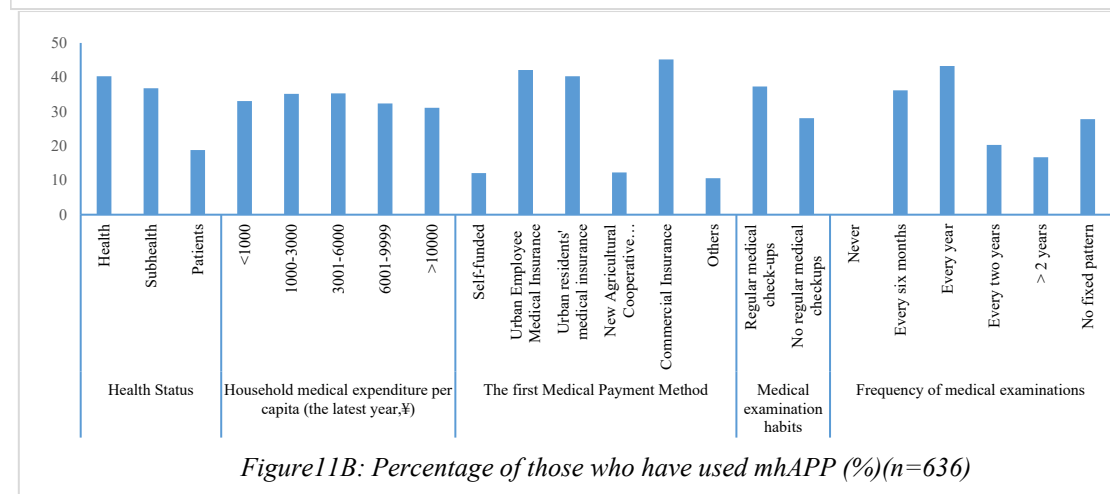
Figure11B: Percentage of those who have used mhAPP (%)(n=636)

The prevalence (utilization) of mhAPP in each group is shown in the above graph. In general, mhAPP prevalence and acceptance were generally consistent-female over male, higher education over lower education, regular medical checkups over no regular checkups, and healthy over sick; the patterns of age, average annual per capita household health care payment, and health insurance payment method were more complex and not simple trends, and these trends are discussed further in the following prevalence influencing factors below. The total mhAPP prevalence found in this study (= 216 people who had used mhAPP / 636 total survey respondents) reached 33.9%, a rate much higher than that reported in a recent study (28.6%) [2], especially since this study counted only exercise mhAPP prevalence, whereas 28.6% was also including medical mhAPPs. this study hypothesized two reasons for the The first is that mhAPP has become a built-in standard for all major brands of cell phones in recent years (e.g., Apple, Samsung, Huawei, Xiaomi, OPPO, etc.), which is bound to prompt new cell phone users to pay attention to mhAPP, and the second is the sudden increase in demand for home fitness in the three years of the coronary epidemic outbreak. It is worth noting that previous studies reported that mhAPP is used by a higher percentage of men[2], and our study does not support this result. It is known that worldwide, men are far more active in fitness than women, and the emergence of higher female mhAPP prevalence must be due to certain features of mhAPP that are more attractive to women, which this study speculates may be related to both indoor fitness classes and diet planning.

3.3.2. Analysis of influencing factors of mhAPP usage rate (penetration rate)

3.3.2.1. Preliminary screening of influencing factors (one-way chi-square test)

Table 2: Preliminary screening of factors influencing mhAPP prevalence (one-way chi-square test)

	Gender	Age	Education Background	Job	Monthly Salary
Chi-square	4.709	19.91	42.84	97.9	11.11
df	1	4	3	5	4
P value	0.03*	0.0005*	<0.0001*	<0.0001*	0.0254*

	Health status	The first medical expenditure method	Medical examination habits	Frequency of medical examinations	Household medical expenditure per capita (the latest year, ￥)
Chi-square	19.24	49.74	5.736	23.29	0.678
df	2	5	1	5	4
P value	<0.0001*	<0.0001*	0.0166*	0.0003*	0.9544

* $p<0.05$

In order to determine the influencing factors of mhAPP prevalence, the one-way chi-square test of prevalence was conducted first to exclude non-significant factors, and the analysis found that there was no significant difference in the per capita cost of medical treatment in households in the recent year, indicating that it was not an influencing factor.

3.3.2.2. Multi-factor logistic regression analysis

According to the principle of logistic regression, the dependent variable, i.e., unused and used mhAPP, was dichotomized as 0 and 1. As for the independent variables, there were unordered multivariate and ordered multivariate, and the unordered multivariate was treated as dummy variable according to the principle of statistical analysis, while the ordered multivariate in this study, such as age group, educational background, monthly salary, etc., its setting itself and its influence on the dependent variable were not equidistant, so it was also dummy variables were treated as dummy variables.

Relative to men, women increased mhAPP use to its 1.446 times. Relative to 55 years and above, all other age groups increased mhAPP use, 45-54 years, to 4.216 times their age, followed by 25-34 years, less than 24 years and 35-44 years, to 3.371, 2.625 and 2.158 times their age, respectively. Relative to education below junior high school, higher education increases mhAPP use, with undergraduate, graduate and high school, 6.223, 5.075 and 3.767 times higher, respectively. Relative to other occupations, only students and civil servants/institutional workers improve mhAPP use, 3.079 and 1.944 times more, respectively. Relative to monthly income(￥) <1500, 10001-20000 and 5001-10000 increased mhAPP use to its 1.139 and 1.119 times, respectively, the 1501-5000 group was not significantly different from it, and the >20000 group reduced mhAPP use to its 0.251 times level. Compared to patients, health and subhealth increased mhAPP use by a factor of 2.875 and 2.519, respectively. Relative to medical first-class expenditure method as self-payment, commercial insurance, urban employees' medical insurance and urban residents' medical insurance increased mhAPP use by 5.765, 5.087 and 4.721, respectively, while new rural cooperative and others had no effect on use. Relative to no regular medical checkups, regular medical checkups increased mhAPP use by 1.532 times. Compared to those who never had a medical checkup, annual and semi-annual checkups increased mhAPP use by 5.592 and 4.472 times, respectively, with no change for every two years, >2 years and no regular checkups.

Table 3: Multiple Logistic regression analysis of factors influencing mhAPP prevalence

Independent variable	Group	B	S.E	Wals	Sig	Exp(B)	95% C.I. for EXP(B) Upper limit	Lower limit
Gender	Male*							
	Female	0.369	0.17	4.691	0.03	1.446	1.036	2.019
Age	≥55 *							
	≤24*	0.965	0.357	7.304	0.007	2.625	1.304	5.285
	25-34	1.215	0.355	11.709	0.001	3.371	1.681	6.762
	35-44	0.769	0.371	4.309	0.038	2.158	1.044	4.462
	45-54	1.439	0.365	15.54	0	4.216	2.062	8.621

Education background	Junior high school and below*							
	High School/Secondary vocational college	1.326	0.275	23.194	0	3.767	2.196	6.462
	Bachelor's degree/ Higher vocational school	1.828	0.31	34.723	0	6.223	3.388	11.432
	Graduate and above	1.624	0.322	25.514	0	5.075	2.702	9.532
Job	Other Job*							
	Student	3.161	1.039	9.257	0.002	23.595	3.079	180.781
	Civil servant and institution employee	2.705	1.041	6.751	0.009	14.961	1.944	115.149
	Enterprise	1.605	1.043	2.368	0.124	4.979	0.644	38.468
	Freelance	1.179	1.071	1.212	0.271	3.25	0.399	26.5
	Retired	0.773	1.443	0.287	0.592	0.462	0.027	7.802
Month salary(¥)	<1500*							
	1501-5000	0.338	0.2	2.869	0.09	1.402	0.948	2.074
	5001-10000	0.598	0.248	5.829	0.016	1.818	1.119	2.954
	10001-20000	0.76	0.321	5.596	0.018	2.139	1.139	4.016
	>20000	0.354	0.524	0.455	0.5	0.702	0.251	1.962
Health status	Patients*							
	Subhealth	1.056	0.255	17.201	0	2.875	1.745	4.736
	Health	0.924	0.247	13.939	0	2.519	1.551	4.09
The first Medical Payment Method	Self-funded*							
	Urban Employee Medical Insurance	1.627	0.33	24.266	0	5.087	2.663	9.718
	Urban residents' medical insurance	1.552	0.352	19.408	0	4.721	2.367	9.417
	New Agricultural Cooperative Medical Insurance	0.174	0.685	0.065	0.799	0.84	0.22	3.213
	Commercial Insurance	1.752	0.475	13.609	0	5.765	2.273	14.621
	Others	0.251	0.611	0.169	0.681	0.778	0.235	2.575
Medical examination habits	No regular medical checkups *							
	Regular medical check-ups	0.427	0.179	5.701	0.017	1.532	1.079	2.175
Frequency of medical examinations	Never*							
	Every six months	1.498	0.672	4.962	0.026	4.472	1.197	16.708
	Every year	1.721	0.625	7.583	0.006	5.592	1.642	19.04
	Every 2 year2	0.571	0.763	0.559	0.455	1.769	0.397	7.891
	> Every 2 year2	0.302	0.877	0.119	0.73	1.353	0.243	7.546
	No fixed pattern	1.093	0.633	2.983	0.084	2.984	0.863	10.321
	Constant	2.037	0.614	11.011	0.001	0.13		

* control group

3.4. The first choice of brands (used and favorite one) and top purpose of use in mhAPP (from mhAPP users' perspective)
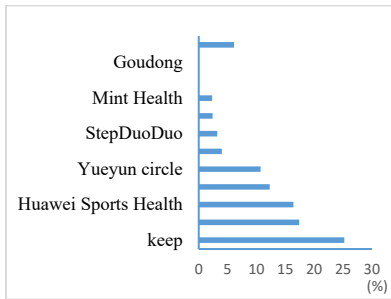

Figure12: The first choice of brand
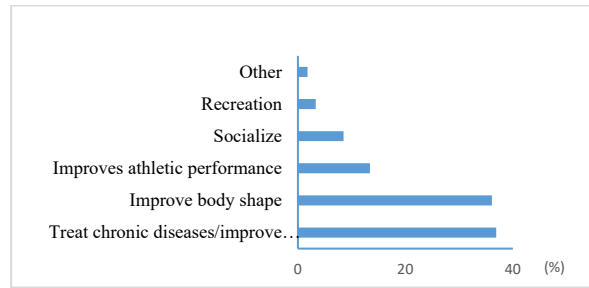*(n=216 who have used mhAPP)*

Figure13: Choice of top purpose of using mhAPP
(n=216 who have used mhAPP)

The first choice of brand (used and most like one) results show: keep choosers are more than 25%, accounting for the largest share. Keep has a good immersion learning course, subsidiary bracelet price is very low, these may be the reason to make it become the king of domestic. Followed by Xiaomi and Huawei sports health, about 15%, Yueyin circle and Yueyun circle slightly more than 10%, these five mhAPP cumulative occupy 80% of the user market. The share of StepDuo, Apple Health, Mint Health, MIGU ShanRun and Goudong are all below 5%. This survey result can be used as a simple indication of the market share of each brand. It is worth noting that Apple Health enjoys a strong reputation among similar products worldwide, but has a low market share in China, which may be related to the great preference of Chinese users for Android phones.

The top purpose of use results shows that those who use APP for the purpose of treating chronic table/improving health and improving body shape both account for about 40%, followed by improving exercise ability at about 13%, while social and entertainment account for less than 10%. This result shows that treating chronic diseases and improving body shape are the strongest motives for mhAPP use.

3.5. Top advantages and disadvantages of mhAPP (from the perspective of mhAPP users)
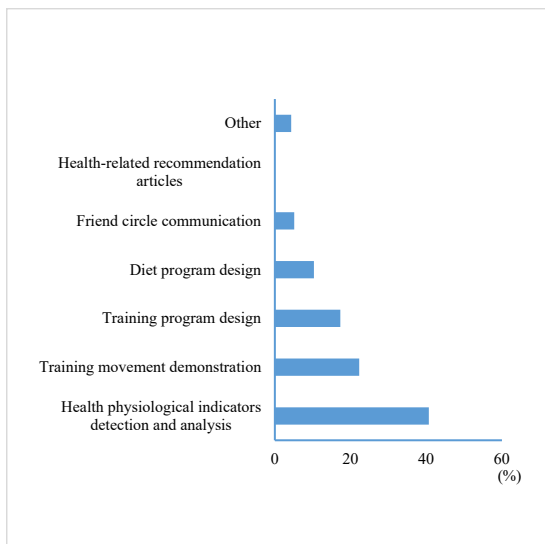
Figure 14: Choice of the most valuable features of
mhAPP   (n=216 who have used mhAPP)
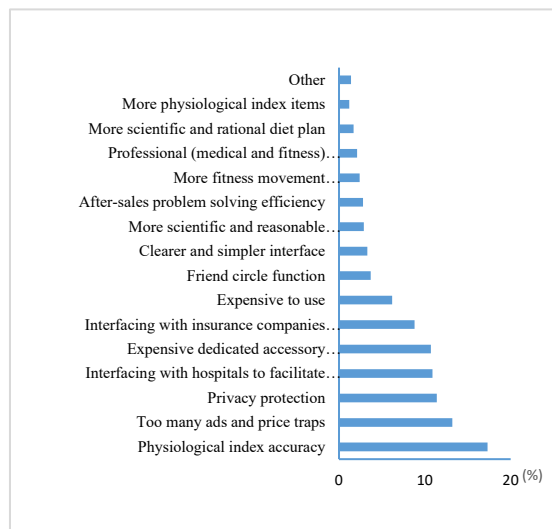
Figure 15: Choice of the most necessary improvements
to mhAPP   (n=216 who have used mhAPP)

The most valuable function of mhAPP: the answer of more than 40% of users is health index detection and analysis, followed by training demonstration courses 20%, training planning and diet program design, 17% and 10% respectively, 5% of the circle of friends, and zero proportion of mhAPP health recommendation / news.

mhAPP needs to improve the primary project: the accuracy of physiological indicators ranks first, nearly 20% of users choose this item, followed by too many advertising and price traps, accounting for

about 15%, privacy protection, data and medical institutions docking (convenient for doctors to diagnose) and the price of auxiliary sensors are slightly more than 10%, data and insurance companies are connected (convenient for insurance companies to confirm insurance qualifications) and APP members have high costs, accounting for about 9% and 6% respectively, and the rest account for less than 5%.

The results suggest that the core competencies of mhAPP are, in descending order, physiological health monitoring, fitness courses, fitness planning, and diet planning, and the disadvantages, in descending order, are poor accuracy of measured physiological indicators, many advertisements, and data that cannot be recognized by hospitals and insurance companies.

3.6. User ratings of mhAPP products

This study investigated mhAPP users' ratings of mhAPP (one of the used and favorite) mhAPP from seven domains (see the figure below). The ratings were divided into 5 levels: 1 very poor, 2 poor, 3 moderate, 4 better, and 5 good.

The results suggest that the security, information accuracy, customer service effective problem solving and customer service communication smoothness aspects of mhAPP need to be improved; the smooth running, online response, convenience, information timeliness, information easy to understand, information user matching, perceived ease of use (easy to learn, skilled operation simple, clear and easy to understand interface) aspects are perfect.
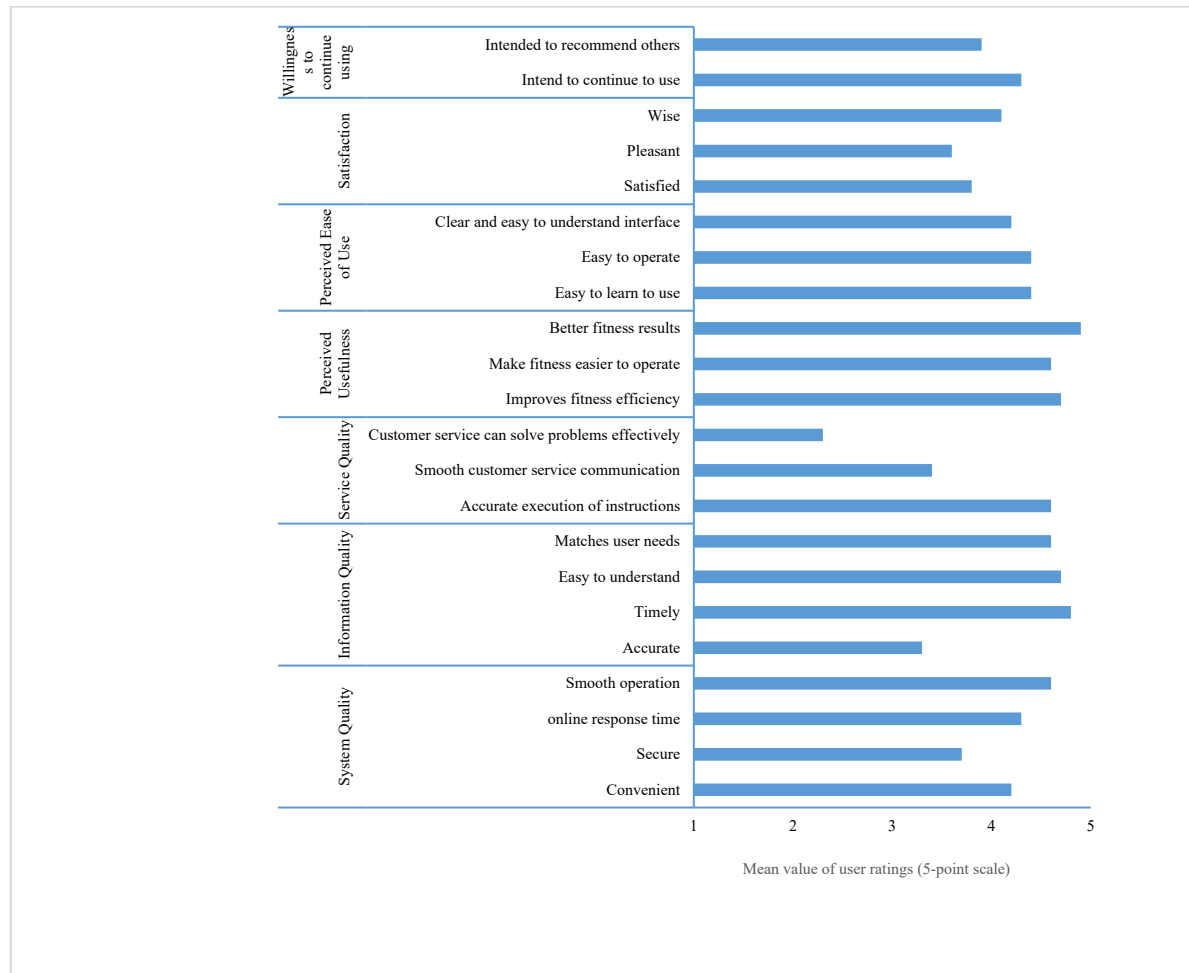

Figure 16: User ratings of mhAPP quality (n=216 who have used mhAPP)

3.7. Industry expert interview results and analysis

Table 4: Summary of doctors interview (n=30)

Question Outline	Summary of interview results
Do you understand the difference between an mhAPP (specifically a sports mhAPP, below) and an online medical app?	21 people answered correctly.
What is your understanding and use of mhAPP (and its wearable sensors)?	Eleven of the 30 people had used at least one mhAPP, seven of them had used its affiliated smart wear, and the remaining 19 said they were aware of it but had not used mhAPP.
How do you see the value of mhAPP exercise/basic health physiological indicators monitoring and fitness guidance features in healthcare?	Common view: monitoring physiological indicators is a good aid for chronic disease diagnosis and treatment, and fitness guidance can improve health.
Do you intentionally refer to the physiological health data collected by mhAPP when diagnosing patients?	27 people said they were happy to refer to the indicators recorded by mhAPP, but also said that the accuracy of mhAPP and its sensor data must be of medical grade. 3 people thought they could not trust mhAPP.
Do you think mhAPP can reduce the pressure on hospitals?	Common view: If mhAPP can really serve as health assessment, exercise supervision and diet balance, it will certainly have the effect of treating the untreated disease, and the pressure on individuals and medical system to seek medical treatment will certainly be reduced, but only if mhAPP really has sufficient accuracy.
Is it feasible for the data collected by mhAPP to enter the patient database of the hospital?	17 people think that it is feasible, that they can try to use the data collected by mhAPP as one of the data sources of the hospital's patient medical record database through WeChat applet or cloud platform as an intermediary, which 5 people proposed that this kind of data connection must be led by government departments, supported by industry standards, regulations and policies, otherwise it is illegal and illegal. 13 people think that there is no sufficient necessity in the near future, there will be no APP manufacturers or hospitals will do related, because of the big gap between different database systems, mhAPP can measure the data, the hospital also has a way to get, but they all think this is likely to be a direction in the further future.

Table 5: Summary of fitness trainers interview (n=30)

Question Outline	Summary of Interview Results
Do you understand the difference between mhAPP (specifically sports mhAPP, same below) and online medical app?	All correct answers
What is your knowledge and use of mhAPP and its wearable sensors?	All have used at least one mhAPP and at least one smartwatch/bracelet attached to mhAPP
What do you think about the usefulness of the indicators collected by mhAPP for fitness?	All of them think it is important for supervising and planning personal fitness.
Do you intentionally refer to the information of physiological indicators collected by their mhAPP when instructing trainees?	9 people originally intended. 21 people said no because they were not confident in the accuracy of mhAPP (and its attached sensors).

How do you view the fitness and nutrition planning function of mhAPP and the scientific rationality of fitness programs?	Common view: mhAPP fitness planning, fitness courses and diet and nutrition programs are regular standard programs, there is no problem with the science itself, which is also a common way for fitness instructors to learn themselves, but this has three reasons to decide that mhAPP cannot replace the gym, first, the gym has professional fitness equipment and venues, which is impossible to accomplish at home. Secondly, the standardization of fitness movements requires close supervision and constant correction of movements by the trainer, and the learning of movements by watching videos only is prone to the health risk of "not knowing if there is a mistake". Thirdly, mhAPP has limited functions and the accuracy of physiological indicators is not enough to provide expert level systematic fitness guidance.
Is it feasible to connect the mhAPP data from trainees to the database of trainees of gym (so that the trainers can provide better targeted guidance to the trainees)?	22 people think it is not feasible because gyms themselves generally do not have professional database either, only some simple user names, contact information, payment records, etc. Database development and management is very expensive and not necessary. 8 people think it is feasible, but only if the cost of data connection is not high. They believe that the mhAPP-gym data connection can provide convenient conditions for on-site and remote fitness guidance services by trainers from gyms, especially since the coronary epidemic outbreak has led to an increase in demand for home fitness, gyms can create an epidemic-regularized gym takeaway model through this data connection, making it a new profit point.

Table 6: Summary of Insurance Managers Interview (n=6)

Question Outline	Summary of Interview Results
Do you understand the difference between mhAPP (specifically sports mhAPP, same below) and online medical app?	Three people answered the difference correctly.
What is your understanding and use of mhAPP (and its attached sensors)?	One person had not used it, and the remaining five had used mhAPP, two of whom had used mhAPP-affiliated smart wear.
How do you see the value of mhAPP's monitoring and recording function in terms of personal insurance business?	Common opinion: Long-term and exercise/quiet health physiological indicators have important value for insurance companies to screen the people who do not meet the health requirements for insurance, and to introduce more suitable insurance products according to the health of the group. They also proposed that the data accuracy should be officially recognized.
How to view the scientific rationality of mhAPP's training program and nutrition program, and fitness video courses based on individual basic indicators and health goals?	Common opinion: the functions are needed for health management, but they know no much about the scientifc nature.
How do you think about the possibility of mhAPP's data access to the insurance company for easier insured qualification check of customers by insurance companies and more reasonable insurance products choice by customers ?	Common opinion: the customer mhAPP information to insurance companies for accurate service customer insurance program is expected to be feasible, but there must be technical and decree support.

Table 7: Summary of mhAPP R&D staffs interview (n=6)

Question Outline	Summary of Interview Results
What is the market positioning of mhAPP (specifically sports and health, same below)?	Common view: the market positioning is health products, but many products may be just toys.
What are the gaps in hardware and software between China domestic mhAPP (and its affiliated smart wear) and mature foreign products (such as Apple Health)? How to improve?	Common view: such products at home (China) and abroad do not differ much in terms of hardware, all using the chips of several major manufacturers (TI, Nordic, Qualcomm, Broadcom, ST), but the software algorithm and software ecology of domestic mhAPP and its affiliated smart wear sensors are backward, in the overall medical field without adequate basic scientific research support, the accuracy and practicality does not meet professional needs, accuracy is generally The accuracy is generally doubted and cannot provide more useful help for consumers with the help of big data. At present, only a few new products of OPPO Health and Huawei Health have passed the medical device certification in China，and it is the data from these products that is credible.
What is the best leading mhAPP in the world? What is good about it?	Common view: Apple Health has the largest market share, a closed and vast software ecosystem, self-designed chips, and the accuracy has passed the medical device certification in the United States and China. But the most worthy of our study is Philip, which uses health big data, combined with hospital information, so that the product, hospital and users form a linkage to fundamentally solve the needs of users, the service passed the U.S. FDA certification, and has a very high acceptability abroad.
What are the differences in profit points of the mainstream mhAPP products at home and abroad?	Common view: China domestic products are profitable in two main ways, namely through the sale of fitness courses and affiliated smart wearable sensors. Foreign mature products are profitable not only through the sale of smart wearable sensors, but also through cooperation with professional organizations (such as medical institutions) and participation in industry standards.
How do the mainstream mobile health products at home and abroad use big data to accurately analyze, process and preserve the data collected from the human body? How to protect personal privacy in this process?	Common view: the current market main APP are in the cell phone side APP application to analyze data, the data in the server are stored through encryption, so as to avoid the server data leakage. There is also an APP that just collects data and analyzes data on the server side, which will involve a lot of legal issues and requires customer authorization to protect personal privacy, mainly by legal maintenance.
We want to establish a mHealth-based service that connects individuals, health service providers (hospitals, fitness organizations, restaurants, tourism and leisure organizations, insurance companies) and governments. What are your thoughts on the design of the theoretical framework, content, solutions and protocols?	Common view: Let mhAPP become the data source of the big health cloud platform, and in through the big health cloud let different organizations get what they need according to their demand. The current domestic epidemic prevention health QR code is worthy of reference, with enterprises developing technology, relevant units providing data, national recognition, and release for implementation, and legislative protection.

According to the interview results, we can be cautious and optimistic about the prospect of mhAPP participation in the services of hospitals, insurance companies and gyms (experts all agree on its great potential value), where the value and science of mhAPP fitness courses, fitness and diet planning are fully affirmed by experts, but there are still three problems, lack of mhAPP accuracy, single profit model and third party organizations (hospitals and insurance companies, etc.) lack intermediary platforms and decree support for using mhAPP data. In this study, we believe that these difficulties can be solved in

three ways, first, cooperate with medical institutions to carry out sufficient basic research and improve the algorithm. The product should pass our medical device certification early, otherwise it will be marginalized. Second, learn the mobile health service model of Apple and Philips, participate in the development of industry standards, and share data with third-party organizations. Third, To establish the service system of mhAPP - big health cloud - third-party institutions and their supporting regulations and decrees.

4. Conclusions

In China, mhAPP (exercise mhAPP, same below) has a good mass base, with a penetration rate of 33.9%.   The distribution of prevalence and acceptance of mhAPP is generally consistent -- female is higher than male, high education is higher than low education, regular medical examination is higher than no regular medical examination, and health is higher than patients. However, the corresponding relationship between prevalence rate and age, family average annual per capita medical payment, and medical insurance payment method is more complex than simple trend.

Factors affecting mhAPP usage (logistic regression) : compared with male, female can increase mhAPP usage to 1.446 times; Compared with those aged 55 years and above, the use of mhAPP in other age groups increased, with the rates of 4.216, 3.371, 2.625 and 2.158 times in 45-54 years, 25-34 years, under 24 years and 35-44 years, respectively. Compared with lower middle school education, higher education level increased the use of mhAPP by 6.223, 5.075 and 3.767 times for undergraduate, graduate and high school education respectively. Compared with other occupations, only students and civil servants/public institution workers increased the use of mhAPP by 3.079 and 1.944 times, respectively. Relative to monthly income. 1500 ￥, 10001-20000 ￥ and 5001-10000 ￥ increased the use of mhAPP by 1.139 and 1.119 times respectively, but 1501-5000 ￥ did not change mhAPP use.   20000 ￥ reduced its use to 0.251 times of the control; Compared with patients, healthy and sub-healthy patients increased mhAPP use by 2.875 and 2.519 times, respectively. Compared with self-payment (the first medical payment method). commercial insurance, urban employee medical insurance and urban residents medical insurance increased the use of mhAPP by 5.765, 5.087 and 4.721 times, respectively, and the new rural cooperative medical system and others had no effect on the use of mhAPP. Compared with no regular medical examination, regular medical examination increased the use of mhAPP to 1.532 times; Compared with those who never had medical examination, the annual and semi-annual medical examination increased the mhAPP use to 5.592 and 4.472 times, respectively, but   every 2-year ,>2 years and the no fixed medical examination without change.

The estimated market share is KEEP (about 25%), Xiaomi Health (about 15%), Huawei Health (about 15%), Pleasant movement Circle (about 10%), Pleasant Running Circle (about 10%). These five mhAPP have a cumulative market share of 80%.

Treating chronic diseases and improving body shape were the top motivations for mhAPP users. The core competitiveness of mhAPP from the largest to the smallest is physiological health monitoring, fitness classes, fitness planning, diet planning, disadvantages from the largest to the smallest are poor accuracy of measured physiological indicators, too much advertising, data can not be recognized by hospitals and insurance companies.

The poor performance of mhAPP in terms of security, accuracy of information, effectiveness of customer service in solving problems and smooth communication with customer service are the main reasons for low user satisfaction. mhAPP's smoothness of operation, online response speed, convenience, timeliness of information, ease of understanding of information, matching of information with users, perceived ease of use (easy to learn, easy to operate skillfully, clear and easy to understand interface) aspects are more perfect. In addition, mhAPP has problems such as single profit model and lack of hardware and software basis (i.e., hardware platform and decree regulation) for cooperation with third-party organizations (e.g., hospitals and insurance companies). These problems can be solved in several ways: first, cooperate with medical institutions to conduct sufficient basic research to improve algorithms and increase accuracy. Second, learn from the mobile health service model of Apple and Philips, participate in the development of industry standards, and share data with third-party organizations, so as to broaden the profit channel. Third, establish the service system of mhAPP - big health cloud platform - third-party institutions and its supporting regulations and decrees.

Acknowledgements

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