

# uBioMacpa Pro User Guide

(Ver. 1.2.0)



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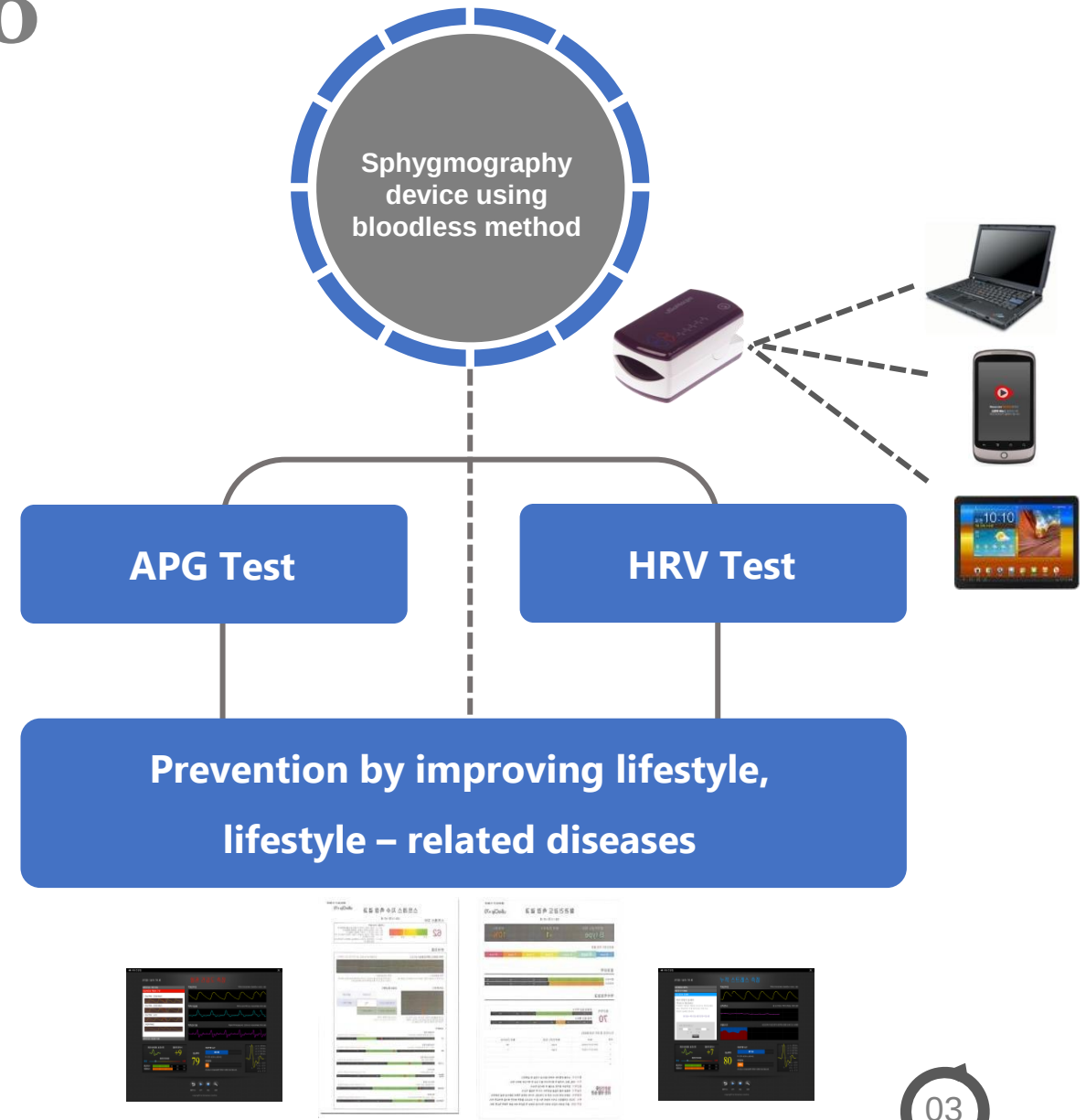
# 01. About uBioMacpa Pro

**uBioMacpa Pro** can help to check our blood circulation status and accumulated stress easily by measuring HRV(Heart Rate Variability) through pulse wave analysis of capillary.

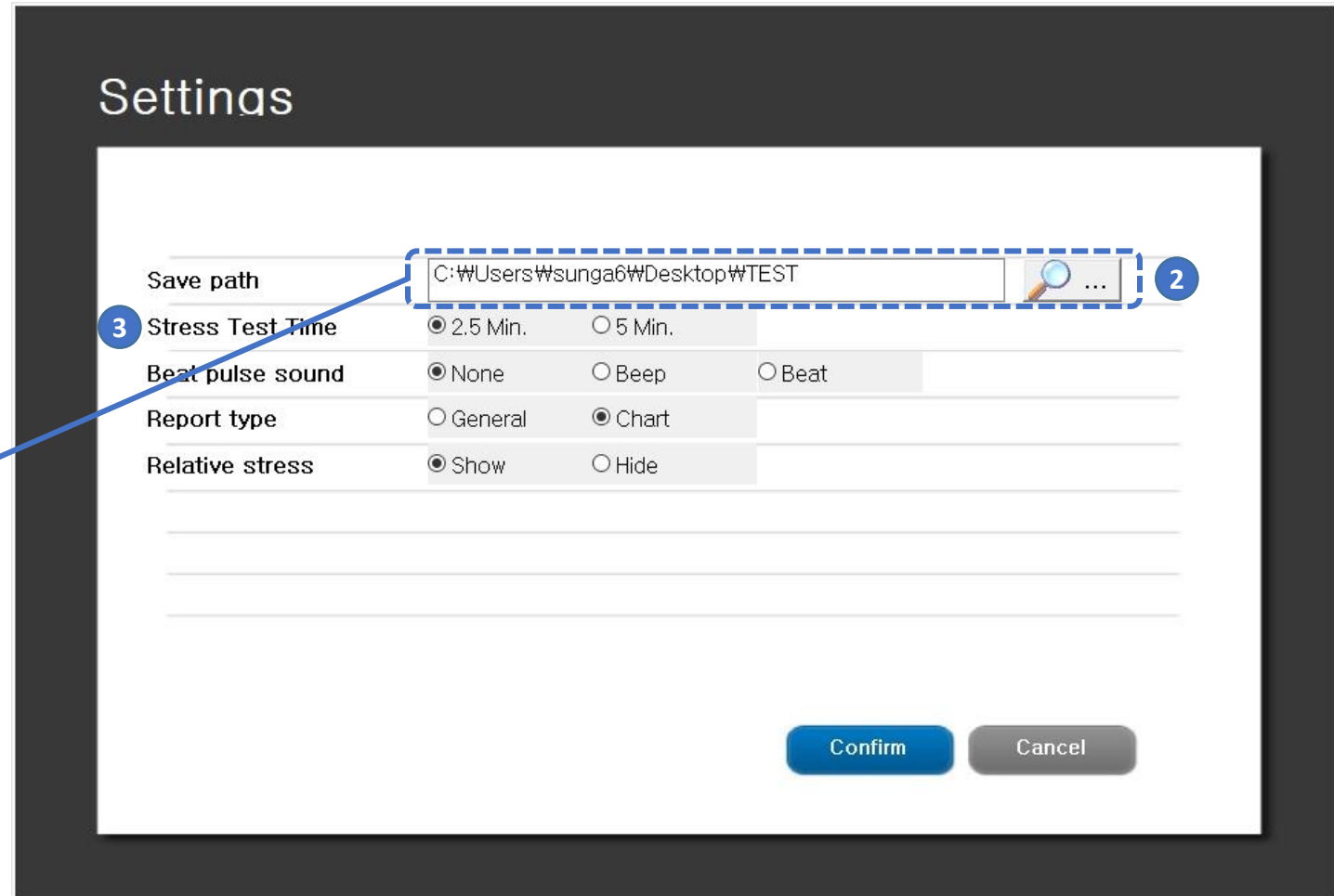
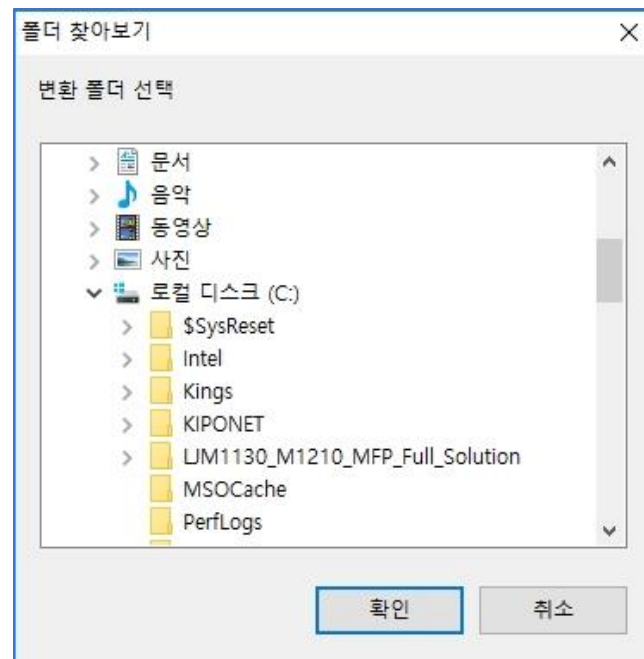
Anybody can easily test accumulated stress and vascular health status at home using **uBioMacpa Pro** device to prevent further development of disease.

## uBioMacp Pro Functions

1. Specify the data storage path
2. Memo and search function
3. You can choose report type (General / Chart)
  - General** - Vascular index report and Stress Index Report separately
  - Chart** - Vascular index report and Stress Index Report together
4. Clipboard, saving as image file function
5. You can choose measuring time (2.5min/5min)
6. You can save the data as Excel.
7. You can replay the data.



# 01. About uBioMacpa Pro



- 1 Click the configuration button.
- 2 You can specify the data storage path.
- 3 You can choose measuring time.

# 01. About uBioMacpa Pro

## Settings

Save path

Stress Test Time ☒ 2.5 Min. ☐ 5 Min.

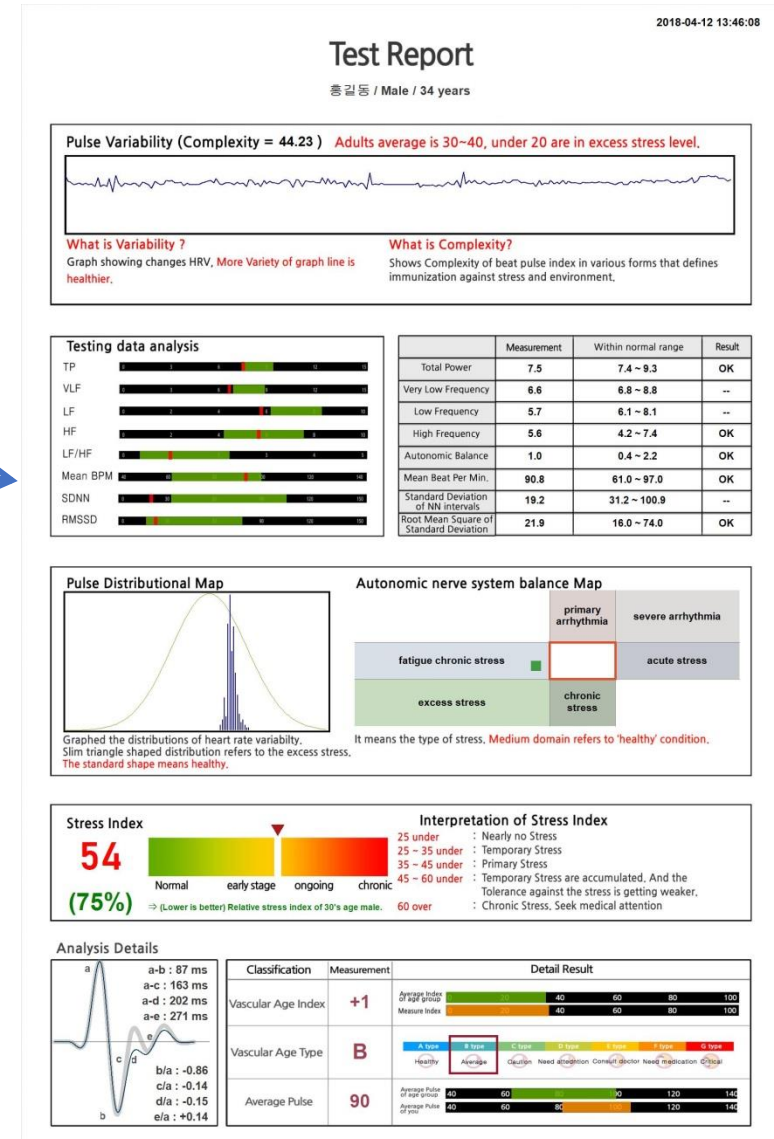
Beat pulse sound ☒ None ☐ Beep ☐ Beat

Report type ☐ General ☒ Chart **1**

Relative stress **2** ☒ Show ☐ Hide

**Confirm** **Cancel**

- 1** You can choose Report type (General / Chart).  
**General** - Vascular index report and Stress Index Report separately  
**Chart** - Vascular index report and Stress Index Report together
- 2** You can choose Relative stress type.



# 01. About uBioMacpa Pro

uBioMacpa PRO

Before

Print

Archive

Clipboard

1

2

2018-04-11 15:21:39

Vascular Age Test Report

홍길동 / Male / 34 years

Summary

Signal Level : 10%

| Classification     | Safe | Caution | Dangerous | Note                                                                                                                      |
|--------------------|------|---------|-----------|---------------------------------------------------------------------------------------------------------------------------|
| Vascular Age Index | ●    |         |           | -30 ~ +5 : Safe (Healthy Lifestyle)<br>+6 ~ +20 : Caution (Attention to Lifestyle)<br>+20 ~ : Danger (Need for Diagnosis) |
| Vascular Age Type  | ●    |         |           | A ~ B type : Safe<br>C ~ D type : Caution<br>E ~ G type : Danger                                                          |

Result of Measurement

| Classification     | Measurement | Detail Result                                                                                                                                                                                                                      |
|--------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vascular Age Index | -1          | <div><div>Average Index of age group</div><div>Measure Index</div><div><div>020406080100</div><div>020406080100</div></div><div>※ Associated with Blood circulation by LifeStyle. Increases than average Index is Bad.</div></div> |

- 1 Save as image file
- 2 Clipboard

# 02. Installation and Operation

## 01 Product Includes



uBioMacpa Pro  
Measuring Probe



uBioMacpa Pro  
Software



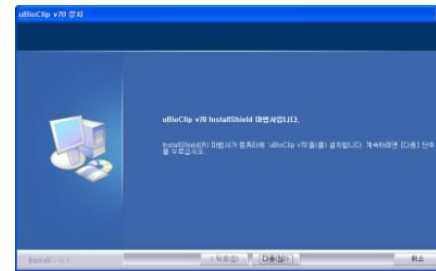
USB Cable & Gender



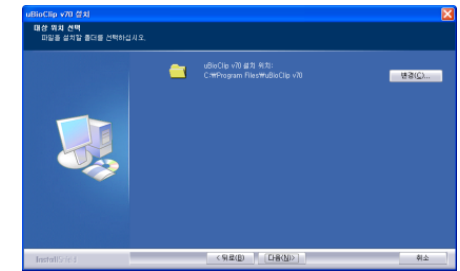
Installation and  
User Manual

## 02 Software installation

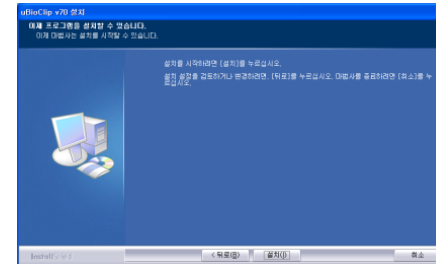
Install the uBioMacpa Pro software. Then it will start installation automatically and will follow the procedure as below.



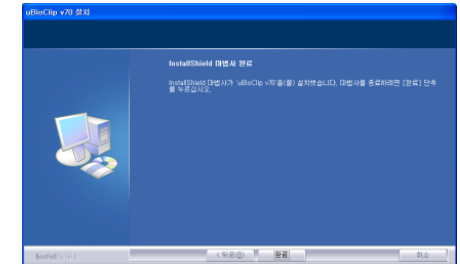
Click “Next[n]” and proceed.



(If you want to change the path, click “Change[C]”).  
Click “Next[n]” and proceed.



Click “Install [I]” and proceed.



When installation is completed, click “Finish”. Make sure the icon is generated on the desktop.



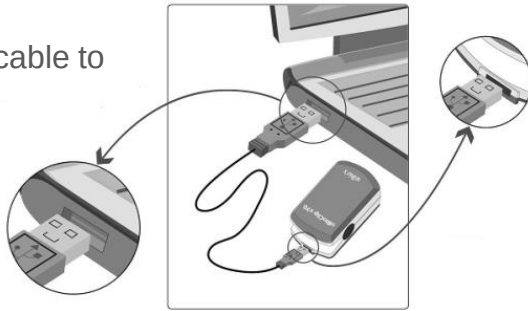


# 02. Installation and Operation

## 03

### Connecting the device to the computer

1) Connect the USB cable to the computer.



2) Then connect the USB cable to the device.

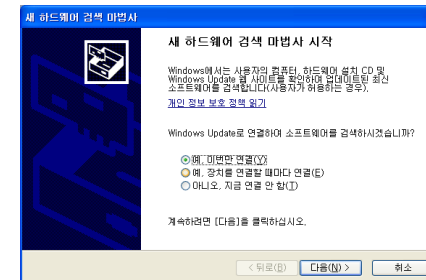


## 04

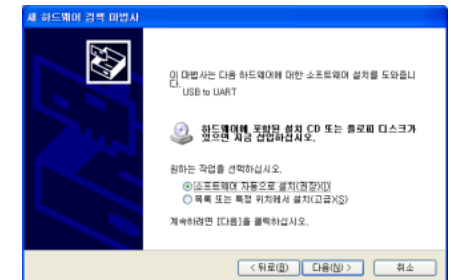
### Running

When you click the icon on the desktop, uBioMacpa Pro will start running.

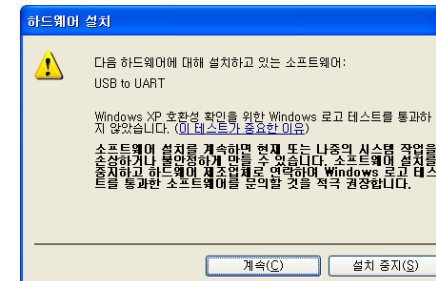
\* When you connect this to a computer USB port for the first time, follow the procedure below.



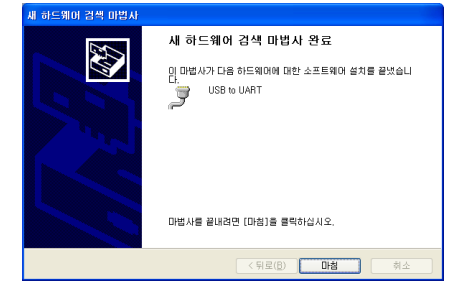
Click “Yes, connect this time only (Y)” and click “Next (N)”.



Click “Automatic installation (recommended)” and click “Next (N)”.



Click “Continue (C)” and proceed”.



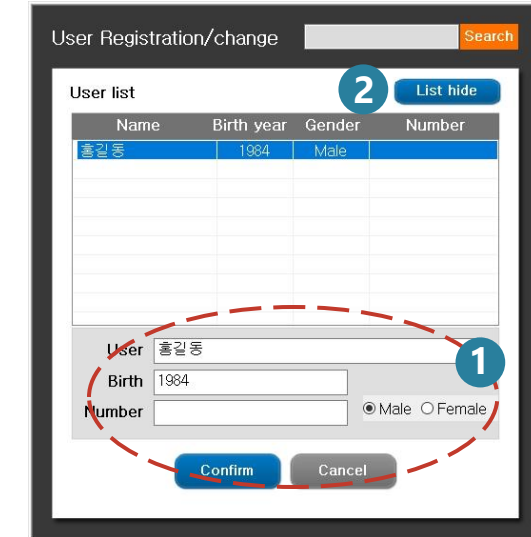
Click “Finish” and finish the connection process.



# 03. User Registration

When you click the icon on the desktop, the main screen will be displayed, Click 5 to register the user for testing.

- Register the user for testing.
- Enter name, date of birth, and sex, 1 and click "Confirm", You will see the data below. 3
- Once you have a test, you can select the user in the list from next time. 2
- There is no limit on the number of the users
- Users have their own records only.
- Viewing previous test result shows only the records for the user.



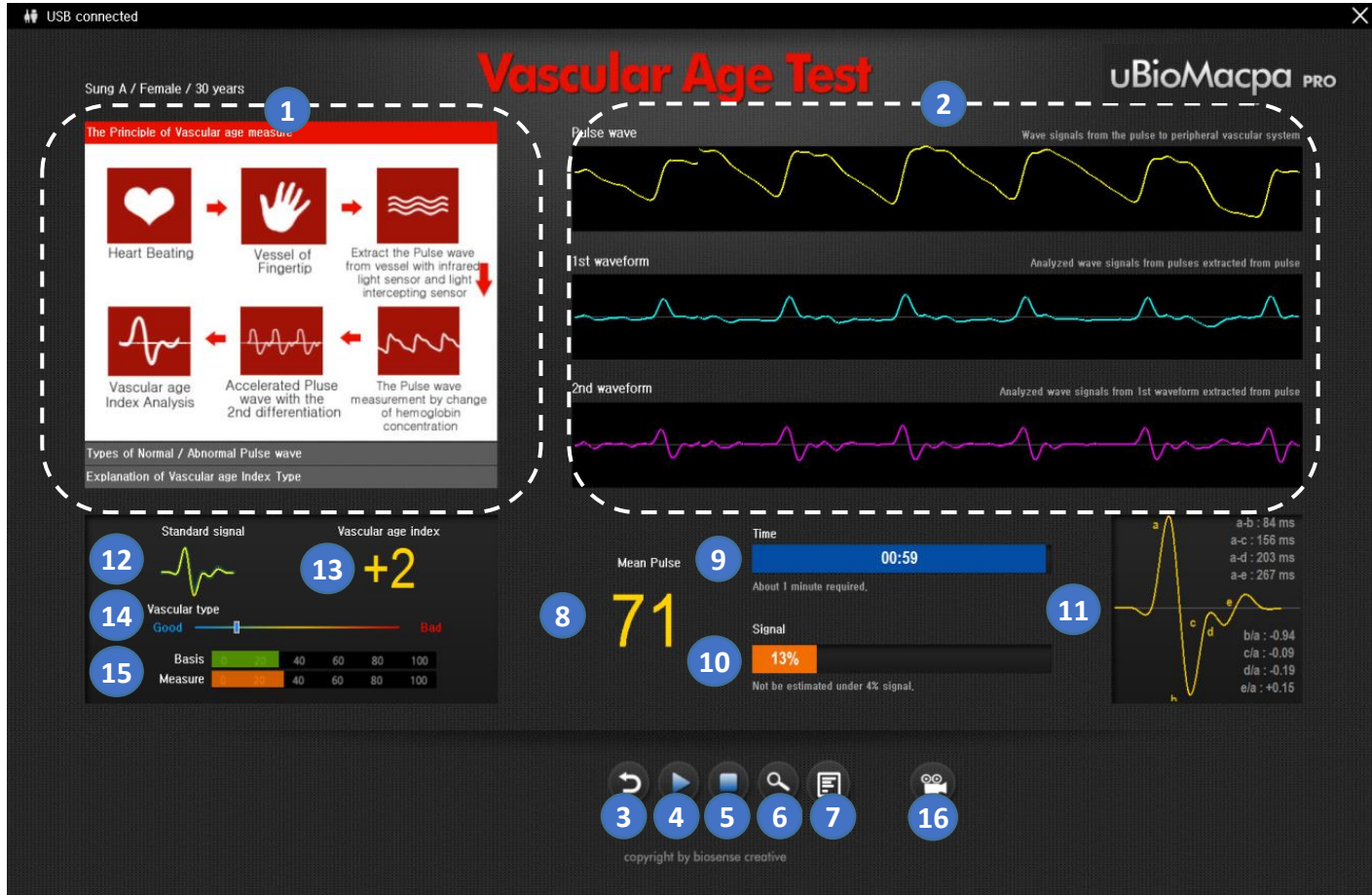
Design of main screen

- Testing vascular health
- Testing accumulated stress
- Viewing records per user
- How to use
- Selecting the user
- Analyzing the test result
- Showing product version
- Converting to Excel
- Finishing the program

## 04. Testing Vascular Health

It gets vascular health level from vascular health type and calculated vascular health age. (Test time = 1 minute)

It moves to analysis screen when the test is finished.



- ## 1 Basis of test and vascular health types

- Basis of testing vascular health level
- Distinguishing normal/abnormal pulse wave
- Meaning of vascular health type

- ## 2 Basis of test and vascular health types

- Pulse wave (wave form of pulsing on peripheral blood vessel)
- Extracted wave from pulsing (wave form from which number of pulse is extracted)
- Wave for analysis from pulsing (wave form from which vascular health index is analyzed)

- 3** Move to main screen

- #### 4 Start testing

- ## 5 Finish testing

- 6 If you click “Viewing test result” before the test is finished, the analysis screen uses only the tested data.

- The data is not saved
- You may do it for fast testing but it is not recommended
- We recommend normal finish of testing and moving for analysis

- ## 7 Memo

- 8 Measured pulse rate per minute

- 15 Average index - age of tested person  
Tested index - Vascular health age  
compared to the age of tested person

- ## 16 Replaying the measured data

- 9 Show test time (process time)
- 10 Reception sensitivity of bio-signal
- 11 Average from the start of test  
Accelerated pulse wave graph

- 12 Comparison of average accelerated pulse wave for the age group and measured accelerated pulse wave
  - 13 Vascular health calculated from accelerated pulse wave
  - 14 Type of vascular health
- There are 7 levels between Good and Bad

# 05. Analysis of test result of vascular health (1)

1

## Summary

- Testing vascular health level is a **screening test** of vessel age and blood circulation level in a noninvasive way.

2

Signal Level : 24%

| Classification     | Safe | Caution | Dangerous | Note                                                                                                                      |
|--------------------|------|---------|-----------|---------------------------------------------------------------------------------------------------------------------------|
| Vascular Age Index | ●    |         |           | -30 ~ +5 : Safe (Healthy Lifestyle)<br>+6 ~ +20 : Caution (Attention to Lifestyle)<br>+20 ~ : Danger (Need for Diagnosis) |
| Vascular Age Type  | ●    |         |           | A ~ B type : Safe<br>C ~ D type : Caution<br>E ~ G type : Danger                                                          |

3

- If the reception signal is 4% or better, it can be tested.
- Higher reception signal does not mean it is better (5% or better is enough).
- When you have cold hands or bad blood circulation, the reception signal may be low and is unable to test.

4

- There are 7 levels (A – G) in **vascular health** level depending on its Resilience.
- The resilience gets worse **as you get older**.
- Healthy adults are usually in B level.
- But they could be in C or D level if they have high blood pressure or diabetes.
- A person who is 60 years old could be in level B if he keeps a good lifestyle.

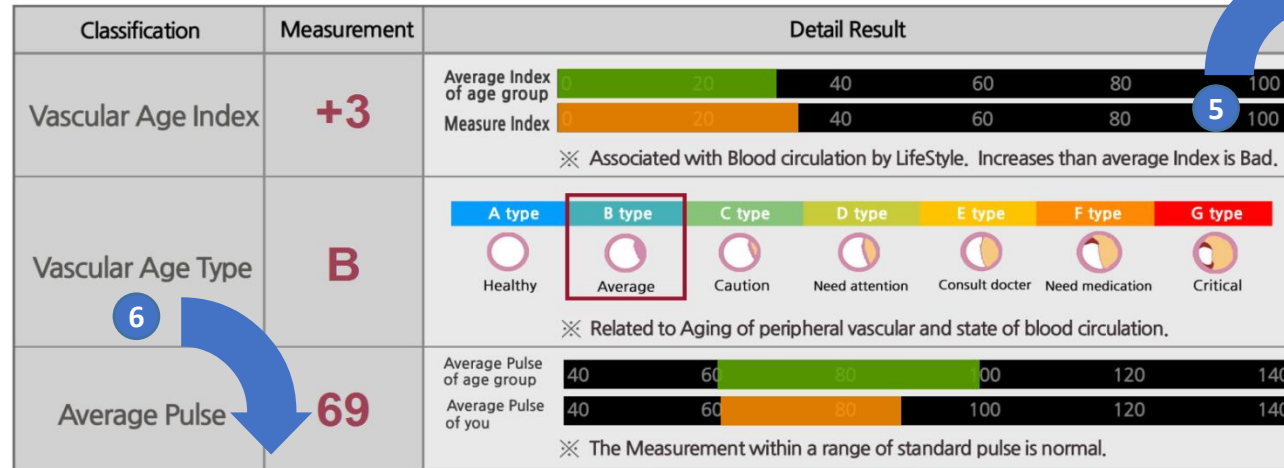
- Diabetes, high blood pressure, stroke, and obesity were considered as adult disease before. But they are considered as **lifestyle disease** these days because they come from irregular eating habit, pollution, and stress.
- Those diseases can be prevented if you change the lifestyle. **So regular checking of vascular health level is important.**

- Vascular health index is related to vascular health but it is also closely **related to lifestyle which affects blood circulation**.
- Eating too much meat, lack of exercise, irregular eating habit, too much drinking, smoking, and frequent instant food cause higher vascular health index.



# 05. Analysis of test result of vascular health (2)

Result of Measurement



- Average age index in vascular health level means the age of testing person.
- When you take away the age of testing person from vascular health age, it becomes vascular health level.
- **Lower value means it is healthier and a good lifestyle is kept.**

- There are 7 levels (A – G) in vascular health level.
- It is related to resilience of vessel tube.
- Healthy people who are 10 – 29 years old are in A level.
- Healthy people who are 30 – 59 years old are in B level.
- If you are 30 – 59 years old and are in C level, you need to be careful.
- If you have adult disease, you may be in C level or worse.
- Elderly people are usually in C level or higher but if you are in good health, you could be in B level.

- Average pulse is average heart rate and green stripe is the range of average pulse per age group.
- Yellow stripe is the average pulse of the testing person and the width is min/max variation. If the variation is more than 1/3 of green stripe, it is good.
- **If the width is narrow, test the stress level.**
- **Pulse variation during measuring stress is related.**

# 05. Analysis of test result of vascular health (3)

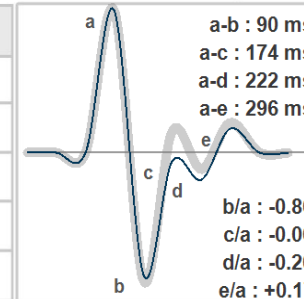
8

- This shows the last five test results. Average index is the average of final tests.
- Blood circulation in peripheral blood vessel is affected by oxygen, nutrition, emotion, and hormone.
- **So you need to test several times and get the average for vascular health level.**

Previous Test Results (Last 4 times) Average Index : +0

| 번호 | Test Date           | Vascular Age Type | Vascular Age Index |
|----|---------------------|-------------------|--------------------|
| 1  | 2014-06-26 11:05:32 | B type            | +2                 |
| 2  | 2014-06-26 11:13:52 | A type            | -4                 |
| 3  | 2014-06-26 11:28:19 | B type            | +0                 |
| 4  | 2014-06-26 11:29:29 | B type            | +3                 |
|    |                     |                   |                    |

Detail Analysis



9

- This shows the average of accelerated pulse wave during the test.
- Points of a, b, c, d, and e are inflection points.
- a-b, a-c, a-d, and a-e are the time taken to reach the inflection points and they are not used during analysis.
- b/a, c/a, d/a, and e/a are used during analysis and they are the ratios of length.



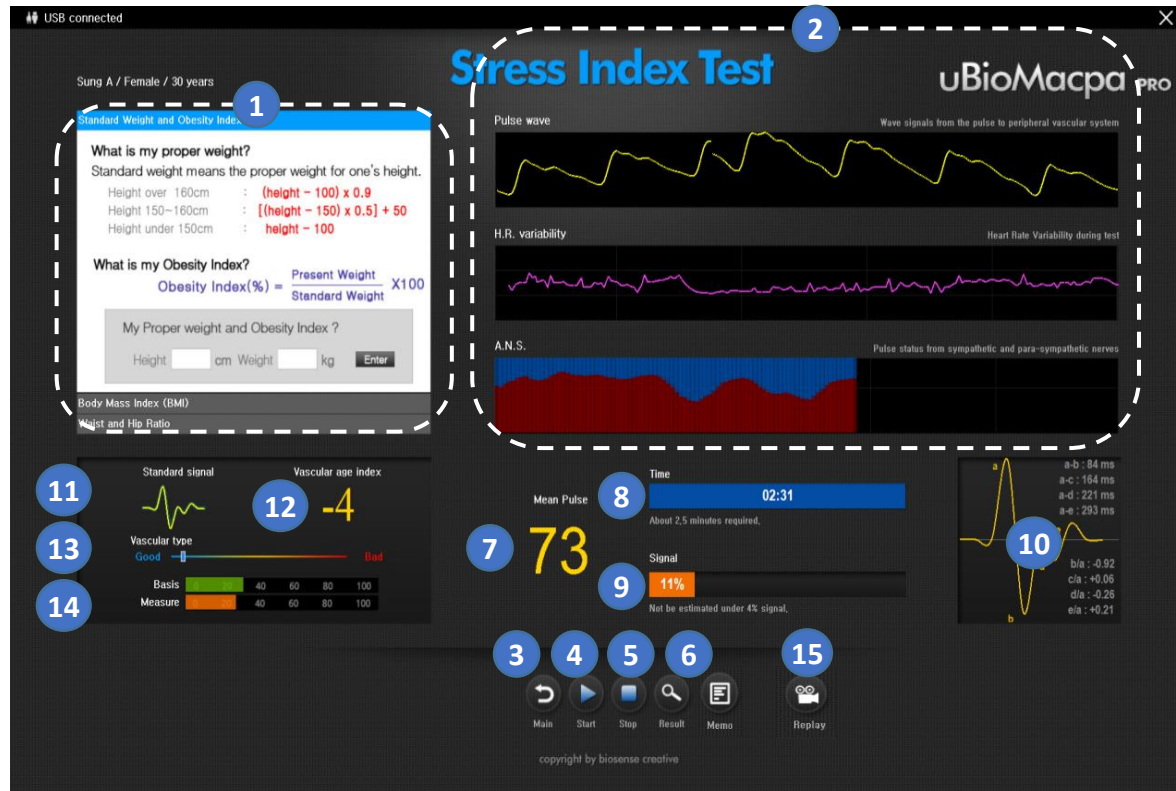
- **You may experience sharp change of vascular health level.**
- This happens when there is sudden change of blood pressure or resilience of blood vessel.
- If that happens **try again after 5 minutes.**
- This happens more to **unhealthy person.**

# o6. Testing Accumulated Stress



**This tests accumulated stress of the body (test time = 2.5 minutes).**

- uBioMacpa tests vascular health and accumulated stress levels at the same time. You can view the test result of vascular health level using “Viewing previous test result”.
  - It analyzes accumulated stress level by getting heart rate variability from pulse wave.
- It moves to analysis screen when the test is finished.**



- Measured pulse rate per minute
- Show test time (process time)
- Reception sensitivity of bio-signal
- Average from the start of test Accelerated pulse wave graph
- Comparison of average accelerated pulse wave for the age group and measured accelerated pulse wave
- Vascular health calculated from accelerated pulse wave
- Type of vascular health There are 7 levels between Good and Bad.

- Calculating 3 types of health-related data

- Standard weight and obesity level
- Getting BMI (body mass index)
- Ratio of waist size and bottom size

- Showing pulse wave and analysis data

- Pulse wave (wave form of pulsing on peripheral blood vessel)
- Heart rate variability (Shows the change of pulsing)
- Automatic nerves (Shows the change of sympathetic nerve and parasympathetic nerve in real time; Starts showing it after 1 minute)

- Finish the test and move to main screen

- Start testing

- Finish testing

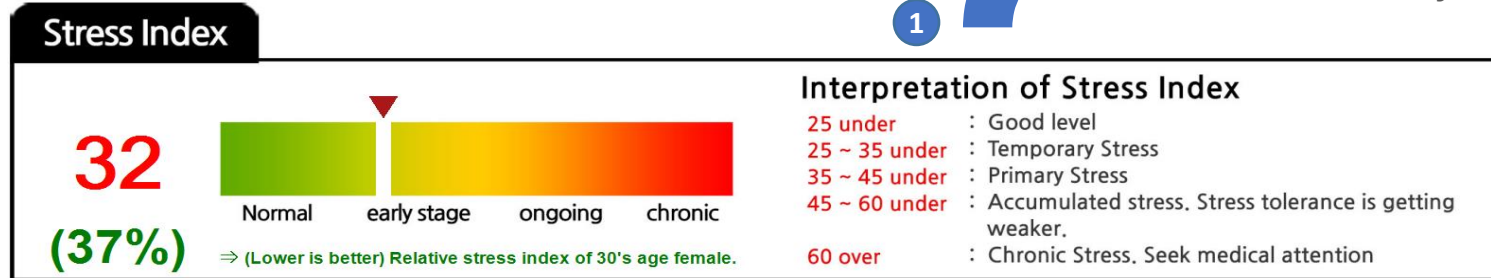
- If you click “Viewing test result” before the test is finished, the analysis screen uses only the tested data.
  - The data is not saved.
  - You may do it for fast testing but it is not recommended.
  - We recommend normal finish of testing and moving for analysis.

- Average index - age of tested person  
Tested index - Vascular health age compared to the age of tested person

- Replaying the measured data

# 07. Analyzing test data of accumulated stress (1)

Stress index is obtained considering all the data (pulse variation, heart rate distribution, balance of automatic nerve, and detailed analysis) below.



Hans Selye, an endocrinologist in Canada and Nobel Prize winner, first used the term stress while he was researching **the biological response when animals are in extreme situation.**

Stress is the response of the body (human being, animal, plant) **to any demand placed upon it internally or externally.** Sympathetic nerve works when you are in danger. For example, it opens pupil wide for better recognition and to get more lights, makes body hairs stand to sense vibration, makes heart beat faster for more blood circulation to arms and legs, tightens muscles to fight or to run away, shrinks peripheral blood vessels to provide more blood where needed, minimizes blood circulation to digestive organs, and make breathe fast for more oxygen. If you stay in such situation for long, sympathetic nerve becomes inactivated.

When you are in stress, automatic nerve works to overcome the situation. But **if this situation goes for long or repeats, body becomes to be used to it and it develops to chronic stress.**

For testing stress, European Society of Cardiology and The North American Society of Pacing and Electrophysiology prepared a guideline on the standards of measurement and interpretation of HRV (Heart Rate Variability). Most medical devices today follow this standard. uBioMacpa is also based on this standard.



# 07. Analyzing test data of accumulated stress (2)

## Data Analysis

Pulse Variability (Complexity = 83.65 ) Adults average is 30~40, under 20 are in excess stress level. <sup>2</sup>



### What is Variability ?

Graph showing changes HRV, More Variety of graph line is healthier.

### What is Complexity?

Complex pulse index in various forms that defines immunization against stress and environment.

## Pulse Distributional Map <sup>3</sup>



Graphed the distributions of heart rate variability. Slim triangle shaped distribution refers to the excess stress. The standard shape means healthy.

## Autonomic nerve system balance Map <sup>4</sup>

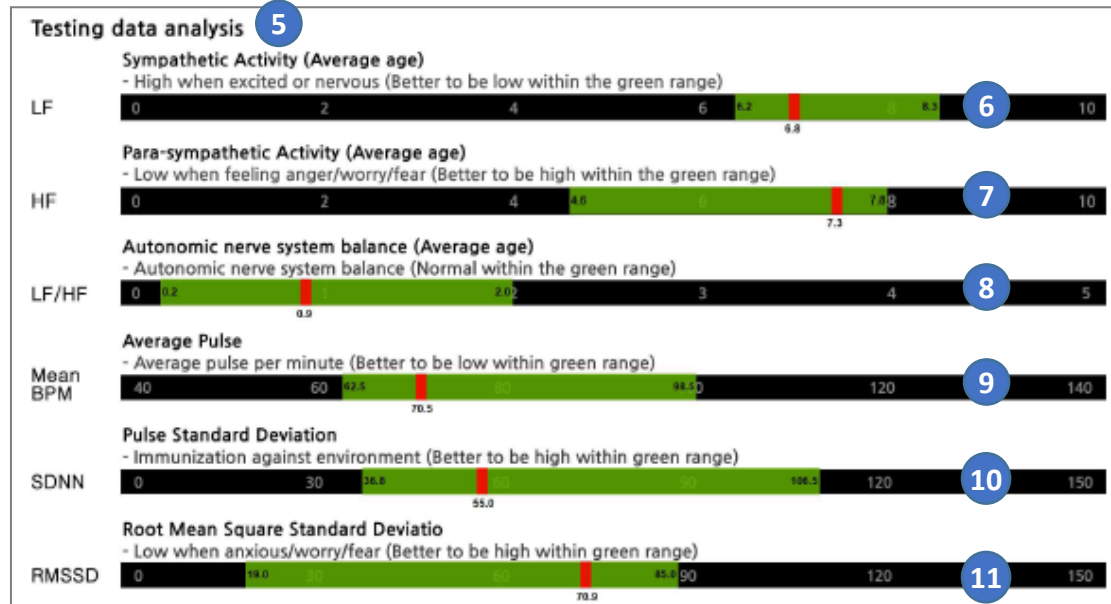


It means the type of stress, Medium domain refers to 'healthy' condition.

- <sup>2</sup> • It is healthier if there is more pulse variation.
- If there are more little sawtooth-like curves, the variation is higher.
- And if it becomes a straight line, it is less sensitive to stimulus.
- <sup>3</sup> • The horizontal axis represents the pulse rate, and the vertical axis represents the pulse rate frequency.
- It is better if heart rate distribution fills the triangle area in an equilateral triangle shape.
- If it becomes an isosceles triangle indicates low variability in heart rate.
- This indicates a state where accumulated stress has dulled responsiveness to external stimuli.
- <sup>4</sup> • Balance of automatic nerve shows accumulated stress level through the rate between activation of sympathetic nerve and activation of parasympathetic nerve.
- The closer it is to the center of red box, it is more balanced.
- Depending on the accumulated stress level, the green square dot moves to chronic stress area on the left.
- If you do not solve it at this stage, it moves to chronic area below.

# 07. Analyzing test data of accumulated stress (3)

- 5 • Activation of sympathetic nerve, activation of parasympathetic nerve, and standard pulse deviation affect stress index in detailed analysis.



- 6 • When you are **tense or excited**, the activation of the **sympathetic nervous system increases**.
- If you are **under continuous stress**, the responsiveness of the sympathetic nervous system dulls, often causing it to move out of the green stripe (standard range per age group) and **shift to the left**.
- 7 • Activation of parasympathetic nerve is higher when you are relaxed.
- But when you are in **anger, worry, or fear**, it gets out of green stripe (standard area per age group) and **moves to left**.
- If the state of low activation of sympathetic nerve goes for long, activation of parasympathetic nerve is affected by it and it becomes low and more stress is accumulated.

- 8 • Balance of automatic nerve shows the rate between activation of sympathetic nerve and activation of parasympathetic nerve.
- If it is in the green stripe, it is normal.
- If it goes to the right or left end after several tests, **the function of automatic nerve is low**.

- 9 • Average pulse is average heart rate.
- If it is in green area (standard area per age group), it is normal.
- Heart beat is automatically controlled to provide oxygen to all body parts through blood.
- If it is always fast, it is called frequent pulse and you may consult with a doctor.
- If it is out of green area and is on the left, it is called infrequent pulse. It may cause fatigue and dizziness but it can happen to people like marathoners who have large lung capacity.

- 10 • Pulse standard deviation is known as index of body adaptability to environment.
- If this gets out of green stripe (standard area per age group) and moves to left, **the immunity to stress becomes weaker**.
- 11 • Mean deviation is another way of checking activation of parasympathetic nerve.
- When you are relaxed, it is higher.
- But when you are in anger, worry, or fear, it gets out of green stripe (standard area per age group) and moves to left.

# o8. Viewing previous test result

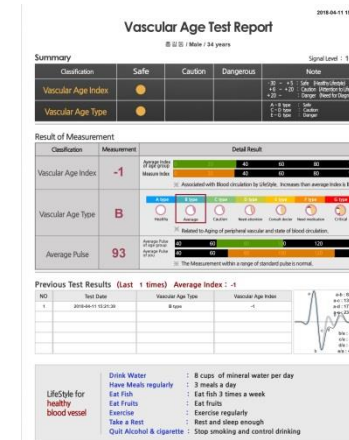
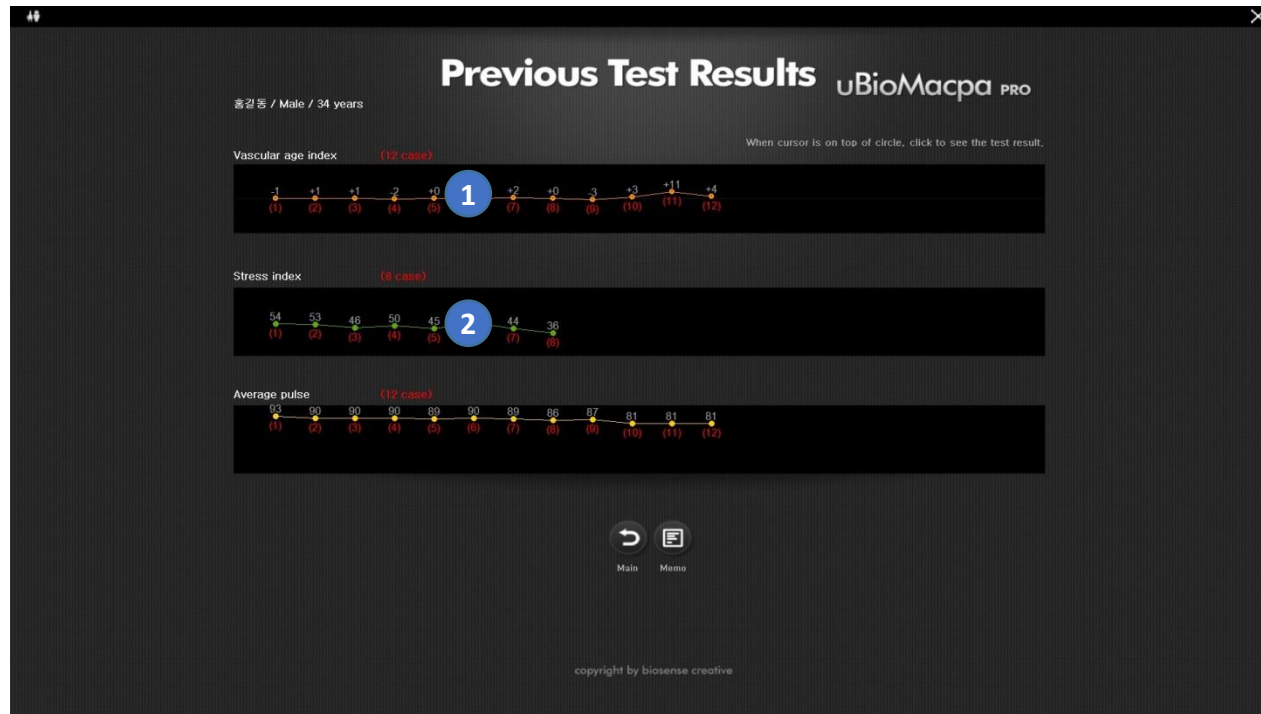


It allows viewing previous test results by test date.

- It shows the test result of vascular health level.
- It shows the test result of accumulated stress.
- It shows the average heart rate records.
- You can delete test records one by one

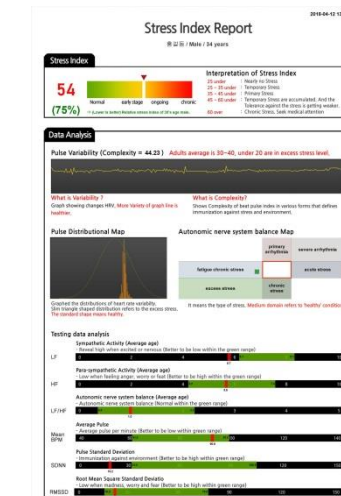
1

Click the point and load the record.

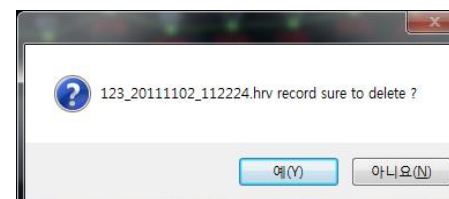


2

Click the point and load the record.



- If you place the mouse pointer on the point and right-click it, **you can delete only the record.**
- If you click “Yes (Y)”, the record gets deleted.



# 09. Deleting all records of a user



You can delete all records of a user by selecting “User Registration/Change” at the initial screen.

- “Delete” deletes all test records of the user.
- You cannot recover the deleted records. So be careful.

User Registration/change

Search

User list

1 List hide

| Name | Birth year | Gender | Number |
|------|------------|--------|--------|
| 홍길동  | 1984       | Male   |        |
|      |            |        |        |
|      |            |        |        |
|      |            |        |        |
|      |            |        |        |
|      |            |        |        |
|      |            |        |        |
|      |            |        |        |

2

User 홍길동

Birth 1984

Number ☐ Male ☐ Female

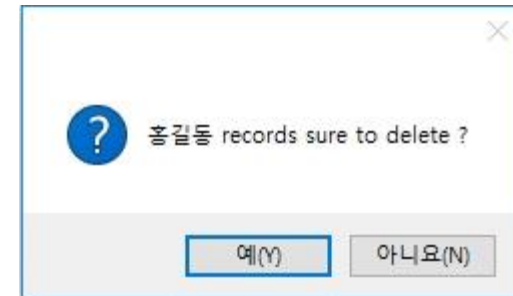
Confirm Cancel

1

Open the list by selecting “Viewing the list”.

2

If you select a user and right-click it, “[Record Deletion]” menu pops up.



If you click “Yes (Y)”, **all records of the user get deleted.**  
(Vascular health record + Accumulated stress record)

# 10. Data storage path (PC – Windows 7 64bit)



Windows 7 64bit : You can follow the data storage path.

( My computer or File Explorer -> (C:)Drive -> Users -> User name -> AppData -> Local -> VirtualStore -> Program Files(x86) -> uBioMacpa -> work )

8개 항목을 선택했습니다. 수정한 날짜: 2014-06-26 오후 12:01 만든 날짜: 2014-06-26 오후 12:01  
크기: 154KB

\* If you can not see the files, please check the folder options.

\* XP or window 7 32bit : (C:)Drive → Program Files → uBioMacpa → work

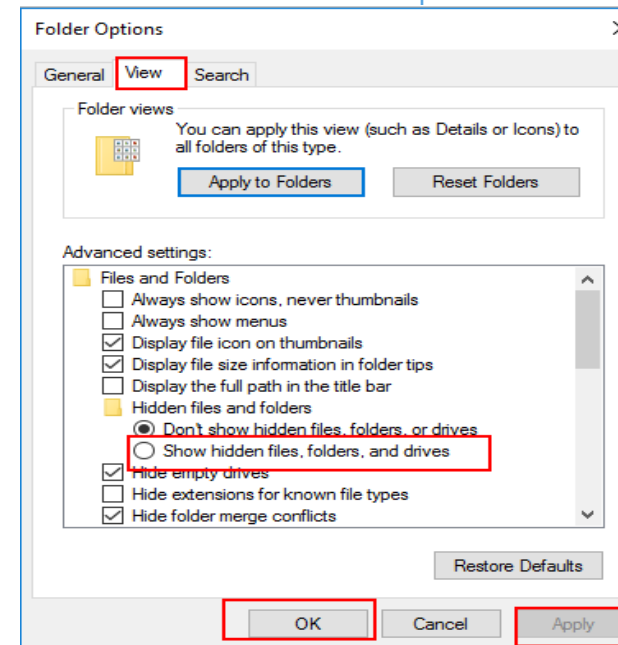
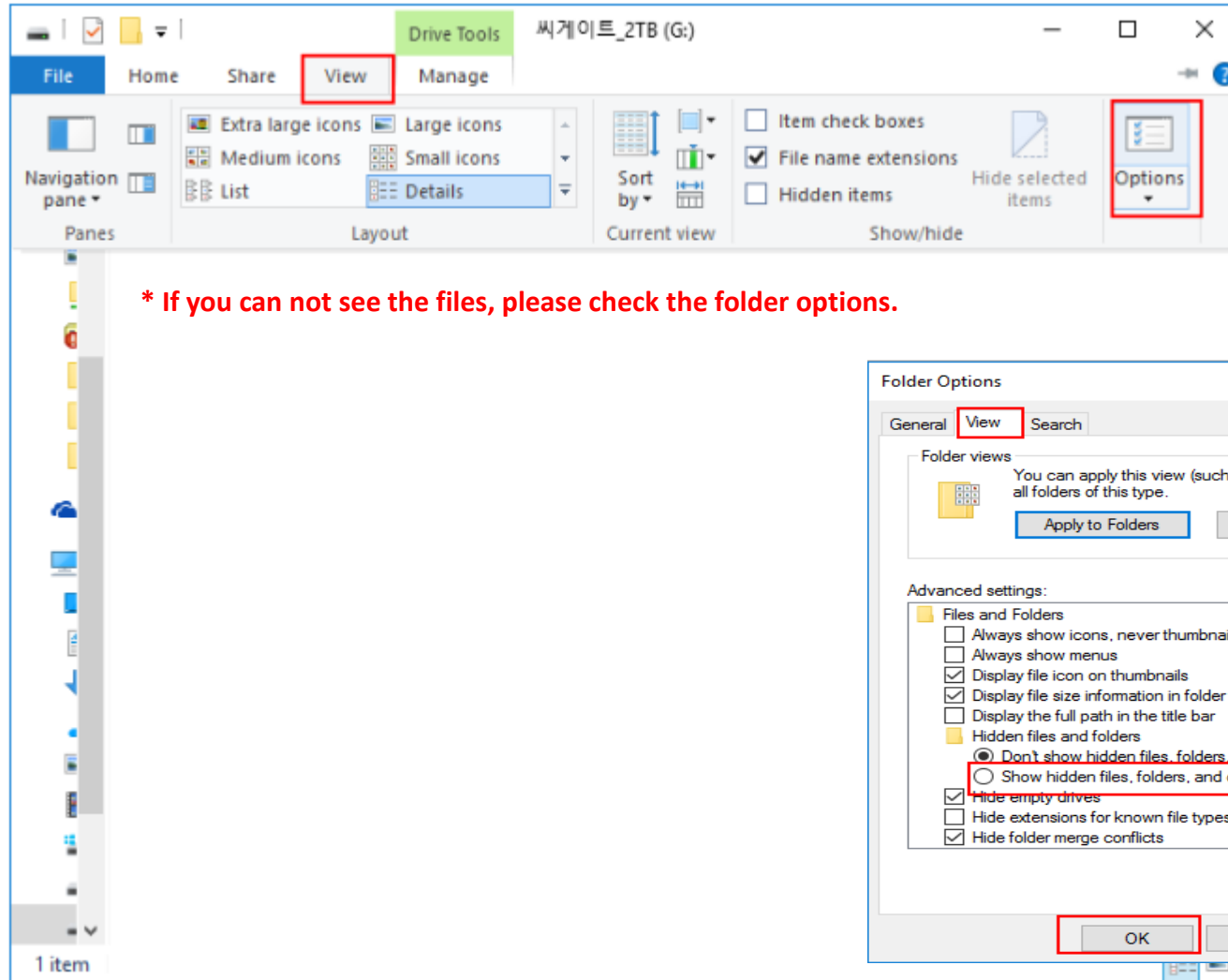


# 10. Data storage path (PC – Windows 8 or 10)



Windows 8 or 10 : You can follow the data storage path.

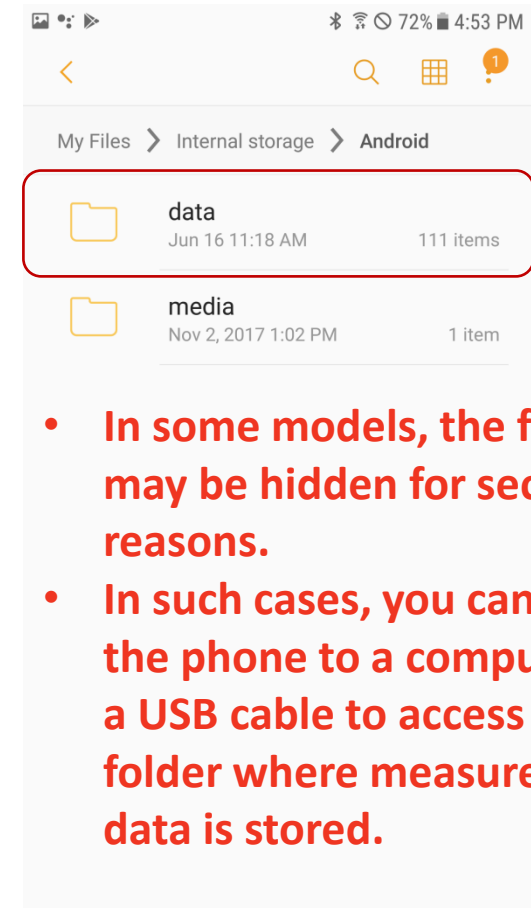
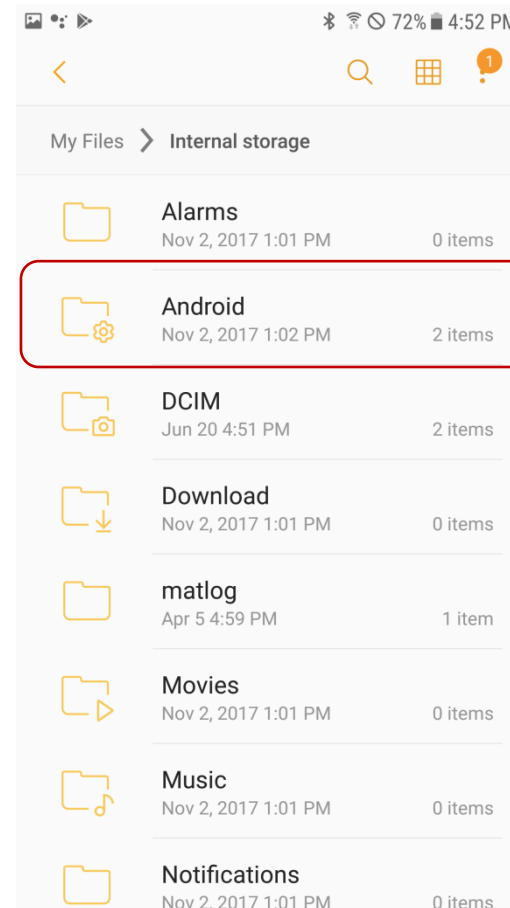
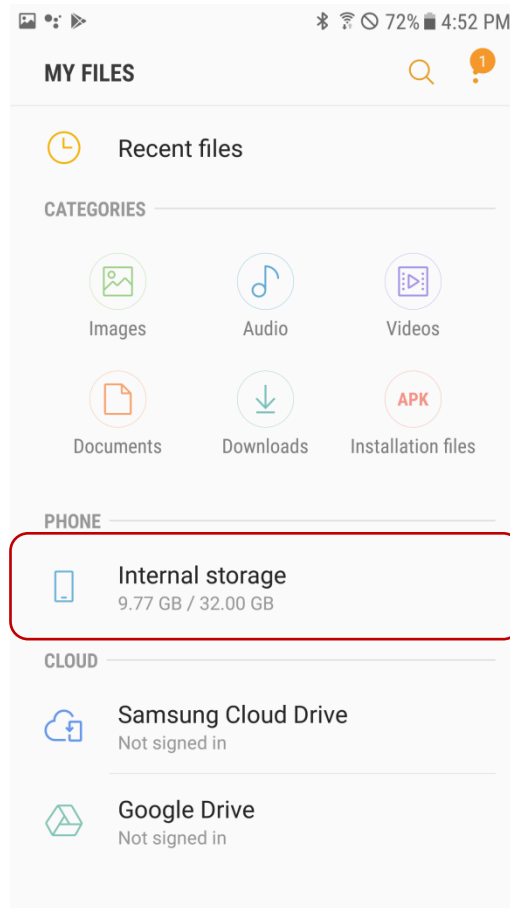
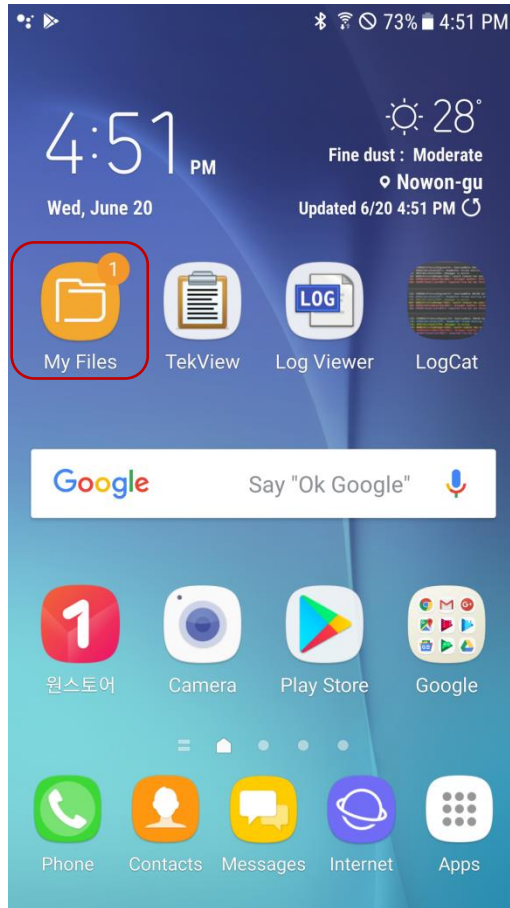
( My computer or File Explorer -> (C:)Drive -> Users -> User name -> AppData -> Local -> VirtualStore -> Program Files(x86)  
-> uBioMacpa -> work )



# 10. Data storage path(Mobile Phone or Tablet)



My Files -> Internal or Other storage -> Android -> data -> com.biosense.ubiomacpa -> files -> work -> test report files

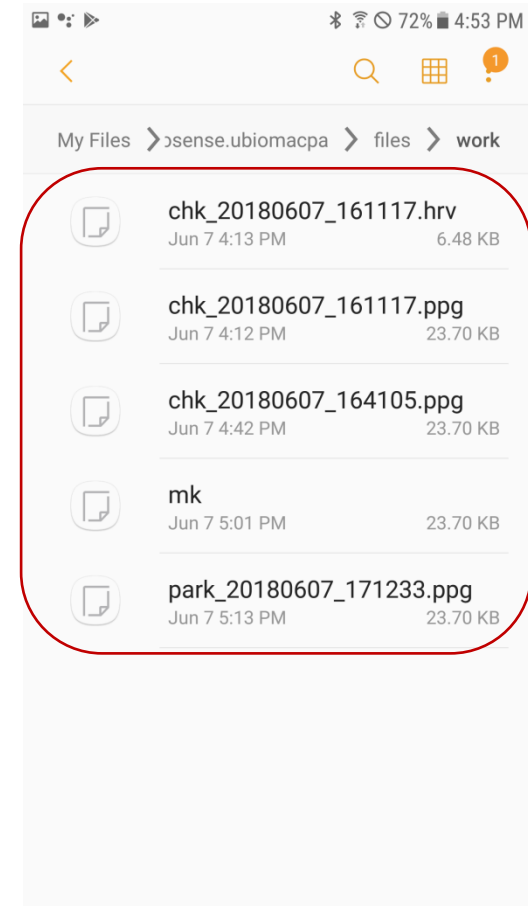
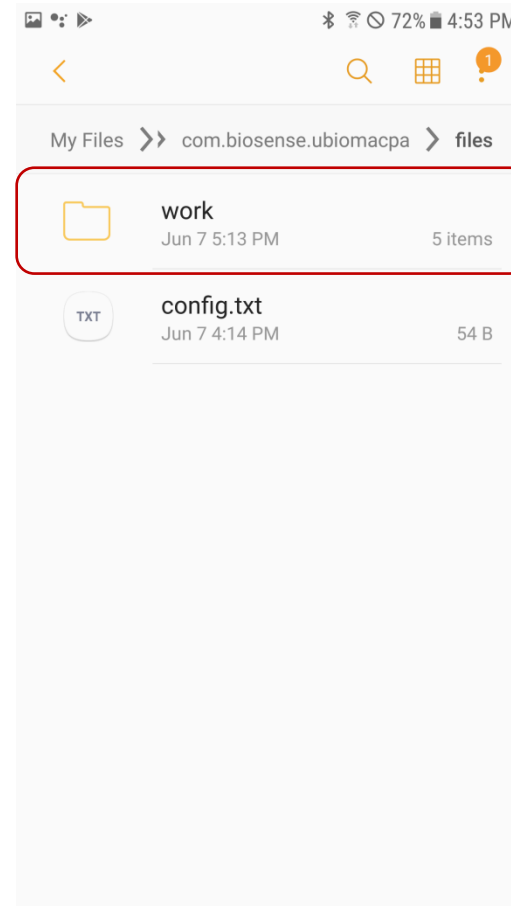
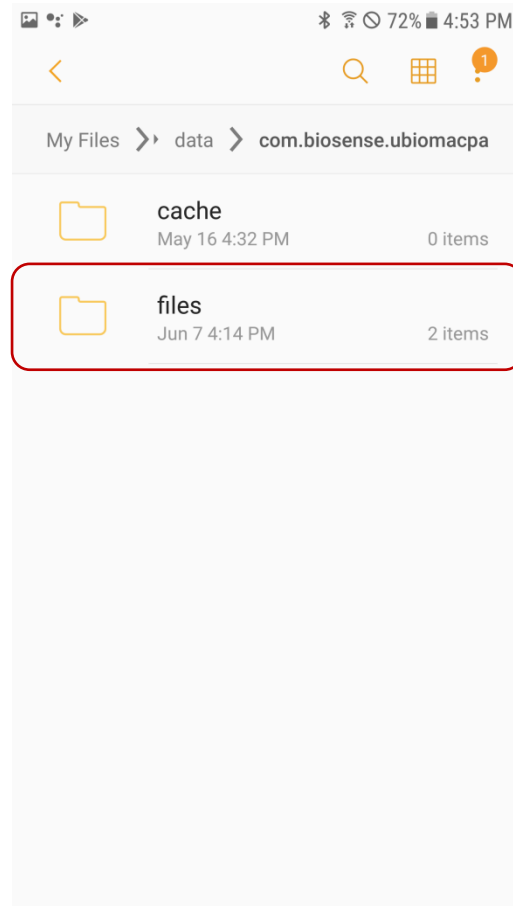
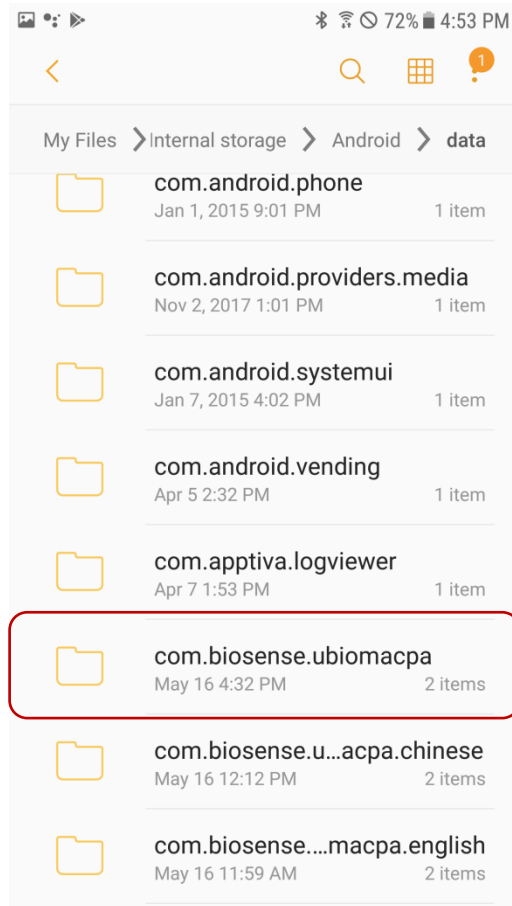


- In some models, the folders may be hidden for security reasons.
- In such cases, you can connect the phone to a computer using a USB cable to access the folder where measurement data is stored.

# 10. Data storage path (Mobile Phone or Tablet)



My Files -> Internal or Other storage -> Android -> data -> com.biosense.ubiomacpa -> files -> work -> test report files

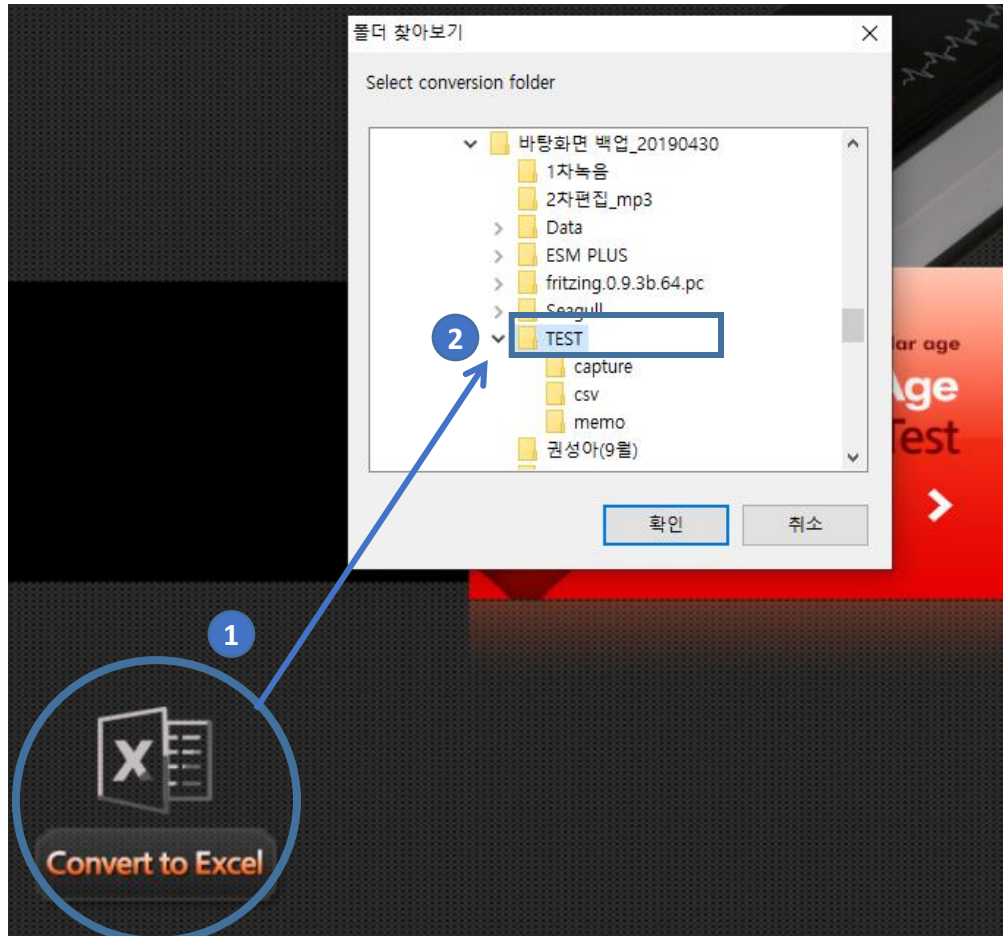


# 11. Converting to Excel



You can save the data as Excel.

- “Delete” deletes all test records of the user.
- You cannot recover the deleted records. So be careful.

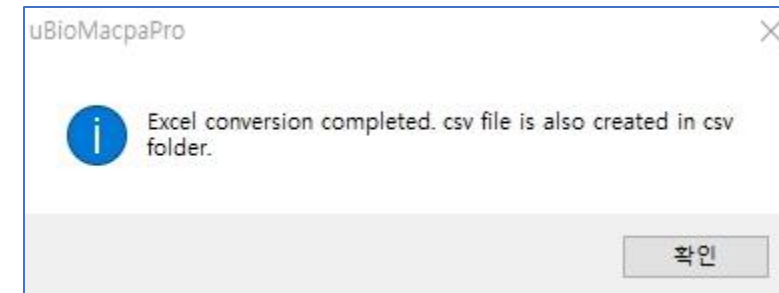


1

Click the ‘Convert to Excel’ button.

2

Select the folder where the measurement data is saved.

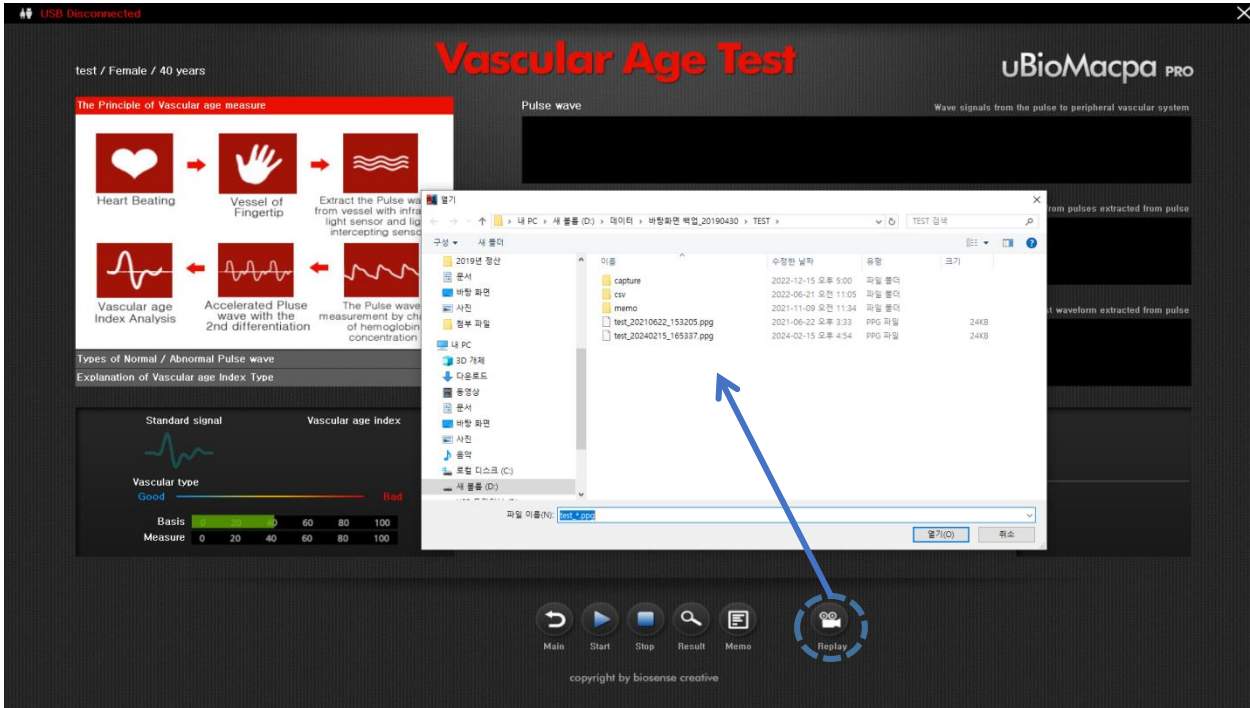


| 1 | User name | Gender | Birth year | Age | Number | Measurement date | Reception | Vascular | Vascular | t-a-b | a-c | a-d | a-e | b/a   | c/a   | d/a   | e/a  | Average p | Stress Inde | R |
|---|-----------|--------|------------|-----|--------|------------------|-----------|----------|----------|-------|-----|-----|-----|-------|-------|-------|------|-----------|-------------|---|
| 2 | sunga6    | Female | 1984       | 37  |        | 2021-06-22 15:36 | 10%       | -1.8     |          | 87    | 165 | 213 | 283 | -0.85 | -0.06 | -0.26 | 0.17 | 82.26     | 27.61       |   |
| 3 | test      | Female | 1984       | 37  | test   | 2021-06-22 15:32 | 11%       | 3.8      |          | 85    | 153 | 198 | 270 | -0.84 | -0.11 | -0.25 |      | 78.88     | 22.99       |   |

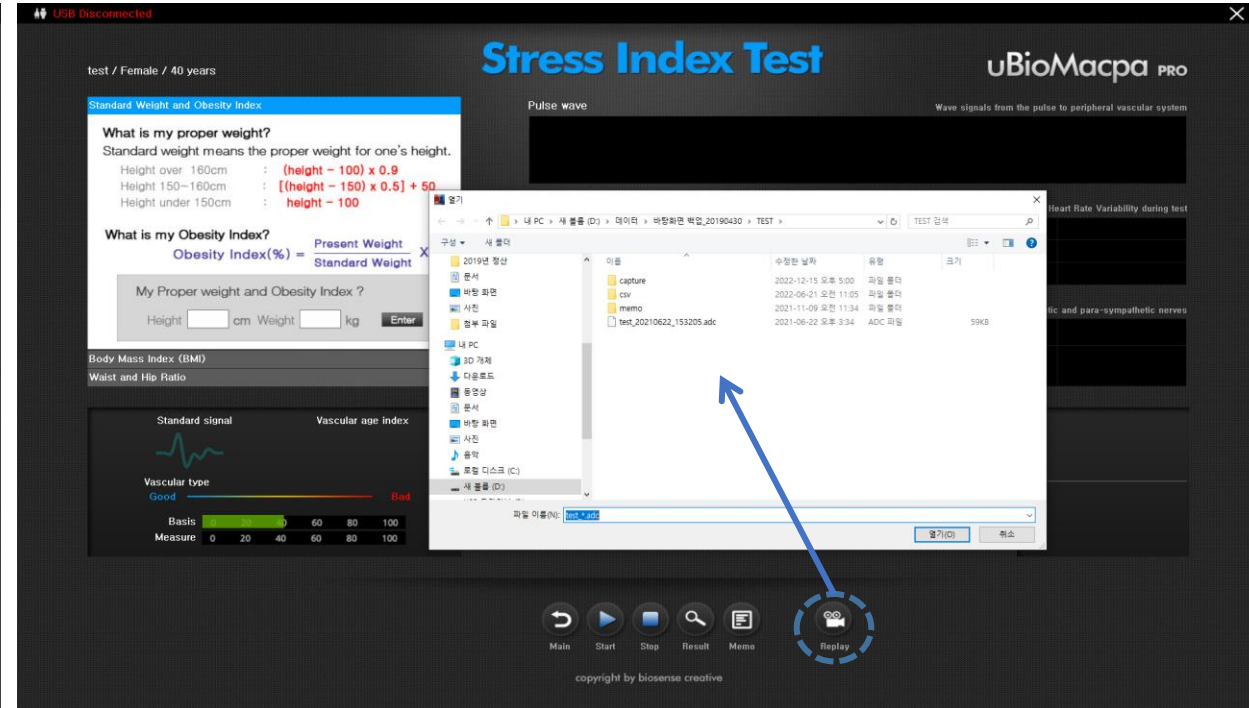
# 12. Replaying



You can replay the measured data in the Vascular Age Test and Stress Index Test screen.



Click 'Replay' button. Only files with the extension 'ppg' can be replayed.



Click 'Replay' button. Only files with the extension 'adc' can be replayed.



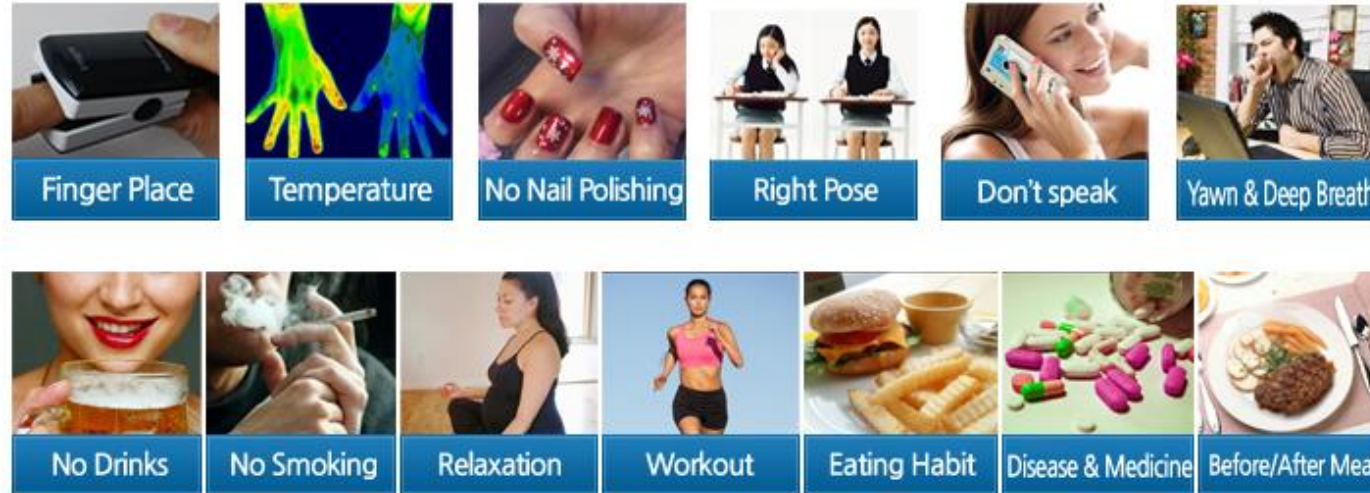
# 13. About the device

- Size: Width(W)×Depth(D)×Height(H) = 58.3×32.84×27.46(mm)
- Weight: 25g
- Material: ABS resin



| Features                | Description                                                                            |
|-------------------------|----------------------------------------------------------------------------------------|
| 1) USB cord             | This connects to the computer. It is used for data communication.                      |
| 2) Test probe           | a test probe to measure pulse wave using infrared rays                                 |
| 3) Light emitting part  | This emits infrared rays to fingers.                                                   |
| 4) Light reception part | A sensor which receives light through fingers                                          |
| 5) Computer             | universal PC, notebook<br>Windows XP/Vista/7<br>CPU : 1GHz, RAM : 512MB<br>HDD : 120GB |

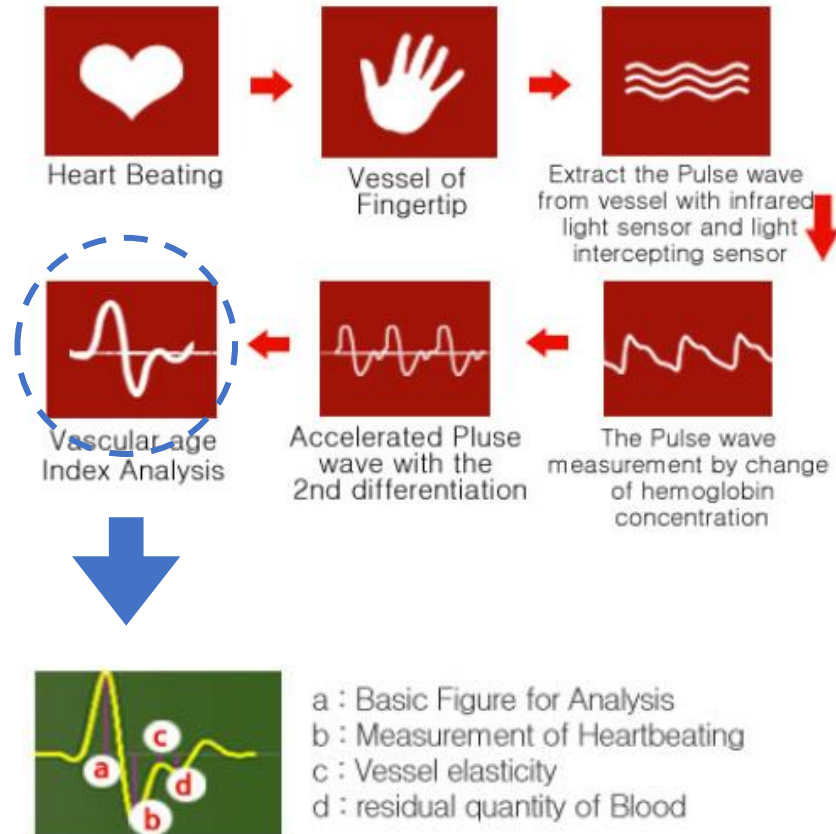
# 14. Caution



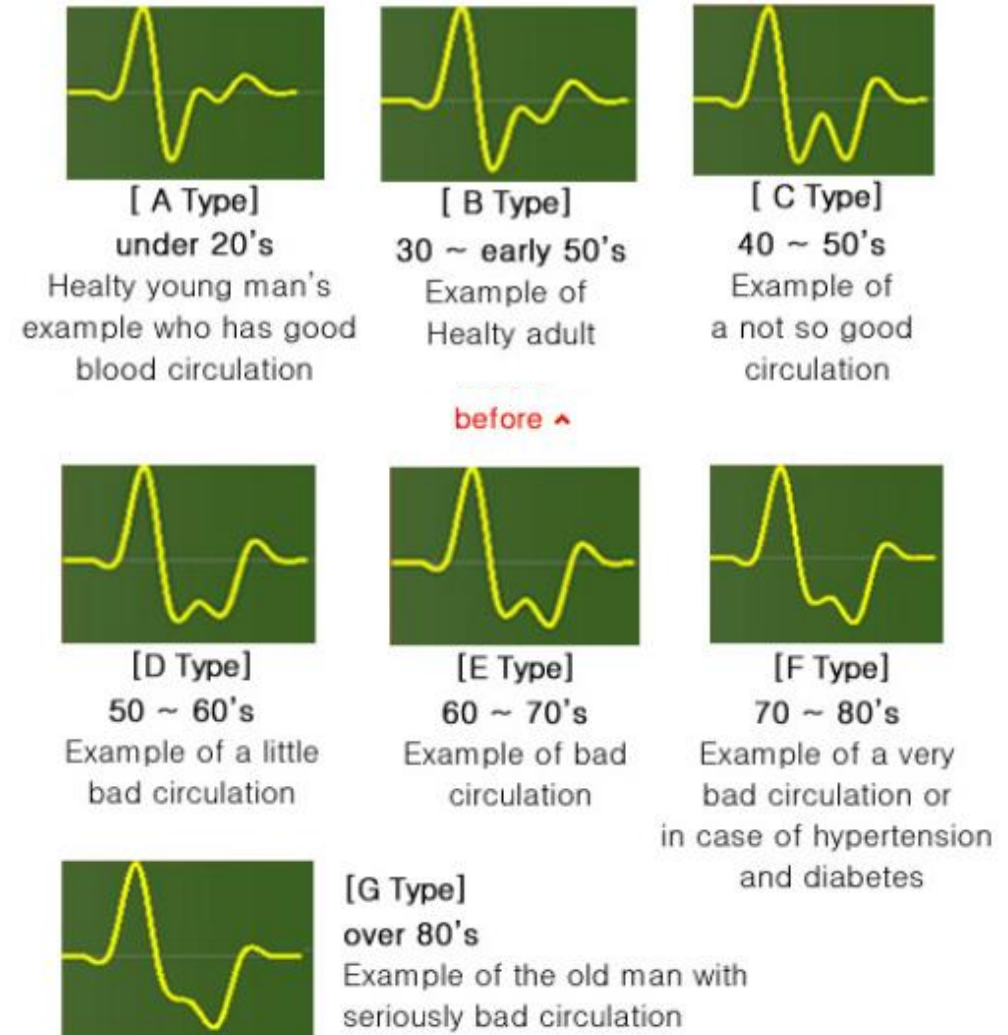
- Calm down for 5 minutes before testing.
- The testing for kids who are 12 years old or younger is not reliable because their fingers are too thin to test.
- If the test result is not what you expected, calm down and try again after 30 minutes
- It is best to use average of 5 test results.
- For better test, the finger in the probe should be placed horizontally with the rubber band for even light reflection.
- Do not test after drinking or smoking. The test may not be reliable.
- When you test during the winter or in cold weather, warm the fingers first.
- Do not yawn or take deep breaths during the test. It may affect automatic nerves.
- When you test outdoors, cover your hand with a towel. The light may affect the test.

# 15. Basis of the test

## < Basis of testing Vascular Health >



## < Type of pulse wave means that the Acceleration >



# 16. Checking pulse wave

< Distinct pulse wave of the human eye >

[Normal Pulse wave – healthy young man]



It has a sharp curve.

**If you test after drinking, it has this shape.**

[Normal Pulse wave – healthy middle aged man]



It has a smoother turn compared to that of a healthy young person.

[Normal Pulse wave – old man]



The cycle of pulse wave is triangle.

**If this happens for people who are not elderly, try again after 5 minutes.**

**If it consists, consult with a doctor.**

[Arrhythmia Pulse wave]



The cycle of pulse wave is not regular. It skips a cycle and gets shorter or longer.

**There are many reasons for irregular pulse. Consult with a doctor for electrocardiogram.**

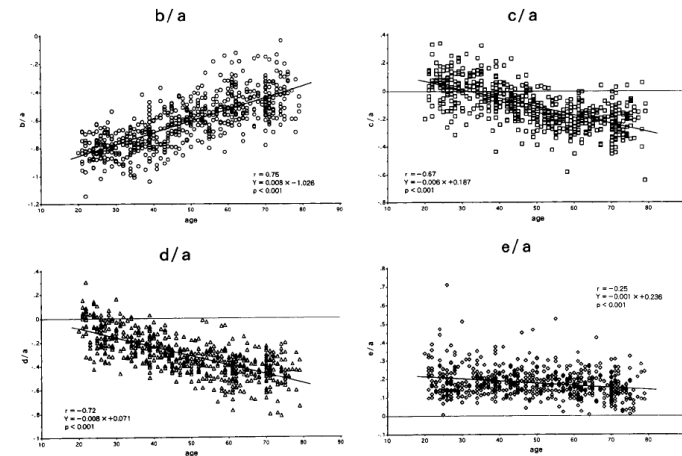
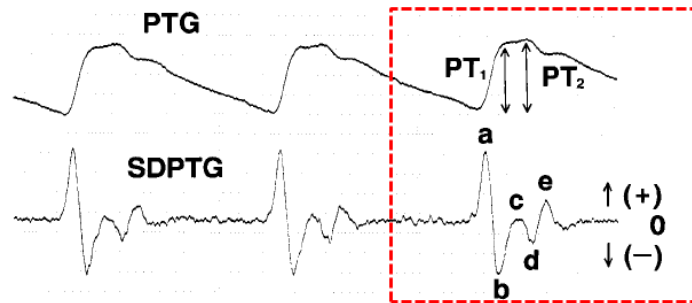
# 17. Basis of testing Vascular Health (1)

**Hypertension**  
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart  
Association  
Learn and Live

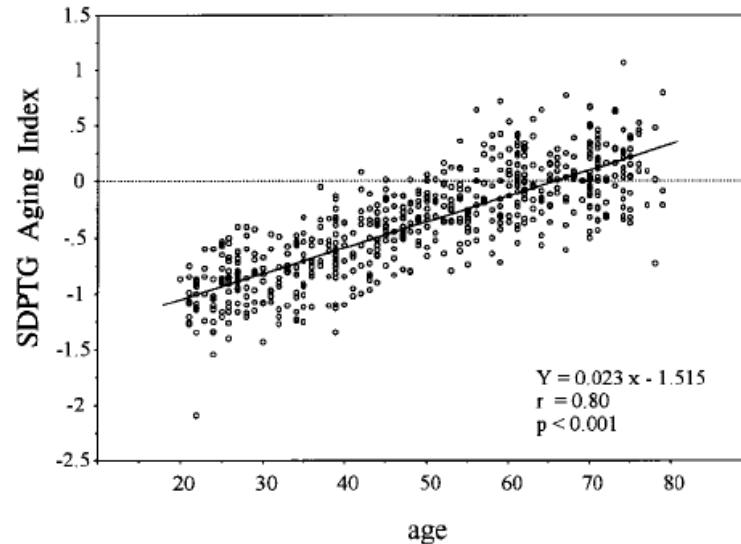
Assessment of Vasoactive Agents and Vascular Aging by the Second Derivative of Photoplethysmogram Waveform  
Kenji Takazawa, Nobuhito Tanaka, Masami Fujita, Osamu Matsuoka, Tokuyuki Saiki, Masaru Aikawa, Simobu Tanura and Chiharu Ito  
*Hypertension* 1998;32:365-370  
Hypertension is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75214  
Copyright © 1998 American Heart Association. All rights reserved. Print ISSN: 0194-911X. Online ISSN: 1524-4563

- Hypertension by **American Heart Association**, 1998; 32; 365-370
- Assessment of Vasoactive Agents and Vascular Aging by the Second Derivative of Photoplethysmogram Waveform
- Assessment of vascular age by analysis of pulse waveform in a noninvasive way
- Analysis of PTG Wave by the second derivative based on 400 males and females with age between 30 and 89 found that the size of peak a, b, c, d, and e is related to age. It is assessing vascular age based on that.





# 17. Basis of testing Vascular Health (2)



**Figure 5.** Relationship between SDPTG aging index and age. SDPTG aging index (b-c-d-e/a) (Y) increased with age (X);  $Y=0.023X-1.515$  ( $P<0.001$ ,  $r=0.80$ ).

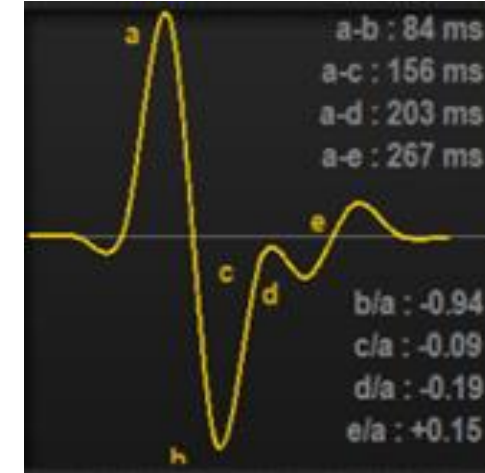
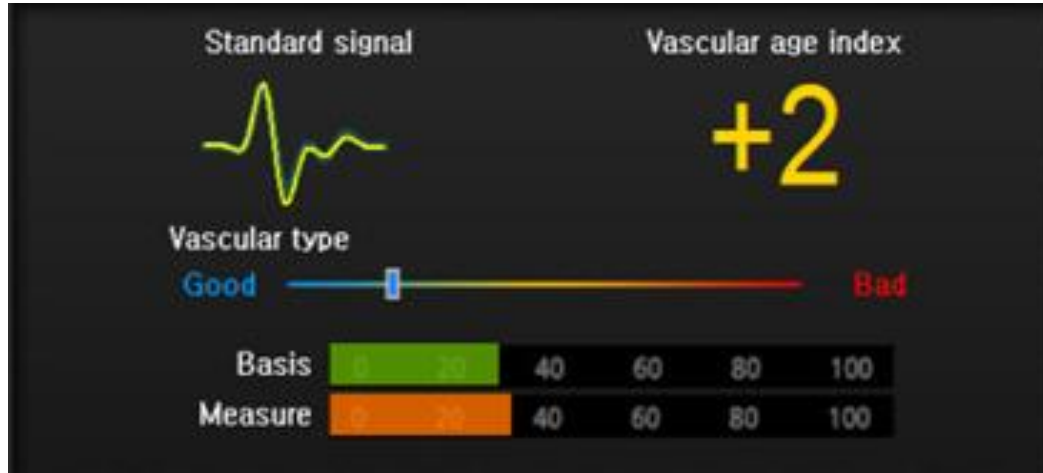
**TABLE 2.** Demographics of Study 2 Subjects With Results of Student's Unpaired *t* Test

| Demographic | 3rd Decade |            | 4th Decade |             | 5th Decade |             | 6th Decade |            |
|-------------|------------|------------|------------|-------------|------------|-------------|------------|------------|
|             | M          | F          | M          | F           | M          | F           | M          | F          |
| Subjects, n | 50         | 50         | 50         | 50          | 50         | 50          | 50         | 50         |
| Age, y      | 26.0±2.2   | 24.4±2.6*  | 34.7±3.2   | 35.9±2.5‡   | 44.7±2.8   | 44.7±2.7    | 54.6±2.8   | 54.5±3.2   |
| Height, m   | 1.72±0.05  | 1.57±0.07* | 1.72±0.05  | 1.58±0.04*  | 1.70±0.06  | 1.56±0.06*  | 1.66±0.06  | 1.56±0.05* |
| Weight, kg  | 65±9       | 48±7*      | 69±10      | 53±7        | 68±8       | 53±8*       | 64±9       | 54±7*      |
| SBP, mm Hg  | 113±10     | 98±8*      | 114±13     | 102±9*      | 116±11     | 104±10*     | 116±13     | 108±16‡    |
| DBP, mm Hg  | 61±8       | 59±5       | 69±10      | 63±7*       | 74±11      | 67±8*       | 77±8       | 70±10*     |
| PP, mm Hg   | 52±11      | 40±8*      | 45±11      | 39±8‡       | 42±8       | 37±8*       | 39±10      | 38±10      |
| MBP, mm Hg  | 79±7       | 72±5*      | 84±10      | 76±7*       | 88±10      | 79±8*       | 90±9       | 83±11*     |
| PR, bpm     | 70±12      | 73±10      | 68±10      | 73±10‡      | 68±11      | 69±11       | 66±10      | 69±10      |
| b/a         | -0.79±0.08 | -0.80±0.11 | -0.81±0.11 | -0.72±0.11* | -0.72±0.11 | -0.60±0.11* | -0.57±0.13 | -0.54±0.11 |
| c/a         | 0.01±0.13  | 0.07±0.10‡ | 0.01±0.12  | -0.01±0.12  | -0.08±0.13 | -0.10±0.07  | -0.18±0.11 | -0.20±0.08 |
| d/a         | -0.10±0.13 | -0.10±0.16 | -0.17±0.15 | -0.24±0.09‡ | -0.29±0.11 | -0.30±0.08  | -0.38±0.14 | -0.36±0.12 |
| e/a         | 0.21±0.12  | 0.19±0.08  | 0.21±0.09  | 0.17±0.05‡  | 0.22±0.08  | 0.17±0.05*  | 0.19±0.08  | 0.17±0.05  |
| SDPTG AI    | -0.91±0.23 | -0.95±0.31 | -0.86±0.28 | -0.64±0.26* | -0.57±0.28 | -0.36±0.23* | -0.20±0.30 | -0.16±0.27 |
| PTG AI      | 0.87±0.14  | 0.88±0.18  | 0.92±0.14  | 1.02±0.14*  | 1.03±0.12  | 1.12±0.16‡  | 1.16±0.19  | 1.13±0.13  |

**TABLE 2.** Continued

| 7th Decade |            | 8th Decade |             | All Decades |             |
|------------|------------|------------|-------------|-------------|-------------|
| M          | F          | M          | F           | M           | F           |
| 50         | 50         | 50         | 50          | 300         | 300         |
| 63.3±2.6   | 63.5±2.6   | 73.0±2.8   | 72.3±2.1    | 49.4±16.4   | 49.2±1.5    |
| 1.66±0.05  | 1.53±0.05* | 1.63±0.06  | 1.50±0.05*  | 1.68±0.06   | 1.55±0.06*  |
| 64±8       | 54±7*      | 62±9       | 50±7*       | 65±9        | 52±7*       |
| 126±20     | 119±22     | 124±17     | 118±16‡     | 118±15      | 108±16*     |
| 77±12      | 74±12      | 73±7       | 70±8        | 72±11       | 67±10*      |
| 49±13      | 45±14      | 51±14      | 47±15       | 46±12       | 41±11*      |
| 93±14      | 89±15      | 90±10      | 86±9‡       | 87±11       | 81±11*      |
| 64±9       | 72±12*     | 64±11      | 71±11‡      | 67±11       | 71±11*      |
| -0.48±0.12 | -0.45±0.13 | -0.48±0.13 | -0.40±0.12* | -0.64±0.18  | -0.59±0.18* |
| -0.20±0.10 | -0.20±0.07 | -0.20±0.14 | -0.24±0.09  | -0.10±0.15  | -0.12±0.14  |
| -0.44±0.11 | -0.43±0.12 | -0.45±0.13 | -0.46±0.13  | -0.30±0.18  | -0.32±0.17  |
| 0.17±0.07  | 0.16±0.06  | 0.16±0.07  | 0.12±0.07‡  | 0.19±0.09   | 0.16±0.07*  |
| -0.01±0.27 | 0.03±0.26  | 0.00±0.32  | 0.18±0.29‡  | -0.43±0.47  | -0.32±0.47‡ |
| 1.20±0.15  | 1.26±0.24  | 1.25±0.20  | 1.27±0.20   | 1.07±0.21   | 1.11±0.22‡  |

# 17. Basis of testing Vascular Health (3)



Test value of uBioMacpa Pro

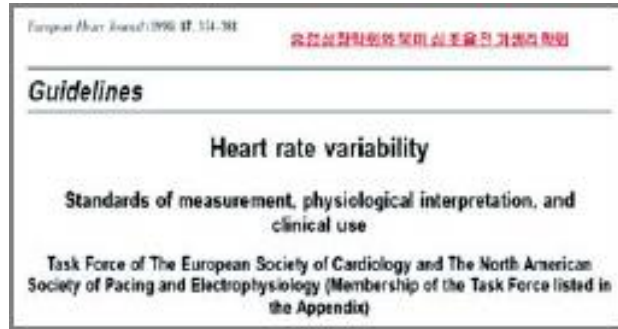
**Vascular health index = vascular age - age**

$$\text{Vascular age} = \left( \left( \frac{b - c - d - e}{a = 1} + 1.515 \right) / 0.023 \right)$$

$$\text{Vascular age (32)} = ( (-0.94 - (-0.09) - (-0.19) - 0.15) + 1.515 ) / 0.023$$

$$\text{Vascular health index} = 32 - 30 = +2$$

# 18. Basis of testing Accumulated Stress (1)



- **European Society of Cardiology and The North American Society of Pacing and Electrophysiology prepared** a guideline on the standards of measurement and interpretation of HRV (Heart Rate Variability).
- Most medical devices today follow this standard.
- uBioMacpa is also based on this standard.

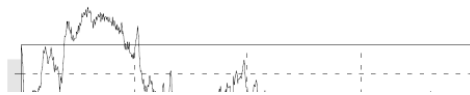
| 구분    | 파라메타       | 내 용                                                                                                |
|-------|------------|----------------------------------------------------------------------------------------------------|
| 시간영역  | SDNN       | Standard deviation of all NN intervals                                                             |
|       | RMSSD      | The square root of the mean of the sum of the squares of differences between adjacent NN intervals |
|       | SDSD       | Standard deviation of differences between adjacent NN intervals                                    |
|       | NN50 count | Number of pairs of adjacent NN intervals differing by more than 50 ms in the entire recording      |
|       | pNN50      | NN50 count divided by the total number of all NN intervals                                         |
| 주파수영역 | TP         | 5 min total power                                                                                  |
|       | VLF        | Power in very low frequency range                                                                  |
|       | LF         | Power in low frequency range                                                                       |
|       | HF         | Power in high frequency range                                                                      |
|       | LFnorm     | LF power in normalised units                                                                       |
|       | HFnorm     | HF power in normalised units                                                                       |
|       | LF/HF      | Ratio LF [ms <sup>2</sup> ] / HF [ms <sup>2</sup> ]                                                |

# 18. Basis of testing Accumulated Stress (2)

HEARTMATH Research Center

## Autonomic Assessment Report

A Comprehensive Heart Rate Variability Analysis



- Autonomic Assessment Report Interpretation Guide and Instructions (Heartmath Research Center, U.S., 1996)
- **A guideline prepared by Heartmath Lab. in America for autonomic assessment and interpretation** (Heartmath Lab. was founded in 1991 to research and teach cardiology. It is a non-profit organization in California, U.S.)
- **Suggests standard value per age group of each item such as** LF, HF, LF/HF, mean BPM, SDNN, and RMSSD

< Range per age group for time and frequency analysis value >

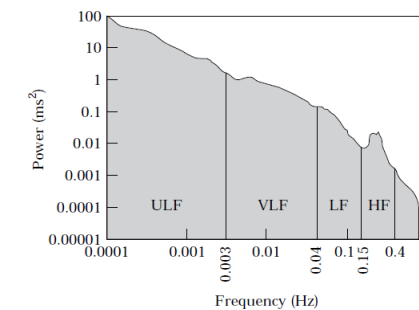
Table 2. Age Ranges and Cutoff Values for Time Domain Variables

| Range | Heart Rate |       | SDNN  |        | SDANN |        | SDNN index |        | Ln rMSSD |       |
|-------|------------|-------|-------|--------|-------|--------|------------|--------|----------|-------|
|       | Lower      | Upper | Lower | Upper  | Lower | Upper  | Lower      | Upper  | Lower    | Upper |
| 10-20 | 64.01      | 99.99 | 94.39 | 265.65 | 78.99 | 247.28 | 42.42      | 112.17 | 3.06     | 4.56  |
| 21-30 | 62.52      | 98.50 | 88.71 | 249.67 | 74.24 | 232.41 | 36.79      | 106.54 | 2.93     | 4.44  |
| 31-40 | 61.03      | 97.01 | 83.37 | 234.66 | 69.78 | 218.43 | 31.16      | 100.91 | 2.80     | 4.31  |
| 41-50 | 59.54      | 95.53 | 78.36 | 220.54 | 65.58 | 205.30 | 25.53      | 95.28  | 2.68     | 4.18  |
| 51-60 | 58.06      | 94.04 | 73.64 | 207.27 | 61.64 | 192.95 | 19.90      | 89.65  | 2.55     | 4.05  |
| 61-70 | 56.57      | 92.55 | 69.21 | 194.81 | 57.93 | 181.35 | 14.26      | 84.01  | 2.42     | 3.93  |

Table 3. Age Ranges and Cutoff Values for Frequency Domain Variables

| Range | Ln Total power |       | Ln ULF |       | Ln 5-min Total power |       | Ln 5-min VLF |       | Ln 5-min LF |       | Ln 5-min HF |       | Ln LF/HF |       |
|-------|----------------|-------|--------|-------|----------------------|-------|--------------|-------|-------------|-------|-------------|-------|----------|-------|
|       | Lower          | Upper | Lower  | Upper | Lower                | Upper | Lower        | Upper | Lower       | Upper | Lower       | Upper | Lower    | Upper |
| 21-30 | 9.12           | 11.05 | 8.80   | 10.88 | 7.57                 | 9.47  | 7.04         | 8.98  | 6.24        | 8.30  | 4.56        | 7.79  | 0.20     | 1.99  |
| 31-40 | 8.97           | 10.90 | 8.67   | 10.74 | 7.36                 | 9.27  | 6.84         | 8.77  | 6.08        | 8.14  | 4.19        | 7.42  | 0.41     | 2.21  |
| 41-50 | 8.82           | 10.75 | 8.53   | 10.60 | 7.16                 | 9.07  | 6.64         | 8.57  | 5.93        | 7.99  | 3.82        | 7.05  | 0.63     | 2.42  |
| 51-60 | 8.67           | 10.60 | 8.39   | 10.47 | 6.96                 | 8.87  | 6.43         | 8.37  | 5.77        | 7.83  | 3.45        | 6.68  | 0.84     | 2.64  |

< Area for each frequency range >



# 19. Certificates for the product (1)

| Item              | Detail description                                                                                                                                                            |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Patent            | <ul style="list-style-type: none"><li>• Testing device of vascular health and stress level by analyzing pulse wave signal (Registration number: 10-0954817)</li></ul>         |
| KFDA Certificate  | <ul style="list-style-type: none"><li>• Medical Device Product Manufacturer (#3447)</li><li>• Medical Device Product Permit (#13-262)</li><li>• KGMP(KTL-AA-110168)</li></ul> |
| Other Certificate | <ul style="list-style-type: none"><li>• CE(KES-E1-13T0070)</li><li>• RoHS(CTS130617-01A1)</li></ul>                                                                           |



# 19. Certificates for the product (2)

