

CLINICAL PRACTICE

Normal resting pulse rate ranges

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Received: April 16, 2015

Accepted: May 25, 2015

Online Published: June 2, 2015

DOI: 10.5430/jnep.v5n8p95

URL: <http://dx.doi.org/10.5430/jnep.v5n8p95>

ABSTRACT

Normal averages for various physiological measures provide a level of framework for determining where a given patient's measure falls relative to its average. In practice though, a range of normal values helps to more realistically identify those outside the average. One important measure, which is a predictor of cardiovascular and all-cause mortality, is the neurological assessment of resting heart rate. Normal averages are available for this measure by race and age categories but data for ranges are lacking. Based on published averages, the present study calculated 95% confidence intervals for resting pulse rate averages and provides a report on the ranges. Such normative data may be of interest to clinicians who use resting heart rate as an outcomes-based measure of neurological fitness.

Key Words: Heart rate, Normal range, Confidence interval

1. INTRODUCTION

Resting heart (pulse) rate (RPR) is a potentially useful measure for neurological fitness because it is: a) a neurologically-based^[1-3] and b) supported by outcomes research (which typically shows that a lower RPR is associated with better outcomes compared to a higher RPR).^[4-6] A variety of health care providers use RPR including nurses, physicians, and chiropractors. Among the reasons nurses obtain RPR data are: a) to document the patient's pulse at admission for baseline, and b) to monitor any changes in RPR that may occur.^[7] Physicians appear to use RPR less-routinely in their routine care compared to nurses, though some physicians have called for increasing its use:

“Although most doctors intuitively consider faster heart rate (HR) as an ominous prognostic sign, and take a slow HR to indicate a lesser likelihood of angina and/or a correct -blocker dosage, few manage HR as a risk factor on a par with cholesterol, blood pressure, *etc.*, checking it regularly, titrating specific treatment, and monitoring long-term response. Yet HR is simplicity itself to measure,

from the pulse or electrocardiogram, and is available at every visit.”^[8]

Chiropractors probably use RPR the least amount compared to nurses and physicians, though a similar suggestion (for increased use for RPR) has been made in chiropractic.^[9] In chiropractic, one area of focus is on chiropractic vertebral subluxation (VS). Briefly, the components of VS consist of a slight vertebral misalignment that results in a neurological disturbance. RPR, being a neurological measure, is a potentially useful measure in assessing the patient's neurological fitness. In particular, RPR may help the chiropractor determine if the patient needs a chiropractic adjustment (for the purpose of improving neurological function).^[10]

Normative RPR data for the United States, obtained from healthy individuals is available in the form of averages. These data are provided by age group (*e.g.*, 20-39), race, and gender.^[11] While it may be common knowledge that RPR varies by age and gender, it can also vary by race.^[11] A normal (healthy) average by itself does not convey what a

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normal range is, the latter being of practical importance in the field. If the patient has an RPR of 72 beats per minute (bpm), and his reference mean is 71 bpm, without knowledge of what the normal range is around the mean, the clinician (e.g., nurse, physician, or chiropractor) does not know if his patient's 72 bpm measurement is higher than a normal range. Blood pressure measurement has advanced to the point where normal ranges are available. For example, normal blood pressure = < 120 / < 80; pre-hypertension = 120-139 / 80-89, etc.^[12]

A numerical range can take the form of a confidence interval (CI), usually set at 95%. A 95% CI of, say 70-72 bpm (derived from a healthy sample) indicates that the mean value elsewhere (in other similar populations) can be expected to be between 70 and 72 bpm, 95% of the time. Thus, (assuming group averages and confidence intervals can be applied to an individual) the patient with a 72 bpm measurement would be 1 bpm higher than the average of 71 bpm for his or her reference group. However, since the reference range in this example is 70-72 bpm, the patient (with 72 bpm) may be considered to have a normal RPR. The formula for a 95% CI is:

Mean +/- (1.96 * sample standard deviation) / square root of the sample size.

CIs can be automatically calculated in software programs such as Excel.

A literature search on this topic (of heart rate ranges by age group) did not reveal any peer-reviewed journal sources. One online source, from the Cleveland Clinic provided "normal" RPR ranges – for two different age groups: a) ages 6-15 (70-100 bpm) and b) 18 and over (60-100 bpm).^[13] This information is of limited value since the RPR ranges are so wide. The wide "normal" ranges here would include, for example, females with RPR of 70-75 who have been shown to be less healthy than their counterparts with an RPR of < 64 bpm.^[14] Thus, a closer look at RPR values is warranted to more accurately determine normative data, a call that is not new.^[15] The normative ranges may be of interest to clinicians such as physicians, nurses, and chiropractors who might use RPR as a measure of neurological fitness. All three of these provider types will encounter minor fluctuations of RPR when obtaining the measurement. Thus, RPR ranges would seem to find application for these providers, even when they may have different objectives and purposes in obtaining RPR.

2. METHODS

The 95% CIs were calculated and tabulated according to age, gender and race using published normative data for the U.S.

population.^[11] These data report means and standard error (SE). Since CIs use standard deviations (SD) for their calculation, as noted above, SEs were converted to SDs, using the following equation: SD = square root (n) * SE. CIs were then calculated in Excel 2010 (Microsoft Corp., Redmond, WA) for each of the following cohorts provided in the aforementioned published normative data: White females, white males, black females, black males, Mexican females, Mexican males. Each cohort had 12 age categories, as follows: <1, 1, 2-3, 4-5, 6-8, 9-11, 12-15, 16-19, 20-39, 40-59, 60-79, and 80+. Thus, the means (which are already reported^[11]) and the CIs (new addition by the author) are reported by cohort and age group. The age groups were already categorized by the source used.^[11]

3. RESULTS

Table 1 provides the means and CIs by cohort (by gender and race) and age group. The width of the CIs varies by cohort and age group. The younger and older age groups tend to have wider CIs. For example, for Mexican females, age group < 1 years old CI = 126-132; ages 9-11 CI = 85-87 and then relatively wide again toward the end, 70-80 for 80+ year olds. This pattern of widths (wider at younger years, more narrow in the mid years, and then wide again toward the end of life) is typical for the other cohorts as well.

Many of the CIs do not overlap within their cohort with neighboring age groups. This indicates that the differences between the means for the age groups are statistically significant. As an example, the CIs for black males ages 6-8 versus 9-11 have non-overlapping CIs: 82-84 bpm for ages 6-8 versus 77-79 bpm for ages 9-11.

4. DISCUSSION

This study provides normative data on ranges for resting pulse rate. Prior to this study, ranges were available but only in a crude (wide) way, and not by cohort and age group like this study provides. These data may be of interest to clinicians using RPR as a method of monitoring neurological progress of the patient, whether the clinician is a physician, nurse, or chiropractor. All three of these provider types use RPR to some extent. When used, RPR will undoubtedly vary from day to day in many cases. This variation however, may be normal and within a range based on a normal (healthy) population as the present study is based on. Table 1 in this paper may be a useful guide for the various patients that present for care. Practical application of these findings is as follows. As an example, if a black female age 25 presents with an RPR of 74 or lower, or 78 or higher, then she would be outside the normal range for her group (see Table 1). In the case of 74 or lower, she would be outside her range in a

good way, in that lower RPR is considered healthier than a higher RPR. Conversely, in the case of 78 or higher for her would suggest she has neurological stress.

It seems reasonable that a clinical judgment could be made regarding an RPR that changes in a particular direction in the short-term. As an example, the patient whose RPR decreases

from 71 to 70, just days apart, has an RPR that is changing in the right (healthier) direction. Of course such a change assumes the RPR measurements were accurate and valid. A recent study took an initial step to investigate the clinical significance of short-term RPR change and is scheduled to be published in June 2015.^[16]

Table 1. Mean (from reference 11) and 95% confidence interval (CI) by cohort (gender and race) and age group. LL = lower limit, UL = upper limit. CIs (LL and UL) are rounded up or down as appropriate to zero number of decimal places.

Age	White females			White males			Black females			Black males			Mexican females			Mexican males		
	M	LL	UL	M	LL	UL	M	LL	UL	M	LL	UL	M	LL	UL	M	LL	UL
<1	131	128	134	128	125	131	130	127	133	129	126	132	129	126	132	128	126	130
1	120	118	122	117	115	119	117	115	119	115	113	117	119	116	122	117	115	119
2 to 3	109	107	111	106	105	107	107	106	108	103	101	105	107	106	108	104	103	105
4 to 5	97	95	99	94	92	96	95	93	97	92	90	94	97	96	98	95	93	97
6 to 8	89	88	90	86	85	87	87	86	88	83	82	84	88	86	90	87	86	88
9 to 11	86	85	87	80	79	81	82	80	84	78	77	79	86	85	87	82	81	83
12 to 15	81	80	82	78	77	79	78	77	79	72	71	73	79	78	80	76	75	77
16-19	79	78	80	73	72	74	77	76	78	67	66	68	77	76	78	72	71	73
20-39	76	75	77	71	70	72	76	75	77	69	68	70	75	74	76	70	69	71
40-59	73	72	74	71	70	72	74	73	75	70	69	71	73	72	74	70	69	71
60-79	73	72	74	69	68	70	74	72	76	72	70	74	73	72	74	70	69	71
80+	73	71	75	71	69	73	72	67	77	68	63	73	75	70	80	66	61	71

Limitations to the present study are that the sample it is based on:^[11] a) does not include a comparison group, *e.g.*, unhealthy persons, to see if there was a difference in RPR between healthy and unhealthy persons. However, other studies indicate that persons at greater risk of an adverse clinical outcome do indeed tend to have different (higher) RPRs compared to their healthier counterparts;^[4-6] b) applies to RPR that is obtained with the methodology used in the reference data (*e.g.*, RPR in the seated position preceded by 4 minutes of seated rest); and c) is from the U.S. On this latter limitation, the author is not aware of substantive differences that might exist between same races from different countries. Thus, the results may be generalize-able to same races in other countries.

A benefit of the study is that the results may be of interest to clinicians who might use RPR to assess their patients' neurological fitness. In particular, these results will provide a framework for determining whether a given RPR falls within a normal range according to a reference group, based on age, race, and gender. This determination may assist the clinician

in deciding whether the patient needs a health care intervention. Another method of RPR interpretation could be to have the individual patient serve as his or her own "control", observing trends in RPR. For example, the patient with an initially low (healthy) RPR that steadily increases over consecutive visits may end up with a neurological disturbance (evidenced by the steady increase in RPR).

5. CONCLUSION

The normal resting pulse rate ranges provided in this report may be of interest to clinicians using resting pulse rate as an indicator for neurological fitness. Such application will help to more realistically identify pulse rates that are lower or higher than average according to the patient's age, gender, and race. Further research is indicated that includes other races, as well as comparisons to groups that are considered to be unhealthy.

CONFLICTS OF INTEREST DISCLOSURE

The author declares that there is no conflict of interest statement.

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