

Blood pressures in subjects for life assurance medical examination and the effect of ten minutes recumbent rest

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ABSTRACT

Background: The prevalence of hypertension in a population is the sum of those individuals with a blood pressure (BP) exceeding 140/90 mm Hg plus those with normal BP on antihypertensive therapy (this is usually about 20–30% of the population). Rest normally reduces BP but the frequency and extent of the fall remains unclear.

Methods: This study analysed the results of 1,008 consecutive life assurance examinations in which BP was recorded twice, before and after a ten minute period of recumbent rest.

Results: Two hundred and twelve subjects had initial BPs of more than 140/90 mm Hg (21%). When all those receiving antihypertensive treatment but with normal BPs were included, this was 26.5%. Of the 212 subjects, BP was at a normal level in 147 (69%) after ten minutes at rest.

Conclusion: BP measurement after a ten minute period of standardised rest could more accurately identify true hypertension.

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INTRODUCTION

Blood pressures (BPs) recorded at the time of life assurance medical examinations provide an opportunity to assess normal levels in a generally healthy population. Normal BP can be defined as 140/90 millimetres of mercury (mm Hg) or less; with 24-hour ambulatory monitoring, 135/85 mm Hg is the threshold and between 130/85 and 135/85 mm Hg is regarded as the average daytime level.¹ For 'office' BPs (taken during a standard appointment) it is recommended that the true BP level should be based on three separate visits and that a sufficient interval is allowed each time for the BP level to become stable: five minutes is suggested with the subject sitting.² The subjects' position, whether sitting or recumbent during the rest period is not regarded as critical.^{3,4}

The prevalence of hypertension in a population is conventionally estimated by adding those subjects with initial BPs of more than 140/90 mm Hg to those with normal BPs on antihypertensive therapy. It is estimated globally as 13.5% of the population.⁵ Larger proportions (between 20% and 30%) have been found in the USA, Canada and the UK and higher still with subjects of Afro-Caribbean and Asian origin.^{6–10}

Life assurance companies normally request a single BP reading from applicants for life cover and unless the reading exceeds 140/90 mm Hg it is not repeated. When the BP level is more than 140/90 mm Hg

insurers request two further recordings, after intervals of five and ten minutes, with the subject at rest. Most life assurance companies will accept a BP of 140/90 mm Hg or less after ten minutes rest as being normal. However, the proportion whose BP is initially above 140/90 mm Hg and who reach non-hypertensive levels is not clear.

In a previous study, BP levels in 640 subjects at life assurance medical examination were reviewed.¹¹ In 23% of cases the initial BP was more than 140/90 mm Hg. In about 70% of these the BP fell to less than 140/90 mm Hg after ten minutes rest. This study analysed subjects seen before 1997, none of whom are included in the current study. In a later study we looked at BPs in another 342 life assurance applicants and found that ten minutes rest (after the first BP reading) resulted in a significant fall in the systolic or mean BP in 84% of subjects (unpublished results). The current study was undertaken to record initial and ten minute BPs in every case and includes the 342 subjects mentioned above.

We compared our results against both the life assurance companies' normal maximum value of 140/90 mm Hg and with the accepted daytime ambulatory level (135/85 mm Hg).¹²

SUBJECTS AND METHODS

Subjects

During the period 1997–2010 1,021 applicants for life assurance policies had their BP taken. Blood pressures were recorded twice, with the second reading taken after ten minutes recumbent rest. Thirteen subjects were rejected, leaving 1,008 for analysis. Of these 13 subjects, in eight BP was not recorded at ten minutes and five were known to be pregnant and were therefore omitted due to the uncertain effect of pregnancy on BP.

Our analysis is therefore based on 1,008 subjects. The majority (936) were Caucasians. Of the 72 individuals of alternative ethnic origin, 62 were from the Indian subcontinent, five were Chinese or Indonesian and five were from Africa or the West Indies. One hundred and five subjects were receiving antihypertensive therapy. Full details of the 1,008 subjects are shown in Table 1.

Methods

Subjects were reassured about the procedure as much as possible. All subjects were sent a preliminary letter containing practical and procedural information. On

arrival at the consulting office the subjects spent between five and ten minutes in the waiting room. The temperature of the premises was always 21°C (70°F) or above.

Blood pressure recording: Blood pressures were taken with a mercury sphygmomanometer and a standard cuff with a bladder measuring 14 cm x 24 cm. If the subjects had thick upper arms a larger cuff with a bladder measuring 15 cm x 27 cm was used. The aim was to allow the bladder to encircle 80% of the upper arm and two-thirds of its length.²

Blood pressures were taken with the subjects recumbent and measurements were to the nearest 5 mm Hg. Two measurements were taken from the right arm, first at the end of the physical examination and then ten minutes later. A third reading was taken from the left arm to ensure there was no gross difference between sides (all differences were less than 5 mm Hg).

Statistical analysis: Differences in BP between males and females were assessed using the two-sample t-test. Initial and ten minute BPs were compared with the paired t-test. Pearson correlations were used to describe the relationship between age and BP.

TABLE 1 Age distribution by ethnicity and gender

Ethnicity and gender	Age (years)				
	Number	Mean	Standard deviation	Minimum	Maximum
All cases	1,008	46.3	10.5	23	82
Male	787	46.4	10.2	23	82
Female	221	45.9	11.6	23	78
Caucasian	936	46.6	10.6	23	82
Male	736	46.6	10.3	23	82
Female	200	46.4	11.6	23	78
Non-Caucasian	72	42.4	9.2	26	76
Male	51	42.6	8.2	26	65
Female	21	41.3	11.5	26	76
From Indian subcontinent	62	42.3	9.0	26	76
Male	47	42.6	8.3	26	65
Female	15	41.5	11.3	29	76
African or West Indian	5	42.6	11.5	31	62
Male	2	39.5	0.7	39	40
Female	3	44.7	15.8	31	62
Chinese or Indonesian	5	42.8	11.4	26	53
Male	2	51.5	2.1	50	53
Female	3	37.0	11.5	26	49

RESULTS

Age, ethnicity and gender details are in Table 1. The main results are analysed in Tables 2–4. We have compared our BP levels both with the life assurance companies' normal maximum value (140/90 mm Hg) and with the accepted daytime ambulatory level (135/85 mm Hg).

Initial blood pressures: From the cohort of 1,008 subjects, 796 (79%) had initial BPs equal to, or less than, 140/90 mm Hg; 212 (21%) had BPs exceeding that level. Further analysis showed that 105 (10.4%) were on antihypertensive therapy and 903 (89.6%) were not.

Mean systolic and diastolic BPs for the above groups are given in Table 2 together with 95% confidence intervals. The mean initial systolic and diastolic BPs for all subjects were 131.3 mm Hg and 79.1 mm Hg. For those on antihypertensive medication these levels were 142.4 mm Hg and 85.3 mm Hg and for those not on antihypertensive treatment, 130.0 mm Hg and 78.4 mm Hg, respectively. The BP levels are analysed by gender in Table 3. Initial systolic and diastolic BPs were higher in males compared to females by 8.0 and 5.4 mm Hg, respectively; both differences were highly significant ($p < 0.001$).

The effect of ten minutes rest on blood pressure: In subjects with an initial BP of greater than 140/90 mm Hg, 147 (69.3%) of them fell to less than 140/90 mm Hg after ten minutes rest, and 73 (34.4%) to 135/85 mm Hg

or less; in those whose initial BP was equal to or less than 140/90 mm Hg, 770 (96.7%) were equal to or less than 135/85 mm Hg after ten minutes rest.

In those subjects with initial BPs of equal to or less than 140/90 mm Hg, 99.9% remained at or below 140/90 mm Hg after ten minutes (0.1%). The reason for this was not clear. Mean changes in systolic and diastolic BPs after ten minutes rest were highly significant ($p < 0.001$) and overall, subjects had a mean percentage reduction of 4.9% in systolic BP and 4.3% in diastolic BP (Table 2).

Effects of antihypertensive therapy: Subjects on antihypertensive medication (105) showed systolic and diastolic BP reductions after ten minutes rest of 6.7% and 4.7% respectively, whereas those not receiving this treatment showed reductions of 4.7% and 4.3% respectively (Table 2).

The prevalence of hypertension: Initial BP readings showed that 212 (21%) of the 1,008 subjects had levels greater than 140/90 mm Hg. Fifty of these were receiving antihypertensive treatment, but a further 55 on antihypertensive therapy had initial BPs of 140/90 mm Hg or less. The antihypertensive medications that the 105 subjects were taking are shown in Table 4. The accepted way of estimating the degree of hypertension in a population is to add those with initial BPs of more

TABLE 2 Blood pressure details for 1,008 subjects including those on and not on antihypertensive medication

Subjects	Systolic blood pressure (mm Hg)			Diastolic blood pressure (mm Hg)		
	Mean	95% confidence interval	p value*	Mean	95% confidence interval	Mean
All subjects (1,008)						
Initial blood pressure	131.3	130.3 to 132.2		79.1	78.5 to 79.7	
10 minute blood pressure	124.5	123.7 to 125.2		75.6	75.0 to 76.1	
Change in blood pressure	-6.8	-7.3 to -6.4	<0.001	-3.5	-3.8 to -3.3	<0.001
Change in blood pressure (%)	-4.9	-5.2 to -4.6	<0.001	-4.3	-4.6 to -4.0	<0.001
Subjects on antihypertensive medication (105)						
Initial blood pressure	142.4	139.6 to 145.2		85.3	83.7 to 86.9	
10 minute blood pressure	132.4	130.0 to 134.6		81.1	79.6 to 82.6	
Change in blood pressure	-10.0	-11.8 to -8.2	<0.001	-4.2	-5.2 to -3.2	<0.001
Per cent change in blood pressure (%)	-6.7	-7.8 to -5.5	<0.001	-4.7	-5.8 to -3.6	<0.001
Subjects not on antihypertensive medication (903)						
Initial blood pressure	130.0	129.0 to 131.0		78.4	77.6 to 79.0	
10 minute blood pressure	123.5	122.7 to 124.4		74.9	74.4 to 75.5	
Change in blood pressure	-6.5	-6.9 to -6.0	<0.001	-3.5	-3.7 to -3.2	<0.001
Per cent change in blood pressure (%)	-4.7	-5.0 to -4.4	<0.001	-4.3	-4.6 to -3.9	<0.001

*p values from Student's t-test

TABLE 3 Blood pressure levels in subjects by gender

Subjects	Blood pressures >140/90 mm Hg		Blood pressures ≤140/90 mm Hg		Blood pressures ≤135/85 mm Hg	
	Number	Per cent	Number	Per cent	Number	Per cent
Male (787)						
Initial blood pressure	181	23.0	606	77.0	500	63.5
10 minute blood pressure	58	7.4	729	92.6	640	81.3
Female (221)						
Initial blood pressure	31	14.0	190	86.0	177	80.1
10 minute blood pressure	8	3.6	213	96.4	203	91.9

TABLE 4 Antihypertensive therapy in 105 subjects on medication

Subjects on one medication	No.
ACE inhibitor	25
Beta blocker	18
Diuretic	7
Angiotensin 2 blocker	7
Ca channel blocker	5
Alpha blocker	3
Unspecified (subject did not know)	1
Subjects on two medications	
ACE inhibitor + beta blocker	7
Diuretic + beta blocker	5
Diuretic + ACE inhibitor	4
Diuretic + angiotensin 2 blocker	3
Diuretic + alpha blocker	2
ACE inhibitor + alpha blocker	2
ACE inhibitor + Ca channel blocker	2
Angiotensin 2 blocker + alpha blocker	1
Angiotensin 2 blocker + Ca channel blocker	1
Alpha blocker + Ca channel blocker	1
Beta blocker + Ca channel blocker	1
Diuretic + Ca channel blocker	1
Subjects on three medications	
Diuretic + beta blocker + ACE inhibitor	1
Diuretic + ACE inhibitor + Ca channel blocker	1
Diuretic + aldosterone inhibitor + vasodilator	1
Diuretic + beta blocker + alpha blocker	1
ACE inhibitor + beta blocker + Ca channel blocker	1
ACE inhibitor + alpha blocker + Ca channel blocker	1
Subjects on four medications	
Diuretic + beta blocker + ACE inhibitor + Ca channel blocker	3

than 140/90 mm Hg to those with normal BPs on antihypertensive therapy. In our study, this gives 267 subjects, which is 26.5% of the cohort.

The effect of ten minutes rest on blood pressure:

Two hundred and twelve of our subjects had initial BPs of more than 140/90 mm Hg and in 147 of these, BP fell to 140/90 mm Hg or less after ten minutes. One subject with a normal initial BP had a BP greater than 140/90 mm Hg after ten minutes rest. In total, 66 subjects (6.5%) had raised BP after ten minutes rest.

Age and blood pressure: We found that BP tended to rise with increasing age. Pearson correlations with initial systolic and diastolic BPs and with the ten minute levels showed values which were all highly significant ($p < 0.001$). However, the actual correlation coefficients were quite low, ranging from 0.23 to 0.28.

Patterns of blood pressure: Of the 212 subjects with initial BPs of more than 140/90 mm Hg, 152 (71.7%) had isolated systolic hypertension and 59 (27.8%) had both systolic and diastolic hypertension. There was only one example of isolated diastolic hypertension. The effect of ten minutes recumbent rest on the whole series resulted in BPs of 140/90 mm Hg or less in 93.5% and 135/85 mm Hg or less in 83.6% of all subjects.

Ethnicity and blood pressure: There were 72 (7.1%) non-Caucasian subjects in our series. Of these, only six (8.3%) had initial BPs of greater than 140/90 mm Hg (Table 5).

Sixty-two subjects were from the Indian sub-continent and six (9.7%) of these had initial BPs of greater than 140/90 mm Hg. Of the five subjects of native African or West Indian origin and five of Chinese or Indonesian origin, none had initial BPs greater than 140/90 mm Hg. The effect of rest on the BPs of the initially hypertensive subjects of Indian ethnic origin are shown in Table 5. In two cases (33%) the BP did not fall to a non-hypertensive level, a roughly similar proportion to the whole series.

TABLE 5 Initially hypertensive non-Caucasian subjects

Gender	Age (years)	Initial blood pressure (mm Hg)	10 minute blood pressure (mm Hg)	Ethnic origin
Male	45	155/100	135/90	Indian
Male*	45	170/100	135/85	Indian
Male	42	145/85	145/85	Indian
Male	45	160/100	140/90	Indian
Male	65	150/90	145/85	Indian (born in Kenya)
Male	56	145/80	135/80	Indian

*on antihypertensive medication

DISCUSSION

The purpose of this study was to show the frequency and degree of lowering of BP achievable with ten minutes recumbent rest, the beneficial effect of which is well known in life assurance companies.

Although most BPs are usually recorded with the subject sitting, we used the recumbent posture as this was better suited to the conditions of medical examination. There is little evidence that BP readings are significantly affected by change of posture from sitting to lying but the topic is still controversial.^{3,4,12,13}

Normal BP on a single or repeated initial 'office' reading is usually accepted as 140/90 mm Hg or less. Recently it has been suggested that there is an element of pre-hypertension in subjects with BP levels between 120/80 mm Hg and 139/89 mm Hg.¹⁴ This is a controversial concept and prompts the question, 'Are we all hypertensive now?'.¹⁵

We have shown that about a fifth (212) of the 1,008 subjects in our study had initial BPs greater than 140/90 mm Hg and that, of those, approximately 70% fell to 140/90 mm Hg or less with ten minutes rest; about one-third fell to 135/85 mm Hg or less, levels regarded as normal for daytime BPs taken by continuous ambulatory monitoring. In other words, only 6.4% of the hypertensive subjects were still considered hypertensive after ten minutes rest and in roughly half of these, the BP was equal to or less than 135/85 mm Hg. In those whose BP was initially equal to or less than 140/90 mm Hg, nearly 97% were at 135/85 mm Hg or less after ten minutes rest.

The accepted method of measuring the proportion of hypertensive people in a population is to assume that all those on antihypertensive therapy are truly hypertensive. The number of subjects with initial BPs of more than 140/90 mm Hg and those with normal BPs on antihypertensive treatment in our study make up 26.5% of the cohort. Our data on initial BPs agree with other findings, supporting a prevalence of hypertension in

between 20–30% of the population.^{5–10} However, when those subjects with raised initial BPs which fell to normal are eliminated, the prevalence is reduced to 15.5%.

Kaplan and Victor¹⁶ point out that even if advice on taking BP is followed, almost all the data on the risks of hypertension are based on only one or a few 'office' readings in large groups of people.

The National Institute for Health and Clinical Excellence (NICE) has recently published new draft guidelines for diagnosing and treating high BP.¹⁷ They recommend that 24-hour ambulatory BP monitoring (ABPM) or home BP monitoring (HPBM) should be offered to all those whose readings are more than 140/90 mm Hg and they should be offered antihypertensive treatment if they have target organ damage. However, they accept that not all patients with two readings of more than 140/90 mm Hg are truly hypertensive.

Blood pressure taken after ten minutes rest is much more likely to represent a subject's true BP level compared with the initial readings. Therefore we consider that a diagnosis of hypertension should not be made unless the BP remains raised after a full ten minutes rest in a physically and psychologically comfortable environment.

CONCLUSION

Surveys indicate that about 30% of the population are hypertensive (>140/90 mm Hg) based on an initial reading. When medically examining candidates for life assurance policies, ten minutes recumbent rest significantly reduces the number showing hypertension, by about two-thirds. Many with initial BPs of less than 140/90 mm Hg also show a significant reduction.

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