

PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Online self-assessment of cardiovascular risk using the Joint British Societies (JBS3) derived heart age tool: A descriptive study
AUTHORS	Patel, Riyaz; Lagord, Catherine; Waterall, Jamie; Moth, Martin; Knapton, Mike; Deanfield, John

VERSION 1 - REVIEW

REVIEWER	Pedro Tauler University of the Balearic Islands. Spain.
REVIEW RETURNED	04-Mar-2016

GENERAL COMMENTS	<p>My main concern regarding this manuscript is the limited applicability of results at an international level. This study has been performed using a tool specifically addressed to people living in England. As it is shown, for example, in Table S1, this population presents several particularities such as higher prevalence of diabetes due to different ethnicities. Thus, in my opinion, the authors should do a hard work trying to explain whether their results are applicable and/or useful for the international, or at least the European, community. At least a comparison with the prevalence of cardiovascular risk factors in other European countries is needed.</p> <p>Minor More discussion focused on comparisons between the present study and similar previous ones (at least references 20 and 21) is required. In my opinion expressions such as "We were surprised..." should not appear in a scientific manuscript. Page 10, revise bibliography insert Angel et al. Any idea and/or previous results regarding the number of users introducing fictitious or wrong values?.</p>
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REVIEWER	Dr Jocasta Ball Mary MacKillop Institute for Health Research, Australian Catholic University, Melbourne, Australia
REVIEW RETURNED	30-Mar-2016

GENERAL COMMENTS	<p>Administrative comments for the authors:</p> <ul style="list-style-type: none"> - Be certain that there are definitions of all acronyms at first mention within the manuscript (e.g. NHS). - Additionally, make sure that there are descriptions (even brief) of concepts that not all readers will be familiar with (e.g. National Services Framework, NHS Choices and . Perhaps most importantly, the Townsend score of deprivation has not been described; therefore the meaning of analysing postcodes is lost. Adding more
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	<p>explanation will make for more general readership and understanding for readers particularly those outside of the UK.</p> <ul style="list-style-type: none"> - Be consistent with the name used for the JBS3 "heart age" tool. A "Heart Age tool" already exists and it could be confusing to readers familiar with the other tool of the same name (Neufingerl, Cobain & Newson, 2014). - Ensure headings are consistent (there is different use of capital letters, colons and & vs and). <p>Abstract:</p> <ul style="list-style-type: none"> - Only 41% of the total number of times the website was accessed resulted in a calculation of "heart age" - what accounts for the large drop-out rate? - The authors state that the tool was "accessed by a group not easily reached by conventional approaches..". What are "conventional approaches", what are the approaches to and what evidence do they have that they have accessed this group? <p>Strengths and Limitations bullet points:</p> <ul style="list-style-type: none"> - Are the results of this descriptive study truly representative of the "public"? - How globally generalisable are these data? - Do these data apply to individuals with different risk profiles (e.g. indigenous individuals, those from Eastern cultures with different risk factor targets e.g. for BMI)? <p>Introduction:</p> <ul style="list-style-type: none"> - Describe what risk factors for CVD are included in the JBS3 novel risk calculator/QRisk Algorithm. How is it "novel"? <p>Methods:</p> <ul style="list-style-type: none"> - Specify what "analytics database" was used. - How was it determined that "heart age" was considered the most user-friendly and acceptable? - Table 1 should go in the Supplementary Material file. - Do the authors think that it is appropriate to make the assumption that data entered at each step is valid? - How was it established whether users had established CVD? If a user did have a previous history but still calculated a "heart age", how was the data identified and removed from analysis? - How was the tool "modified"? - The authors state that some summary statistics generated were means and medians. Did this also include calculation of standard deviations or inter-quartile ranges? If so, state this (and include in the presentation of these data in the "Results" section). - What was the "full detailed analysis" comprise of? - Is the 2001 census (15 years old) the most relevant data to base deprivation scores on? - It is a big assumption that data not entered = knowledge gap. This perhaps needs more discussion. - In describing that "hypercholesterolaemia" is >5mmol/L, do they mean total cholesterol? What about other components such as HDL and LDL levels? - Obesity is defined as a BMI > or = 30kg/m² (the authors define it as >30kg/m² only). - What is the HSE survey and why was this used? <p>Results:</p> <ul style="list-style-type: none"> - An attrition rate of almost 59% of those who accessed the tool but did not complete the data journey is large and may have introduced
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	<p>selection bias into the sample.</p> <ul style="list-style-type: none"> - Under "Age", it states that a third of users were aged <40 years, but the proportions of women versus men of this group does not add up to 100% (30.6% women and 32.8% men). Can this please be clarified? - "The user 5-year age profile correlates well with the England 5-year age profile from age 25 to 85 years (R=0.95) (ONS 2014, data not shown)" - does this refer to population data for the UK in 2014? i.e. are the authors providing evidence that the age distribution of users is representative of the population? Also, ONS should be defined. - Numbers of users should be provided in addition to the descriptions provided (e.g. what is the number of "people aged 30 to 60" and "older people >75 years?"). - The proportion of different user ethnic groups only adds up to 99.9%. - How was the Townsend score estimated? - Did the characteristics of the users match the characteristics of population for whom data was collected in the Census that was compared when analysing the Townsend score range (i.e. is it a like-for-like comparison)? - Why was information on entered numerical values only available for a 3 month period and for only a small proportion of users completing the journey (24%)? - Are the authors stating that 94% (130,000/138,252) of users quit the journey at the cholesterol/blood pressure stage or is this 130,000 of the total number of completions? - Again, I think numbers should be provided in addition to the proportions for completeness. - Do the authors believe that the target SBP of 120mmHg for 19% of users is accurate or could users be inputting what they "know" to be the ideal SBP? - The authors should consider analysing if differences between groups are statistically significant or not. - Under "BMI", the authors write that "of these, 5% were underweight" but the previous sentence reports the mean BMI. This needs rewording. - Again obese is stated as a BMI>30 but this should be BMI > or = 30. Include units of measurement as well. - The authors should ensure that "mean" is included when describing data being compared (i.e. mean height, mean weight, mean BMI). This needs also to be clarified on the graphs. - For cholesterol, it must be stated that it is mean total cholesterol that is reported (not just mean cholesterol) and again this needs to be rectified on the graphs. - Under "cholesterol" (which should be total cholesterol), what does "proportion" refer to? The proportion of users completing the data journey? Including numbers would also add to the clarity. In addition, "population for England" should read "population of England". - Do the authors believe that a mean SBP of 121.4mmHg is accurate when more than 25% of the UK population has hypertension according to the NHS? - There appears to be discrepancies between the proportions of users reporting hypertensive SBP values and those reporting being treated for hypertension: initially, it is reported that 9.4% report SBP values >140mmHg. Then it is stated that 49% either reported a SBP >140mmHg or being treated for hypertension (i.e. 39.6% are treated hypertensives if 9.4% as stated above have SBP values >140mmHg). Then under "Other Medical Conditions", it states that 18.6% had "treated high blood pressure". What is the discrepancy
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	<p>and which data are correct?</p> <ul style="list-style-type: none"> - How do the authors explain the large difference between the users self-reporting that they smoked and those reported by HSE 2013? - Comparisons with current population data (HSE etc) should be in the discussion not in the results section. <p>Discussion:</p> <ul style="list-style-type: none"> - There is discussion around the impetus of developing a public version of the JBS3 Heart Age calculator to broaden access to CVD risk assessment, to empower individuals to proactively manage their risk factors and potentially to improve NHS Health Checks programme participation". Do the authors believe this has occurred and if yes, how can this be determined? - The authors describe that the tool is "of much greater complexity". Than what? This perhaps needs to be elaborated on. - Where the authors suggest that "almost 80% of users reported not knowing their cholesterol level and 50% a BP level reading", was this actually reported by users or do the authors assume that there was a gap in the user's knowledge due to no data input? - Following discussion of the "Know Your Numbers" campaign, there is a suggestion/assumption by the authors that individuals who don't know "their numbers" have poor risk factor profiles. - There is conflicting discussion on blood pressure (second paragraph of page 11). The authors state that blood pressure values were very similar to the UK population survey data but then states that blood pressure values "appeared lower than expected". Which is it? - The discussion needs to be more structured and have a clear and more comprehensive limitations section. <p>Other sections/figures/tables:</p> <ul style="list-style-type: none"> - References are presented in an inconsistent format (ref #7 does not have brackets around the issue; ref 8 doesn't include an issue number where the others do; ensure that references for books, media releases, data etc is consistent). - Under "Funding", grant numbers should be provided. - Table 1 is not necessary to be included in the main manuscript (place in the Supplementary Material section if the authors still wish to include it for context). - The title of the y axis of Figure 3B should match that of Figure 3A. Figure 3C is perhaps not needed as it is discussed in the manuscript text. - Figure 4 is quite busy. Consider if it adds to the description included in the manuscript text. - Figure 5 could be changed to a table. It would be interesting to know the numbers of those whose heart age was equal to the users' chronological age and how many had a heart age lower than their chronological age. The age group 80-89 years is missing. The numbers only add up to 522,368 in total - where are the other 53,414 users? They aren't all in the 80-89 year category. (- Supplementary Figure S5 - the top graph should be titled S5A not S5B). <p>General overall comments for consideration:</p> <ul style="list-style-type: none"> - A description of the contents of the tool needs to be included. This should emphasise which data points are defaulted if not completed (and to what). It also needs to be clearer which missing data results in a heart age not being calculated and what defaulted data will still allow this calculation. - The most important consideration about the presented study is
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	<p>that:</p> <p>a) it is unknown whether individuals from other countries used the tool and this research compares the data to UK population statistics;</p> <p>b) users could have completed the data journey more than once and may have done so to assess different health scenarios;</p> <p>c) despite missing values, a heart age was still calculated (inaccurate or missing information may lead to incorrect evaluations);</p> <p>d) there is huge selection bias within the group of users - those with low health literacy, those with low computer literacy, those with low motivation to understand or change their risk profile, those with no access to the internet (most likely those of lower socio-economic status or older individuals);</p> <p>e) there is inherent problems with self-reported health data regarding accuracy;</p> <p>f) there is a potentially negative effect of the publicity which usually triggers the "worried well" to assess their health status.</p> <p>- Do the authors think that if a large number of users didn't "know their numbers", is it better to promote GP visits/health checks rather than invest in an online tool that may not be accurate?</p>
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VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

-My main concern regarding this manuscript is the limited applicability of results at an international level. This study has been performed using a tool specifically addressed to people living in England. As it is shown, for example, in Table S1, this population presents several particularities such as higher prevalence of diabetes due to different ethnicities. Thus, in my opinion, the authors should do a hard work trying to explain whether their results are applicable and/or useful for the international, or at least the European, community. At least a comparison with the prevalence of cardiovascular risk factors in other European countries is needed.

We thank the reviewer for raising this issue for clarification. The message and focus of this paper is to convey the UK experience of using an online heart age calculator for communication of CVD risk to the wider population using digital means. While the actual tool we have used is derived from the JBS3 calculator and is UK centric, other very similar heart age tools exist for other populations and indeed a global one is also available through the World Heart Foundation (www.heartage.me).

We show that it is possible to deliver such a tool online, that members of the public are able to use it and show an enthusiasm for doing so. Again, while we describe this in relation to the UK population, the message is relevant to all countries where online resources are available including all European countries. In fact, our work supports the findings of colleagues in Spain who have tested in an RCT whether using a heart age tool influences behavior or not (Lopez-Gonzalez, 2015).

We present user demographics and numbers primarily to show that the data entered are likely to be valid as they broadly reflect the expected values for a cohort without known CHD. The numbers however are self-entered and as the reviewer points out some may be erroneous or repeated. As such we hope the reviewer will agree that comparing these data to more rigorously collected estimates of risk factor prevalence from other countries, while certainly of some interest, is unlikely to add to the main message of this short descriptive paper.

Minor

-More discussion focused on comparisons between the present study and similar previous ones (at least references 20 and 21) is required.

We have added additional sentences in the discussion on page 12 as follows:

“A previous study of users of another online heart age tool derived from the Framingham risk calculator and delivered as part of the Flora/Becel marketing campaign, identified remarkably similar

numbers with 77% and 47% of users not knowing their total cholesterol or blood pressure values, respectively.²⁰ Our study differs from this report as the JBS3 tool was derived from a more contemporary risk calculator (QRisk, incorporating other variables like deprivation index) and offered within the remit of the National Health Service as part of a wider public health campaign to encourage people to participate in the national health checks program. Nonetheless the messages are consistent and figures are in line with national estimates for awareness of risk factor levels in the UK and in other countries, such as in the USA or Australia which have targeted this problem with a “Know Your Numbers” campaign.²¹”

-In my opinion expressions such as “We were surprised...” should not appear in a scientific manuscript.

This has been edited to “There was a high uptake..” on page 10, paragraph 3.

-Page 10, revise bibliography insert Angel et al.

The correct reference and author surname (Lopez-Gonzalez) has now been inserted.

-Any idea and/or previous results regarding the number of users introducing fictitious or wrong values?

We identify in results how many users entered “out of range” data for blood pressure and cholesterol as an indication of this problem. Beyond that it is not possible to know if data is fictitious or incorrect and this information is not easily available, but the point is important and is added to the limitations section.

Reviewer: 2

- Be certain that there are definitions of all acronyms at first mention within the manuscript (e.g. NHS). Thank you, we have done this throughout the manuscript.

- Additionally, make sure that there are descriptions (even brief) of concepts that not all readers will be familiar with (e.g. National Services Framework, NHS Choices and . Perhaps most importantly, the Townsend score of deprivation has not been described; therefore the meaning of analysing postcodes is lost. Adding more explanation will make for more general readership and understanding for readers particularly those outside of the UK.

We have removed the mention of National Service Framework and replaced this with “government health policies”; we state that NHS Choices is a “government run health website for the NHS” and have explained and referenced the Townsend Score of deprivation as “a means of assessing affluence, based on residential location”.

- Be consistent with the name used for the JBS3 "heart age" tool. A "Heart Age tool" already exists and it could be confusing to readers familiar with the other tool of the same name (Neufingerl, Cobain & Newson, 2014).

“Heart Age Tool” is increasingly used in the literature as a new means of presenting CVD risk (using an underlying risk calculator – Framingham or QRisk for example). We believe that the context and earlier descriptions of the tool in the title, introduction and methods should clarify for readers which version of the tool we are referring to throughout the text. Also, from a practical perspective, stating “JBS3 derived Heart Age Tool” throughout the text is also cumbersome for the reader.

- Ensure headings are consistent (there is different use of capital letters, colons and & vs and). Thank you. We have corrected these where apparent

Abstract:

- Only 41% of the total number of times the website was accessed resulted in a calculation of "heart age" what accounts for the large drop-out rate?

Website hits were included as anyone viewing the landing page that explained the tool and what it does. To clarify we have edited the sentence to “The online tool landing page was viewed...” Of note, despite this early stage dropout, the completion rate is still very high for online health tools of this sort hosted on the NHS choices website as stated in the discussion.

- The authors state that the tool was "accessed by a group not easily reached by conventional approaches..". What are "conventional approaches", what are the approaches to and what evidence do they have that they have accessed this group?

Conventional approaches in this context means a doctor led assessment in person, usually in general practice. In the UK, members of the public are being invited for a “health check” where risk assessment is undertaken in person. It is well established that those who are young and well, especially younger males (users of the tool) do not visit family physicians for screening or risk assessment visits.

Strengths and Limitations bullet points:

- Are the results of this descriptive study truly representative of the "public"?

We state that the characteristics of the users are broadly representative of the population. As far as we can tell, this is correct based on UK health survey and demographic data. For example the deprivation profile is very closely aligned to that of England. Of course, few studies of this type can be truly representative, and this is not our claim.

- How globally generalizable are these data?

The concept of using an online tool for conveying risk is potentially applicable globally wherever digital and social media exist. Whether uptake of the tool and the user profiles are the same in middle and lower income countries requires further testing.

- Do these data apply to individuals with different risk profiles (e.g. indigenous individuals, those from Eastern cultures with different risk factor targets e.g. for BMI)?

The purpose of the study was to describe the experience of using an online CVD risk assessment tool in a high income nation where CVD is a high priority. We show that it is popular and feasible in this context. Clearly more appropriate tools (perhaps using locally developed risk calculators – not Framingham or QRisk) for different nations or peoples would need to be developed and then tested in their own right.

Introduction:

- Describe what risk factors for CVD are included in the JBS3 novel risk calculator/QRisk Algorithm. How is it "novel"?

We have provided references for both JBS3 and QRisk in the text. In addition we have now listed the components that are required to generate the QRisk score and thus heart age in supplementary material. QRisk is a relatively well known risk calculator that provides traditional % risk estimates for CVD. The JBS3 tool is novel in that it takes the underlying calculations from QRisk and presents them in a variety of different ways to convey risk, including heart age, life expectancy free from CVD and impact of altering risk behavior on all of these metrics.

Methods:

- Specify what "analytics database" was used.

The data was stored in a secure server hosted server. The data itself was stored in a variety of data tables which the ‘export’ function of the dashboard then assembled into a .csv file for download so the data could then be analyzed.

- How was it determined that "heart age" was considered the most user-friendly and acceptable?

The concept of heart age was developed jointly with Professor Spiegelhalter who has published

widely on risk communication metrics. It is based on experience in other specialties such as “lung age” which has been applied successfully in patients with COPD (Morris and Temple, 1985). Field testing prior to development of the JBS3 calculator was highly positive from a range of patient groups and medical practitioners and continues to be so following launch of JBS3 calculator. This was therefore the basis for taking this particular metric from the JBS3 tool to present to the public on the NHS Choices website.

- Table 1 should go in the Supplementary Material file.

We feel this is relevant to present to the reader as it conveys an appropriate description of the user breakdown, the numbers of users and a feel for what the tool looks like.

- Do the authors think that it is appropriate to make the assumption that data entered at each step is valid?

We feel that as the demographics and risk factor distributions are “broadly” representative of the population from data using health surveys we feel that it is an appropriate assumption. Of course some data may be incorrect or artificial or repeatedly entered and this is fully acknowledged in the limitations.

- How was it established whether users had established CVD? If a user did have a previous history but still calculated a “heart age”, how was the data identified and removed from analysis?

The tool explicitly states that those with CVD should not use the tool and if they try, they are given a message to go to their GP. Given this is an online tool, reliant on users entering accurate data, it is neither possible to identify or exclude individuals with heart disease who may have entered data by not declaring CHD. However based on population estimates this proportion of individuals with CHD is likely to be small relative to those without CHD and ultimately does not change the wider message of the paper.

- How was the tool “modified”?

The full JBS3 tool is “physician facing” and designed to be run by a healthcare professional in front of a patient so that metrics can be explained and interacted with. The simpler heart age tool was modified to be more public friendly (using lay terminology) and only permit estimation of a single heart age metric as opposed to other more complex metrics which would require explanations.

- The authors state that some summary statistics generated were means and medians. Did this also include calculation of standard deviations or inter-quartile ranges? If so, state this (and include in the presentation of these data in the “Results” section).

This has been stated and standard deviations for the 3 mean values (cholesterol, BP, BMI) are now provided.

- What was the “full detailed analysis” comprise of?

This has been changed to “detailed analysis” and refers to the analysis described in the subsequent paragraphs

- Is the 2001 census (15 years old) the most relevant data to base deprivation scores on?

At the time we started developing the tool we only had access to the 2001 census. For the next version, we will look to use data from Census 2011. One key variable included in the QRisk original algorithm (BMJ 2008) was ‘Townsend deprivation score - output area level 2001 census data evaluated as a continuous variable’. So, in this context, it was correct to use the 2001 census data because that was what was deemed clinically appropriate and statistically correct.

- It is a big assumption that data not entered = knowledge gap. This perhaps needs more discussion.

This is a fair point and of course this is an assumption. However on further inspection we have no

reason to believe people would use the risk score to estimate a heart age yet choose to withhold their cholesterol or blood pressure value. The % of users who did not know their values is also similar to other published reports which add further validity to this assumption.

- In describing that "hypercholesterolaemia" is $>5\text{mmol/L}$, do they mean total cholesterol? What about other components such as HDL and LDL levels?

Only total cholesterol was requested for the tool to estimate a heart age, so the reviewer is correct that this refers to Total Cholesterol. Although LDL and HDL are not usually known to patients and are not required for estimation of the heart age, information on HDL was collected. Numerical values for this component were stored and therefore available for analysis in the last 3 months of the period covered by this paper. 15% of the 138,252 users completing the tool in this 3 months period entered a plausible value for HDL (0.5 to $<4\text{mmol/L}$). Those 21,390 users had a mean HDL of 1.9mmol/L (SD 0.8; median 1.7mmol/L ; IQR 1.1)

- Obesity is defined as a BMI $>$ or $= 30\text{kg/m}^2$ (the authors define it as $>30\text{kg/m}^2$ only).
Thank you, this has been edited

- What is the HSE survey and why was this used?

The Health Survey for England (HSE) is a series of annual surveys about the health of people living in England. The survey started in 1991 and has been carried out annually since then. The survey is used to help plan health services, look at ways of improving people's health and changes to the nation's health over time, and at inequalities in health. It gives a representative picture of people living in private households in England. <http://www.hscic.gov.uk/healthsurveyengland>

Results:

- An attrition rate of almost 59% of those who accessed the tool but did not complete the data journey is large and may have introduced selection bias into the sample.

As mentioned above, there is not really a 59% attrition rate as people may have chosen not to pursue the heart age estimate after seeing the front page and description of the study or did not have time to continue and came back at a later stage. Nonetheless, a completion rate of 41% is still considered very high for a digital health tool hosted on a health service website.

- Under "Age", it states that a third of users were aged <40 years, but the proportions of women versus men of this group does not add up to 100% (30.6% women and 32.8% men). Can this please be clarified?

We have edited the text to now read "There was an inverse trend with age and tool use, with nearly a third of users <40 years (30.6% women, 32.8% men). Two thirds of users were between the ages of 40-74 (68% women and 64.9% men), the target age for the NHS Health Checks (Figure 1), with only 1.4% of women and 2.3% of men 75 years or over."

Thus for women: $30.6 + 68.0 + 1.4 = 100$ and men: $32.8 + 64.9 + 2.3 = 100$

- "The user 5-year age profile correlates well with the England 5-year age profile from age 25 to 85 years ($R=0.95$) (ONS 2014, data not shown)" - does this refer to population data for the UK in 2014? i.e. are the authors providing evidence that the age distribution of users is representative of the population? Also, ONS should be defined.

Yes, the reviewer is correct that this refers to the population of the UK and conveying a sense of representativeness is the purpose of the statement and figure. ONS is Office for National Statistics – this has now been spelled out and a reference provided.

- Numbers of users should be provided in addition to the descriptions provided (e.g. what is the number of "people aged 30 to 60" and "older people >75 years?").

Given the large numbers, we feel that proportions are appropriate for clarity and ease of review in the main text. However for completeness we have provided the full numbers in supplementary material. If

the editorial team would like us to include these numbers in the main paper we would be happy to include these.

- The proportion of different user ethnic groups only adds up to 99.9%.

By providing only one decimal place it appears as though the numbers do not add up to 100. We have updated the text to account for this

“The majority (86.94%) of users self-reported ethnicity as white (also the default option if left blank). Of the remainder, users identified as “Other” (3.73%); “Indian” (3.33%), “Other Asian” (2.87%); “Chinese” (1.05%) and “Pakistani” (0.85%). There were substantially fewer “Black African”, “Black-Caribbean” and “Bangladeshi” users (0.62%, 0.40% and 0.21% respectively).”

- How was the Townsend score estimated?

The Townsend deprivation scores are widely used in health research, particularly in academic research in England and Wales. Please refer to the reference provided for a full description of Professor Townsend’s work – which is beyond the scope of this response.

- Did the characteristics of the users match the characteristics of population for whom data was collected in the Census that was compared when analysing the Townsend score range (i.e. is it a like-for-like comparison)?

It can of course never match exactly unless the same people were included, but broadly yes – it is based on the English population, the demographics for which are similar (but not the same) to those of tool users.

- Why was information on entered numerical values only available for a 3 month period and for only a small proportion of users completing the journey (24%)?

This data was only stored at a later stage and was due to technical issues relating to roll out of the tool.

- Are the authors stating that 94% (130,000/138,252) of users quit the journey at the cholesterol/blood pressure stage or is this 130,000 of the total number of completions?

We state “138,252 users completing the user journey” - thus by definition those who dropped did not complete the journey and are not included in that figure. The 130,000 who dropped out is in reference to the total number from the start (See Table 1).

- Again, I think numbers should be provided in addition to the proportions for completeness.

As the numbers are large we have kept to proportions. However if the editors feel this is needed for clarity we can provide these.

- Do the authors believe that the target SBP of 120mmHg for 19% of users is accurate or could users be inputting what they “know” to be the ideal SBP?

We agree this is always possible as many people are familiar with 120mmHg as being the population standard or ideal blood pressure. This is acknowledged in the limitations section.

- The authors should consider analyzing if differences between groups are statistically significant or not.

We did not identify the need for any direct statistical comparison given this is a descriptive study. If the reviewer has identified any specific comparisons that would help the message of the paper, we would be willing to run such analyses.

- Under “BMI”, the authors write that “of these, 5% were underweight” but the previous sentence reports the mean BMI. This needs rewording.

We have removed the “of these” part of the sentence

- Again obese is stated as a BMI>30 but this should be BMI > or = 30. Include units of measurement as well.

This has now been corrected and units added

- The authors should ensure that "mean" is included when describing data being compared (i.e. mean height, mean weight, mean BMI). This needs also to be clarified on the graphs.

We have edited this where identified. Specifically supplementary Figure 5 has been clarified.

- For cholesterol, it must be stated that it is mean total cholesterol that is reported (not just mean cholesterol) and again this needs to be rectified on the graphs.

We have clarified throughout the text that Total Cholesterol is being referred to as opposed to "cholesterol". We assume the reviewer is referring to supplementary figure 5, for which we have changed the figure title to again reflect that we are discussing Total Cholesterol.

- Under "cholesterol" (which should be total cholesterol), what does "proportion" refer to? The proportion of users completing the data journey? Including numbers would also add to the clarity. In addition, "population for England" should read "population of England".

We state at the beginning of the section relating to these numbers "Information on entered numerical values was available for a 3 month period (May to July) for 138,252 users completing the user journey." Thus all data from that point onwards refers to those from this 138,252 cohort. We have edited the grammatical error.

- Do the authors believe that a mean SBP of 121.4mmHg is accurate when more than 25% of the UK population has hypertension according to the NHS?

This estimate is likely for two reasons - firstly because most of the population does not have hypertension, and the majority of users of the tool were younger whereas hypertension is much more common with increasing age. Secondly, as discussed above, a substantial number entered 120mmHg as their blood pressure which may have reduced the overall mean. However neither of this alters our message that the tool is readily accessed and used by the public and that the objective of the initiative was to get people to think about their risk and get this measured rather than a survey to get a population mean blood pressure estimate.

- There appears to be discrepancies between the proportions of users reporting hypertensive SBP values and those reporting being treated for hypertension: initially, it is reported that 9.4% report SBP values >140mmHg. Then it is stated that 49% either reported a SBP >140mmHg or being treated for hypertension (i.e. 39.6% are treated hypertensives if 9.4% as stated above have SBP values >140mmHg). Then under "Other Medical Conditions", it states that 18.6% had "treated high blood pressure". What is the discrepancy and which data are correct?

We thank the reviewer for identifying this inconsistency. Of the statements, 9.4% of users did indeed enter a plausible value for SPB reported SBP values >140mmHg and of the 575,782 completing the tool, 18.6% had "treated high blood pressure". However the 49% value is incorrect and is now replaced by "Overall, 21% either reported a SBP of > 140mmHg or were treated for hypertension". We apologize for this error.

- How do the authors explain the large difference between the users self-reporting that they smoked and those reported by HSE 2013?

It is conceivable that those accessing the tool may be more health conscious and are thus less likely to be smokers. This is also reflected in the slightly lower cholesterol values. Also the survey was performed a while ago and public health trends for smoking and cholesterol have been changing with time.

- Comparisons with current population data (HSE etc) should be in the discussion not in the results section.

A key component of our results is demonstrating representativeness of those accessing the tool – thus we feel it is appropriate to include in the results section where we can present numbers and estimates rather than presenting new data in the discussion.

Discussion:

- There is discussion around the impetus of developing a public version of the JBS3 Heart Age calculator to broaden access to CVD risk assessment, to empower individuals to proactively manage their risk factors and potentially to improve NHS Health Checks programme participation". Do the authors believe this has occurred and if yes, how can this be determined?

This has not yet occurred but is being worked on actively. Members of our group are working with Public Health England to incorporate the heart age assessment and other tools within JBS3 into the national CVD strategy.

- The authors describe that the tool is "of much greater complexity". Than what? This perhaps needs to be elaborated on.

The full JBS3 tool is more complex than this modified public facing heart age tool, as described earlier.

- Where the authors suggest that "almost 80% of users reported not knowing their cholesterol level and 50% a BP level reading", was this actually reported by users or do the authors assume that there was a gap in the user's knowledge due to no data input?

As stated earlier, this is assumed due to lack of data entry and is consistent with reports from other countries.

- Following discussion of the "Know Your Numbers" campaign, there is a suggestion/assumption by the authors that individuals who don't know "their numbers" have poor risk factor profiles.

Assuming that the reviewer is referring to the very next sentence where we state that "These data point to an ongoing need to educate and empower the public to reduce their risk factor burden" – this is a general statement even for those who are healthy to be aware of their CVD risk, know their numbers and adopt and maintain a healthy lifestyle at an early stage in life before the onset of disease.

- There is conflicting discussion on blood pressure (second paragraph of page 11). The authors state that blood pressure values were very similar to the UK population survey data but then states that blood pressure values "appeared lower than expected". Which is it?

We have edited the statement to say:

"Where values were entered, height, weight and blood pressure distributions were similar to the UK population survey data, supporting the representativeness of those accessing the tool although overall total cholesterol, blood pressure values and smoking prevalence appeared to be lower than expected"

- The discussion needs to be more structured and have a clear and more comprehensive limitations section.

As a group we have given great thought to the structure of the discussion to convey this specific message and would therefore disagree with the reviewer on this point.

Other sections/figures/tables:

- References are presented in an inconsistent format (ref #7 does not have brackets around the issue; ref 8 doesn't include an issue number where the others do; ensure that references for books, media releases, data etc is consistent).

Thank you, this has been corrected and correctly formatted for BMJ style

- Under "Funding", grant numbers should be provided.

Funding details have been added

- Table 1 is not necessary to be included in the main manuscript (place in the Supplementary Material section if the authors still wish to include it for context).

We feel this table helps the reader understand the tool and user dropout at each stage. We would be happy to move it to supplementary if the editors feel this is needed.

- The title of the y axis of Figure 3B should match that of Figure 3A. Figure 3C is perhaps not needed as it is discussed in the manuscript text.

We have amended the Y axis for this figure. We felt visually figure 3C is useful for summarizing the data on knowledge gaps (with potential wider online and presentation use), but would be happy to remove it if the editors feel this should be done, as the data are discussed in the text.

- Figure 4 is quite busy. Consider if it adds to the description included in the manuscript text.

We felt this figure adds visually to the narrative that prevalence of common conditions are consistent with what would be expected, while the additional information by ethnicity adds an extra dimension of data not covered elsewhere. Again, we would be happy to move this to the supplement if the editors feel this would be helpful.

- Figure 5 could be changed to a table. It would be interesting to know the numbers of those whose heart age was equal to the users' chronological age and how many had a heart age lower than their chronological age. The age group 80-89 years is missing. The numbers only add up to 522,368 in total - where are the other 53,414 users? They aren't all in the 80-89 year category.

We feel that the information presented in figure 5, visually adds interest to the paper and the message. Given this is a report about online tools and risk communication, we feel quite strongly about presenting data visually for optimal impact. Nonetheless, we have provided the actual numbers by age group in a table that allows the reviewer to see the actual numbers.

To clarify the numbers, there were 3,825 users aged 80 to 86. A total of 49,589 did not enter their date of birth and were given an age of 30 by default. These users are excluded from Figure 5.

(- Supplementary Figure S5 - the top graph should be titled S5A not S5B).

Thank you, this has been edited

General overall comments for consideration:

- A description of the contents of the tool needs to be included. This should emphasize which data points are defaulted if not completed (and to what). It also needs to be clearer which missing data results in a heart age not being calculated and what defaulted data will still allow this calculation. Thank you, we agree this would be helpful. We have included in supplementary material the data points required for estimation of the heart age and the details regarding defaulted values.

- The most important consideration about the presented study is that:

a) it is unknown whether individuals from other countries used the tool and this research compares the data to UK population statistics;

b) users could have completed the data journey more than once and may have done so to assess different health scenarios;

c) despite missing values, a heart age was still calculated (inaccurate or missing information may lead to incorrect evaluations);

d) there is huge selection bias within the group of users - those with low health literacy, those with low computer literacy, those with low motivation to understand or change their risk profile, those with no access to the internet (most likely those of lower socio-economic status or older individuals);

- e) there is inherent problems with self-reported health data regarding accuracy;
- f) there is a potentially negative effect of the publicity which usually triggers the "worried well" to assess their health status.

These are all valid concerns and have been considered in the discussion or explicitly stated in limitations. Ultimately the message of the paper is that there is a clear desire by the public to assess their own risk using digital media, that users are those not easily accessed through traditional health pathways and that there is an important knowledge gap that could be addressed with campaigns like the NHS health checks or "know your numbers". Ultimately this paper is about the emerging opportunities afforded by digital media for health improvement for the wider population.

- Do the authors think that if a large number of users didn't "know their numbers", is it better to promote GP visits/health checks rather than invest in an online tool that may not be accurate? This is in fact the purpose – the online tool is linked to the NHS Health checks, an initiative to get people to visit their GP to get their BP and cholesterol checked. NHS England has invested a considerable amount of time and effort to promote this campaign yet only 20% of those invited have attended. This online tool was designed to broaden opportunities for the public to consider and where necessary act on their CVD health. The online tool specifically encourages people to go their GPs to obtain an NHS health check particularly when they do not know their BP or cholesterol.

VERSION 2 – REVIEW

REVIEWER	Pedro Tauler University of the Balearic Islands. Spain
REVIEW RETURNED	06-Jun-2016

GENERAL COMMENTS	All comments have been addressed and/or justified properly
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REVIEWER	Dr Jocasta Ball Mary MacKillop Institute for Health Research Australian Catholic University, Melbourne, Australia.
REVIEW RETURNED	15-Jun-2016

GENERAL COMMENTS	I thank the authors for the responses and clarifications they have provided to the points raised. I believe that this manuscript is now ready for publication.
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