

1 **Whole blood donors' post-donation symptoms diminish quickly but are discouraging: results from**
2 **6-day symptom diaries.**

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26 Running head: Whole blood donor's 6-day symptom diary

27

1 **Abstract**

2 *Background:* Whole blood donors may experience post-donation symptoms such as fatigue, dizziness
3 or headache after blood donation, which could influence donor retention. We aimed to examine post-
4 donation symptoms during one week after whole blood donation, investigate donor characteristics
5 associated with symptoms and evaluate associations between symptoms and donor return.

6 *Methods:* During one week, whole blood donors who donated successfully at one of the collection
7 centres in the Netherlands were invited to participate. 3076 Donors filled in a diary, assessing post-
8 donation symptoms during day 1 to 6 after donation. We used linear mixed models analyses to
9 determine the change in post-donation symptoms after donation for male and female donors
10 separately. Furthermore, we investigated associations between post-donation symptoms and donors'
11 physical characteristics using multivariable regression and determined associations between
12 symptoms and donor return.

13 *Results:* Donors reported fatigue as the most common symptom, with approximately 3% of donors
14 experiencing severe problems at the first day after donation. Multiple symptoms improved
15 significantly up to day 3 after whole blood donation. Age, BMI, blood pressure (male donors) and blood
16 volume (female donors) were significantly associated with post-donation symptoms. Donors with less
17 fatigue after whole blood donation were more likely to return for their next donation within 31 days
18 after receiving an invitation.

19 *Conclusion:* Post-symptoms improve up to three days after whole blood donation. Our results may help
20 blood collection centres to identify donors more prone to post-donation symptoms and provide
21 personalized information about the presence and course of post-donation symptoms, possibly
22 increasing donor return rates.

23

24 **Keywords:** whole blood donor, post-donation symptoms, blood donation, diary, donor return.

1 Introduction

2 To protect the quality of blood products and safeguard the health of blood donors, assessing the
3 suitability of whole blood donors is a rigorous process.[1] Nonetheless, a whole blood donation may
4 affect donors' health and donors may experience adverse events such as vasovagal reactions, nerve
5 injuries or bruises after whole blood donation.[2] Although multiple studies have investigated adverse
6 events and donors' wellbeing, knowledge is mainly based on on-site observations.[2-4] Post-donation
7 symptoms such as weakness, dizziness or fatigue have received less attention, while these may be
8 experienced for multiple days after a whole blood donation.[3, 5] This study therefore adds to the
9 literature by focusing on the days following donation to map the immediate natural history of
10 symptom progression and change.

11 A 500 mL whole blood donation might be beneficial for some donors while harming others.[6, 7]
12 Donating whole blood is known to induce iron loss, possibly leading to iron deficiency-related
13 symptoms such as fatigue.[8] Furthermore, a loss of blood volume may temporarily reduce blood
14 pressure but increases the risk of a vasovagal reaction.[9, 10] In addition, higher body mass index has
15 been found to be associated with less post-donation symptoms.[11] Previous research has shown that
16 negative symptoms such as fatigue and dizziness may be more common in women than men.[7, 11,
17 12] Negative post-donation symptoms may result in a higher risk of donors ceasing to donate whole
18 blood.[13, 14] However, donors may experience positive post-donation symptoms, increasing the
19 probability of returning for their next donation.[15] These positive symptoms can include increased
20 energy or wellbeing [6] or a sense of emotional gain from having made a blood donation, referred to
21 as warm glow (i.e. *"helping because it makes you feel good"*).[15, 16]

22 Blood collection centres may advise donors to avoid strenuous physical activities for at least 48 hours
23 after a whole blood donation.[17] However, literature on the timing and duration of post-donation
24 symptoms in the days after a whole blood donation is limited. A meta-analysis on the effects of blood
25 donation on endurance exercise showed that maximal oxygen uptake and exercise capacity was

1 reduced in the first two days after a whole blood donation.[18] Furthermore, data from post-donation
2 interviews of whole blood donors showed that post-donation symptoms such as fatigue may be best
3 detected one to three days after donation.[19]

4 More information on donors' experiences of post-donation symptoms in the week after donation
5 enables to better inform donors about the presence and course of these symptoms in the days after a
6 whole blood donation. Furthermore, knowledge on associations between donor characteristics and
7 symptoms provides potential for personalized medicine and the development of targeted
8 interventions in a more specific rather than generic fashion. When blood collection centres are able to
9 provide more accurate information about post-donation symptoms or develop an appropriate
10 intervention to diminish post-donation symptoms, donors may be less likely to stop donating due to
11 symptoms. Therefore, we investigated the presence and course of possible post-donation symptoms
12 and the association with donor characteristics. Finally, we assessed whether post-donation symptoms
13 were associated with donor return.

14

15 **Methods**

16 *Setting*

17 In the Netherlands, Sanquin is the only organisation authorized to collect and distribute blood
18 products. Sanquin's blood collection centres are distributed throughout the country, with fifty fixed
19 collection centres and multiple mobile collection centres. When eligible, men are allowed to donate a
20 maximum of 5 times/year and women a maximum of 3 times/year. The total volume drawn during a
21 whole blood donation is 500 mL. Sanquin's current guidelines for donor eligibility include Hb cut-offs
22 of ≥ 8.4 mmol/L for men and ≥ 7.8 mmol/L for women, which is in accordance with international
23 guidelines and European legislation.[20] Donors with low Hb (measured prior to donating in capillary
24 blood with HemoCue 201, Angelholm, Sweden) are deferred from donating for 3 months. All donations
25 are voluntary and non-remunerated. Before every donation, blood donors are asked for consent for

1 their information and leftover material of their donation to be used for medical scientific research
2 purposes and improving the quality of blood supply.

3

4 *Study population*

5 All donors making a whole blood donation at one of the fixed blood collection centres during a pre-
6 selected week in February 2019 were asked to participate in this study. This week corresponded to
7 one of the measurement time points of the FIND'EM study,[21] where both new (i.e. a donor
8 undergoing pre-donation screening) and repeat donors (i.e. a donor making a whole blood donation
9 or attempt) were asked to fill in a questionnaire assessing physical and mental wellbeing and iron
10 deficiency- and donation-related symptoms. Detailed information about participant enrolment can be
11 found elsewhere.[21] For the current study, whole blood donors with a successful donation were asked
12 to fill in a diary assessing post-donation symptoms. New whole blood donors were not eligible for the
13 current study as they first undergo a screening procedure and are not allowed to donate whole blood
14 during their first visit. Sanquin's Ethical Advisory Board has approved the study protocol and
15 considered the study not to fall within the scope of the Medical Research Involving Human Subjects
16 Act. All participating donors provided their written informed consent.

17

18 *Data collection*

19 To determine the severity of post-donation symptoms, donors were asked to fill in a 6-day paper and
20 pencil diary assessing post-donation symptoms during day 1 to day 6 after donation. After completion
21 of the diary, donors were asked to send the diary to the research team using a prepaid return envelope.
22 The diary contained the symptoms: fatigue, dizziness, discomfort and headache, scored on a 5-point
23 Likert-type scale from 1 = 'I experience no problems' to 5 = 'I experience many problems', and energy
24 level, quality of sleep and general health, scored from 1 = 'very bad' to 5 = 'excellent' (supplementary

1 file). These symptoms correspond to pre- and post-donation symptoms reported by donors in previous
2 studies.[6, 11] We refer to a score of 'many problems' or 'very bad' as severe symptoms and we
3 reported the percentage of donors experiencing severe symptoms. The diary also contained three
4 questions regarding warm glow (i.e. 'Recalling your past donation; 1. Do you feel good about yourself,
5 2. Do you feel emotionally positive about yourself and 3. Do you have a warm feeling inside'), which
6 could be scored on a 7-point Likert scale from 'Very strongly disagree' to 'Very strongly agree'. The
7 items covering feelings of warm glow were highly correlated (Cronbach's alpha 0.78), and therefore
8 calculated into a sum score from the responses to the three items, representing one total score for
9 feelings of warm glow, per day. A Microsoft Access Database (Microsoft office 2013) was designed to
10 enter the responses of all participants. A research assistant entered the responses and randomly
11 checked the entered data of approximately 10% of the diaries.

12 Pseudo-anonymized data on sex, date of birth, haemoglobin levels, height, weight, blood pressure and
13 donor return were extracted from the donor database (eProgesa software application; MAK-SYSTEM).
14 We calculated age at the time of donation from date of birth and body mass index (BMI, kg/m^2) using
15 height (m) and weight (kg). Haemoglobin (mmol/L) in capillary blood obtained with a finger stick
16 (Hemocue AB, Ängelholm, Sweden) and blood pressure (mmHg; Omron Hem-907XL, Lake Forest, IL,
17 USA) were measured prior to the whole blood donation. Blood volume was calculated using a sex-
18 specific formula (men: $0.3669 \times (\text{height})^3 + (0.03219 \times \text{weight}) + 0.6041$; women: $0.3561 \times (\text{height})^3 +$
19 $(0.03308 \times \text{weight}) + 0.1833$).[22] Female donors aged <45 years were considered pre-menopausal.
20 Donor return was determined for donors who received an invitation within 12 months after data
21 collection. Donors with a donation attempt within 31 days after receiving an invitation for their next
22 donation were considered returned. Donors who switched from donating whole blood to another
23 donation type, such as plasma, were also considered returned. Donor return was missing for donors
24 who did not receive an invitation within 12 months.

25

1 *Data analysis*

2 Descriptive statistics are presented (mean and standard deviation; SD or median and interquartile
3 range; IQR) for all eligible donors and for those who filled in a diary. We used linear mixed model
4 analyses to investigate changes in post-donation symptoms between subsequent days. Separate
5 regression analyses were performed for the symptoms fatigue, dizziness, discomfort, headache,
6 energy level, quality of sleep, general health and warm glow. We also performed linear mixed model
7 analyses to assess associations between donor characteristics and changes in post-donation symptoms
8 by adding donor characteristics to the linear mixed models described above. Continuous variables (i.e.
9 age, haemoglobin levels, BMI, blood volume and blood pressure) were centered by subtracting the
10 mean score from the individual score, allowing easy interpretation of coefficients. A final multivariable
11 mixed model was selected after a backward selection procedure for each of the symptoms.
12 Coefficients of donor characteristics with the highest p-value were removed from the model one by
13 one and coefficients with a p value of ≤ 0.05 remained in the final model. All mixed model analyses
14 included a random intercept to take into account the correlated observations within the donor.

15 Finally, we investigated the association between post-donation symptoms and feelings of warm glow
16 with donor return using logistic generalized estimating equations (GEE). Again, a backward selection
17 procedure was performed and only post-donation symptoms and/or the variable representing the
18 total score for feelings of warm glow, with a p value of ≤ 0.05 , remained in the final model. Regression
19 coefficients (β) with 95% confidence intervals (CI) were reported for each final model.

20 The moderator effect of sex was investigated by adding interaction terms to all models. Due significant
21 interactions, results were reported for male and female donors separately.

22

23 **Results**

24 *Data collection*

1 During the pre-selected week in February 2019, 6723 whole blood donors visited one of the fixed blood
2 collection centres. Of these, 644 donors were deferred from donating due to low haemoglobin levels,
3 a visit to a non-European country in the preceding four weeks, the risk of an infectious disease or other
4 medical reasons. Another 141 donors were not invited to participate, as the volume drawn during
5 blood donation was below 450 mL. A total of 5938 donors were eligible for the present study, of which
6 5582 were invited (94% of eligible donors) and 5061 provided consent (85% of eligible donors) to
7 participate. Reasons for not participating were: not interested (n=22), holiday (n=23), participation
8 takes too much time (n=57), timing of participation (n=17), no knowledge of the Dutch language (n=4),
9 privacy reasons (n=6), other (n=10). A total of 382 donors did not specify the reason for non-
10 participation. Finally, we received 3076 diaries (52% of eligible donors) that were entered into our
11 Microsoft Access Database. In 136 diaries, one or more responses were missing with an average of
12 nine (IQR 1 – 16) missing responses in these diaries. We randomly checked the entered data of 357
13 diaries (12%) and in 11 cases, one of the responses was entered incorrectly. As one diary consisted of
14 60 responses, the error rate of data entry was 0.05.

15

16 *Study population*

17 Donor characteristics are presented in Table 1. In short, 53% of participating donors were female,
18 median age was 52 (IQR 37 – 61) years for male participants and 44 (IQR 27 – 55) for female
19 participants. Male donors had an average BMI of 26 (SD 3) kg/m² and female donors 25 (SD 4) kg/m².
20 Average haemoglobin level was 9.26 (SD 0.59) mmol/L for males and 8.47 (SD 0.50) mmol/L for
21 females. The average number of donations in the past 2 years was six for male donors and four for
22 female donors. The median time since the donors' previous whole blood donation was 91 (71 – 161)
23 days for men and 153 (132 – 220) days for women. Overall, characteristics of participants correspond
24 to characteristics of eligible donors (Table 1). For both male and female donors, participants were more
25 likely to return for their next donation within 31 days after receiving an invitation compared to eligible

1 donors. Of participating donors, 30 donors switched to another donation type, 65 donors were
2 deferred for > 12 months and 16 donors did not receive an invitation due to unknown reasons. Ten
3 donors who were deferred for > 12 months stopped donating due to medical reasons, stopping was
4 requested by the donors themselves in only four cases.

5

6 *Post-donation symptoms in whole blood donors*

7 Mean scores for each individual symptom during day 1 to day 6 after donation are presented in Figure
8 1 for male and female donors separately. During day 1 to day 6 after whole blood donation, 7% of male
9 donors and 16% of female donors reported severe symptoms. On the first day after a whole blood
10 donation, fatigue was the most commonly reported symptom, with approximately 3% of donors (n=82)
11 experiencing severe fatigue. Severe headaches (n=39), low energy level (n=38) or poor quality of sleep
12 (n=26) were reported by approximately 1% of donors at day 1. Severe dizziness (n=19) was reported
13 by 0.5% of donors, as well as severe discomfort (n=19), and a poor general health (n=13). On the
14 second day after whole blood donation, 1.5% of donors (n=47) reported severe fatigue and six days
15 after whole blood donation, 1% of donors (n=31) still reported severe fatigue. Severe headache (n=24),
16 low energy level (n=25) and poor quality of sleep (n=35) was still reported by 1% of whole blood donors
17 and 0.5% still reported severe dizziness (n=10), discomfort (n=13) and poor general health (n=19) at
18 day 6 after donation.

19

20 *Changes in post-donation symptoms*

21 Male donors showed a significant decrease in fatigue, dizziness, discomfort and headache and a
22 significant increase in energy level, quality of sleep, general health and warm glow from day 1 to day
23 2 after whole blood donation. Changes in fatigue, dizziness, discomfort, energy level and quality of
24 sleep were also significant from day 2 to day 3. Furthermore, fatigue showed a significant decrease

1 and energy level a significant increase from day 5 to day 6 (Table 2). Female donors showed significant
2 decreases in fatigue, dizziness, discomfort and headache from day 1 to day 2 and from day 2 to day 3
3 after donation. Energy levels significantly increased from day 1 to day 2 and from day 2 to day 3.
4 General health significantly improved from day 2 to day 3. Female donors also reported significant
5 changes in fatigue, dizziness and quality of sleep from day 3 to day 4. Finally, headache showed a
6 significant decrease and energy level a significant increase from day 5 to day 6. No significant changes
7 in warm glow were observed (Table 2).

8

9 *Associations between donor characteristics and changes in post-donation symptoms*

10 In both male and female donors, higher age was associated with less fatigue, dizziness, headache and
11 higher energy level post-donation, as shown in Table 3. In male donors, higher age was also associated
12 with feeling less uncomfortable and higher blood pressure was associated with higher energy level and
13 better quality of sleep. In female donors, higher age was associated with more warm glow and higher
14 blood volume was associated with less fatigue, dizziness, headache and feeling less uncomfortable.
15 Higher BMI was associated with worse general health after whole blood donation in male and female
16 donors.

17

18 *Association between post-donation symptoms and warm glow with donor return*

19 The final model for both male and female donors showed that fatigue was significantly associated with
20 donor return (male donors: $\beta = -0.11$, CI = $-0.21;-0.02$, female donors: $\beta = -0.13$, CI = $-0.20;-0.05$).
21 Donors reporting less fatigue across the six days after donation were more likely to return within 31
22 days after their next invitation.

23

24 **Discussion**

1 Post-donation symptoms significantly improve up to three days after whole blood donation in both
2 male and female donors. Older donors, donors with lower BMI, higher blood pressure (males) and
3 higher blood volume (females) reported less post-donation symptoms. Donors with less fatigue after
4 whole blood donation were more likely to return for their next donation.

5 This is the first study that tracked post-donation symptoms on a daily basis during one week after
6 donation in a large cohort of more than 3000 participants (52% of eligible whole blood donors). This
7 enabled us to investigate the timing and duration of these symptoms, as well as associations between
8 multiple donor characteristics and post-donation symptoms. Although a paper and pencil diary was
9 practically more feasible than electronic diaries, it should be mentioned that this may have introduced
10 low compliance and hoarding.[23] Participating donors had a higher donor return rate compared to
11 eligible donors, possibly because more committed donors are more likely to participate in
12 research.[24] In our study we were limited to investigate the association between routinely measured
13 donor characteristics and post-donation symptoms. Other characteristics, such as smoking status or
14 ethnicity may also affect symptoms after whole blood donation.[6, 12]

15 Fatigue was the most commonly reported post-donation symptom in both male and female donors,
16 which generally is in line with previous studies. We found a low percentage of donors reporting severe
17 problems for one or more post-donation symptoms compared to previous studies.[6, 11] However,
18 differences in phrasing of the questions likely explains differences in the prevalence of post-donation
19 symptoms across studies.

20 Our results show that the severity of most symptoms significantly decreases from day 1 to day 2 and
21 from day 2 to day 3. Currently, Sanquin Blood Bank advises donors to wait for at least 12 hours after a
22 whole blood donation before resuming work. Although it is unlikely that symptoms could be a serious
23 danger for the donor or others up to three days after whole blood donation, donors could benefit from
24 more accurate information regarding the course of possible post-donation symptoms. This may even
25 translate into higher donor return rates. Van Remoortel et al. showed that exercise capacity was

1 reduced in the first two days after a whole blood donation, probably due to a loss of haemoglobin
2 mass.[18] A temporarily loss of haemoglobin mass and reduced exercise capacity may be the cause of
3 symptoms such as fatigue reported by participating donors during the first two days after whole blood
4 donation,[25] but small reductions in capacity may only influence the performance of professional
5 athletes.[18] Our finding that some symptoms improved from day 5 to day 6 after whole blood
6 donation while no changes were found from day 3 to day 4 or from day 4 to day 5 may be unexpected.
7 Possibly, this is caused by inclinations to report not experiencing any problems on the final day of the
8 diary. Independent of the duration of such a diary, this may result in a significant change in symptoms
9 from the second-last to final day.

10 In both male and female donors, we found that younger age was associated with more post-donation
11 symptoms, as previously reported.[7, 26] This finding may be explained by a selection process of
12 donors experiencing post-donation symptoms to stop donating.[6] Male donors with higher blood
13 pressure reported higher energy levels and better quality of sleep after donating whole blood
14 compared to male donors with low blood pressure. Previous research has reported that blood
15 donation may temporarily decrease blood pressure, resulting in a decrease in complaints such as
16 headache.[27] On average, male participants had a higher blood pressure compared to female
17 participants. This may explain why the association between blood pressure and post-donation
18 symptoms was only present in male donors.

19 Wiltbank et al. reported that blood volume was the strongest predictor of faint and hypotensive
20 reactions after donating, suggesting that donors with low blood volume may be at risk for adverse
21 reactions.[9] While female donors with less blood volume experienced more symptoms, the
22 association between blood volume and post-donation symptoms was not found in male donors. This
23 may be explained by the generally larger proportion of the total blood volume drawn from female
24 donors compared to male donors.

1 Our finding that both male and female donors with higher BMI reported worse general health,
2 contradicts findings reported by Van den Hurk et al. and Teglkamp et al. who found more negative
3 symptoms in donors with low BMI.[6, 11] However, literature investigating the association between
4 weight and health status report inconsistent findings.[28-30] Furthermore, the association between
5 BMI and general health may not be linear, with underweight and obese donors experiencing more
6 problems compared to donors with normal weight. Only a small proportion (1%) of participating
7 donors was underweight.

8 Our finding that donors who experience less fatigue were more likely to return for their next donation
9 supports previous literature reporting that adverse reactions (including fatigue) have a negative impact
10 on donor return rates.[13, 31, 32] Although previous studies reported positive associations between
11 positive post-donation symptoms and donor return,[15] feelings related to warm glow were not
12 significantly associated with donor return in our study. Previous research has shown that warm glow
13 is a stronger motivator for experienced donors compared to inexperienced or non-donors.[15, 33]
14 Therefore, we tested the moderator effect of donor experience (i.e. <4 vs ≥ 4 previous donations[15])
15 by adding the interaction term with warm glow to the model, which was not significant (male donors:
16 $p = 0.91$, female donors: $p = 0.15$). During data collection, we received many questions regarding the
17 meaning of the questions related to warm glow, especially regarding the question 'Do you have a warm
18 feeling inside'. Some donors assumed these questions related to feelings of affection or even fever. It
19 is therefore unclear whether donors interpreted these questions as experiences of emotional gain and
20 we recommend in future research to explain more clearly what is meant by this.

21 Possibly, new donors experience more and severe symptoms after whole blood donation compared to
22 repeat whole blood donors, but stop donating due to these problems without blood banks being aware
23 of this. Donors who experience fatigue after donating whole blood may benefit from more accurate
24 information about the presence and course of these symptoms in the days after donation, possibly
25 resulting in donors being less likely to stop donating due to symptoms. However, there could also be a

1 possibility that providing more accurate information regarding post-donation symptoms negatively
2 influences donor return rates. Interventions to reduce post-donation symptoms in whole blood donors
3 should be developed and probably be targeted to donors most likely to experience negative symptoms.
4 Pre-donation hydration and leg exercise may attenuate presyncopal reactions, including dizziness.[34]
5 The effectiveness of pre-donation hydration, leg exercise, and other interventions in reducing post-
6 donation symptoms such as fatigue should be further investigated.

7

8 **Conclusion**

9 Multiple post-donation symptoms significantly improved up to three days after whole blood donation.
10 Age was significantly associated with multiple post-donation symptoms in whole blood donors.
11 Furthermore, donors who reported less fatigue were more likely to return within 31 days after their
12 next invitation. These findings may help blood collection centres to provide personalized information
13 about the presence and course of post-donation symptoms, possibly increasing donor return rates.

14

15 **Acknowledgements**

16 We would like to thank all donors for their contribution to the study.

17

Table 1. Donor characteristics

	Male eligible donors N=2943	Female eligible donors N=2995	Male participants N=1461	Female participants N=1615
Age, median (IQR), years	48 (31 – 59)	42 (26 – 55)	52 (37 – 61)	44 (27 – 55)
BMI, mean (SD), kg/m ²	25.5 (3.5)	24.7 (3.9)	25.5 (3.4)	24.6 (3.8)
Haemoglobin, median (IQR), mmol/L	9.2 (8.8 – 9.7)	8.4 (8.1 – 8.8)	9.2 (8.8 – 9.7)	8.4 (8.1 – 8.8)
Blood volume, mean (SD), L	5.6 (0.6)	4.3 (0.5)	5.7 (0.6)	4.3 (0.5)
Systolic blood pressure, mean (SD), mmHg	136.7 (14.9)	126.3 (14.8)	137.6 (14.9)	126.9 (14.9)
Post-menopausal, %		41%		49%
Total number of whole blood donations, median (IQR)	29 (7 – 66)	11 (4 – 31)	43 (14-78)	12 (3 – 31)
Number of whole blood donation in past 2 years, median (IQR)	6 (4 – 8)	4 (3 – 5)	7 (5 – 8)	4 (2 – 5)
Time since last whole blood donation, median (IQR), days	91 (71 – 152)	154 (133 – 225)	91 (71 – 161)	153 (132 – 220)
Donors return within 31 days after invitation, %	64%	56%	71%	64%
Donor return missing, %	3%	7%	2%	4%

BMI = Body Mass Index, IQR = interquartile range, kg = kilogram, L = liter, m = meter, mmhg = millimetres of mercury, mmol = millimol, N= number of participants, SD = standard deviation

Table 2. Changes in post-donation symptoms

	Day 1 β (CI)	Day 1 to day 2 β (CI)	Day 2 to day 3 β (CI)	Day 3 to day 4 β (CI)	Day 4 to day 5 β (CI)	Day 5 to day 6 β (CI)
Male donors						
Fatigue	1.77 (1.72;1.82)	-0.15 (-0.19;-0.11)*	-0.07 (-0.11;-0.03)*	-0.02 (-0.06;0.02)	-0.02 (-0.06;0.02)	-0.05 (-0.10;-0.01)*
Dizziness	1.25 (1.22;1.27)	-0.07 (-0.09;-0.04)*	-0.03 (-0.05;-0.00)*	-0.02 (-0.04;0.01)	-0.01 (-0.03;0.01)	-0.01 (-0.03;0.02)
Discomfort	1.25 (1.22;1.28)	-0.03 (-0.06;-0.01)*	-0.01 (-0.04;0.01)*	-0.02 (-0.05;0.00)	0.003 (-0.02;0.03)	-0.02 (-0.04;0.01)
Headache	1.30 (1.26;1.33)	-0.08 (-0.12;-0.05)*	-0.01 (-0.04;0.03)	0.00 (-0.04;0.03)	0.01 (-0.02;0.04)	-0.02 (-0.06;0.01)
Energy level	3.99 (3.95;4.03)	0.11 (0.08;0.15)*	0.05 (0.01;0.08)*	0.03 (-0.00;0.07)	0.02 (-0.02;0.05)	0.05 (0.02;0.09)*
Quality of sleep	4.11 (4.06;4.15)	0.06 (0.03;0.10)*	0.02 (-0.01;0.06)*	-0.01 (-0.05;0.02)	0.03 (-0.01;0.06)	0.02 (-0.01;0.05)
General health	4.29 (4.25;4.32)	0.03 (0.01;0.05)*	0.01 (-0.02;0.03)	0.02 (-0.00;0.04)	0.00 (-0.02;0.02)	0.01 (-0.01;0.03)
Warm glow	16.93 (16.75;17.11)	0.13 (0.06;0.21)*	-0.02 (-0.10;0.05)	0.04 (-0.04;0.12)	-0.04 (-0.12;0.04)	0.05 (-0.02;0.13)
Female donors						
Fatigue	2.38 (2.33;2.44)	-0.27 (-0.32;-0.22)*	-0.15 (-0.20;-0.10)*	-0.13 (-0.18;-0.08)*	-0.03 (-0.08;0.03)	-0.05 (-0.10;0.00)
Dizziness	1.62 (1.58;1.65)	-0.21 (-0.24;-0.17)*	-0.11 (-0.15;-0.08)*	-0.05 (-0.09;-0.02)*	-0.02 (-0.06;0.01)	-0.01 (-0.05;0.02)
Discomfort	1.46 (1.43;1.49)	-0.12 (-0.15;-0.08)*	-0.06 (-0.09;-0.02)*	-0.01 (-0.05;0.02)	-0.01 (-0.05;0.02)	-0.03 (-0.06;0.01)
Headache	1.63 (1.59;1.69)	-0.13 (-0.18;-0.08)*	-0.08 (-0.13;-0.03)*	-0.01 (-0.06;0.04)	0.01 (-0.04;0.06)	-0.05 (-0.10;0.00)*
Energy level	3.63 (3.59;3.67)	0.17 (0.13;0.20)*	0.09 (0.06;0.13)*	0.05 (0.01;0.09)	0.03 (-0.01;0.07)	0.06 (0.02;0.10)*
Quality of sleep	3.94 (3.89;3.98)	0.01 (-0.02;0.05)	0.00 (-0.04;0.04)	0.05 (0.01;0.08)*	0.01 (-0.02;0.04)	0.04 (-0.00;0.07)
General health	4.16 (4.13;4.19)	0.02 (-0.01;0.04)	0.02 (-0.00;0.04)*	0.01 (-0.01;0.04)	0.00 (-0.02;0.03)	0.02 (-0.00;0.05)
Warm glow	16.56 (16.40;16.72)	0.05 (-0.05;0.14)	0.01 (-0.09;0.10)	0.08 (-0.02;0.18)	-0.01 (-0.11;0.09)	0.09 (-0.01;0.19)

Fatigue, dizziness, discomfort and headache were scored on a 5-point Likert scale from 'I experience many problems' to 'I experience no problems'.

Energy level, quality of sleep and general health were scored on a 5-point Likert scale from 'very bad' to 'excellent'.

Warm glow represents the sum score from the responses to the three items, 1. Do you feel good about yourself, 2. Do you feel emotionally positive about yourself and 3. Do you have a warm feeling inside', ranging from 3 (i.e. 'Very strongly disagree') to 21 ('Very strongly agree')

β = regression coefficient, CI = confidence interval

* p < 0.05

Table 3. Associations between donor characteristics and change in post-donation symptoms

Male donors	Day 1 β (CI)	Day 1 to day 2. β (CI)	Day 2 to day 3. β (CI)	Day 3 to day 4. β (CI)	Day 4 to day 5. β (CI)	Day 5 to day 6. β (CI)	Age β (CI) ¹	Blood pressure β (CI) ¹	BMI β (CI)
Fatigue	1.77 (1.72;1.82)	-0.15 (-0.19;-0.11)*	-0.07 (-0.11;-0.03)*	-0.02 (-0.06;0.02)	-0.02 (-0.06;0.02)	-0.05 (-0.09;0.01)*	-0.11 (-0.14;-0.08)*		
Dizziness	1.25 (1.22;1.27)	-0.07 (-0.09;-0.04)*	-0.03 (-0.05;-0.00)*	-0.02 (-0.04;0.01)	-0.01 (-0.02;0.01)	-0.01 (-0.03;0.01)	-0.02 (-0.03;-0.00)*		
Discomfort	1.25 (1.22;1.28)	-0.03 (-0.06;-0.01)*	-0.01 (-0.04;0.01)	-0.02 (-0.05;0.00)	0.00 (-0.02;0.03)	-0.02 (-0.05;0.01)	-0.02 (-0.03;-0.01)*		
Headache	1.30 (1.26;1.33)	-0.08 (-0.12;-0.05)*	-0.01 (-0.04;0.03)	-0.00 (-0.04;0.03)	0.01 (-0.02;0.04)	-0.02 (-0.06;0.01)	-0.04 (-0.06;-0.03)*		
Energy level	3.99 (3.95;4.03)	0.11 (0.08;0.15)*	0.05 (0.01;0.08)*	0.03 (-0.00;0.07)	0.02 (-0.02;0.05)	0.05 (0.02;0.09)*	0.04 (0.01;0.06)*	0.03 (0.00;0.05)*	
Quality of sleep	4.11 (4.07;4.15)	0.06 (0.03;0.10)*	0.02 (-0.01;0.06)	-0.01 (-0.05;0.02)	0.03 (-0.01;0.06)	0.02 (-0.01;0.05)		0.04 (0.01;0.07)*	
General health	4.16 (4.13;4.19)	0.02 (-0.01;0.04)	0.02 (-0.00;0.05)	0.01 (-0.01;0.04)	0.00 (-0.02;0.03)	0.02 (0.00;0.05)			-0.2 (-0.3;-0.1)*
Warm glow	16.93 (16.75;17.11)	0.13 (0.06;0.21)	-0.02 (-0.10;0.06)	0.04 (-0.04;0.12)	-0.04 (-0.12;0.04)	0.05 (-0.02;0.13)			
Female donors	Day 1 β (CI)	Day 1 to day 2. β (CI)	Day 2 to day 3. β (CI)	Day 3 to day 4. β (CI)	Day 4 to day 5. β (CI)	Day 5 to day 6. β (CI)	Age β (CI) ¹	Blood volume β (CI) ¹	BMI β (CI)
Fatigue	2.38 (2.33;2.41)	-0.27 (-0.32;-0.22)*	-0.15 (-0.20;-0.10)*	-0.12 (-0.18;-0.08)*	-0.03 (-0.08;0.03)	-0.05 (-0.1;0.004)	-0.14 (-0.17;-0.11)*	-1.07 (-1.95;-0.19)*	
Dizziness	1.62 (1.58;1.65)	-0.21 (-0.24;-0.17)*	-0.11 (-0.15;-0.08)*	-0.05 (-0.09;-0.02)*	-0.02 (-0.06;0.01)	-0.01 (-0.05;0.02)	-0.03 (-0.05;-0.02)*	-1.15 (-1.72;-0.58)*	
Discomfort	1.46 (1.43;1.49)	-0.12 (-0.15;-0.08)*	-0.06 (-0.09;-0.02)*	-0.01 (-0.05;0.02)	-0.01 (-0.05;0.02)	-0.03 (-0.06;0.01)		-0.72 (-1.26;-0.18)*	
Headache	1.63 (1.59;1.68)	-0.13 (-0.18;-0.08)*	-0.08 (-0.13;-0.03)*	-0.01 (-0.06;0.04)	0.01 (-0.04;0.06)	-0.05 (-0.10;0.00)*	-0.08 (-0.10;-0.06)*	-0.81 (-1.47;-0.15)*	
Energy level	3.63 (3.59;3.67)	0.17 (0.13;0.20)*	0.09 (0.06;0.13)*	0.05 (0.01;0.09)*	0.03 (-0.01;0.07)	0.06 (0.02;0.10)*	0.09 (0.07;0.11)*		
Quality of sleep	3.94 (3.89;3.98)	0.01 (-0.02;0.05)	0.00 (-0.04;0.04)	0.05 (0.01;0.08)*	0.01 (-0.02;0.04)	0.04 (0.00;0.07)			
General health	4.16 (4.13;4.19)	0.02 (-0.01;0.04)	0.02 (-0.001;0.05)	0.01 (-0.01;0.04)	0.00 (-0.02;0.03)	0.02 (0.00;0.05)			-0.1 (-0.2;-0.00)*
Warm glow	16.56 (16.40;16.72)	0.05 (-0.05;0.14)	0.01 (-0.10;0.10)	0.08 (-0.02;0.18)	-0.01 (-0.11;0.09)	0.09 (-0.01;0.19)	0.16 (0.07;0.25)*		

Fatigue, dizziness, discomfort and headache were scored on a 5-point Likert scale from 'I experience many problems' to 'I experience no problems'.

Energy level, quality of sleep and general health were scored on a 5-point Likert scale from 'very bad' to 'excellent'.

Warm glow represents the sum score from the responses to the three items, 1. Do you feel good about yourself, 2. Do you feel emotionally positive about yourself and 3. Do you have a warm feeling inside', ranging from 3 (i.e. 'Very strongly disagree') to 21 ('Very strongly agree')

β = regression coefficient, CI = confidence interval, BMI = Body Mass Index

* p < 0.05

¹coefficients and confidence intervals have been multiplied by a factor 10.

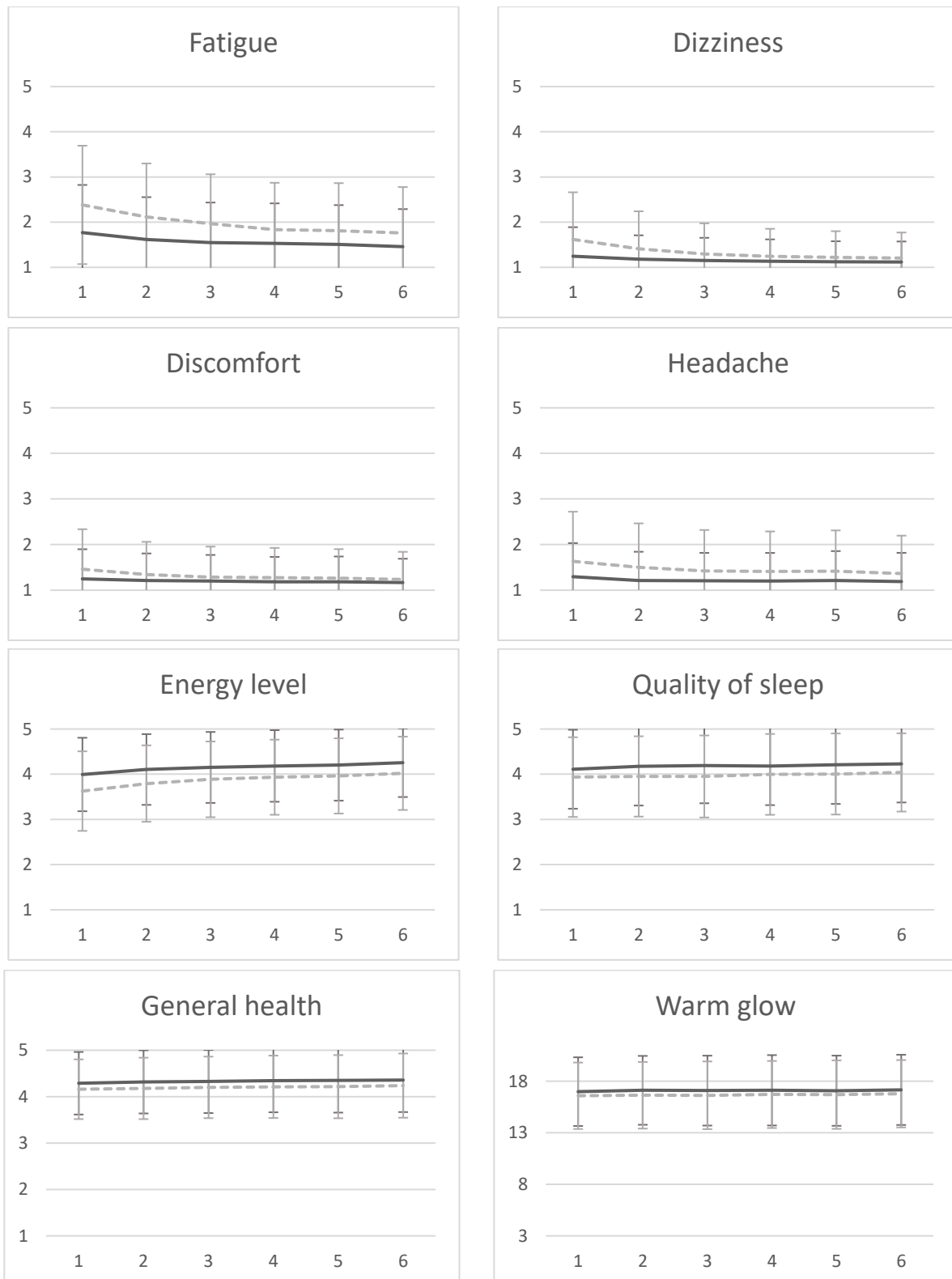


Figure 1. Mean score (vertical axis) with standard deviation for each symptom during day 1 to day 6 (horizontal axis) after whole blood donation for male (solid line) and female (dashed line) donors separately.

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DIARY FIND'EM study



Identification sticker or enter
the identification number

Dear participant,

Below this text you will find the diary for the FIND'EM study. Do you want to fill in this diary during 6 days after your blood donation? The diary consists of 10 questions divided over 3 parts. For each question you are asked to provide a score that best suits your experience. Above each part is explained how you can enter the score. In addition, we recommend you to fill in the top row with dates belonging to day 2, day 3, etc. before you start the diary. This prevents you from entering a score for the wrong day. On the back of the page you will find an example of how the diary can be completed.

When the diary is complete (when all days have been filled in), you can return it to Sanquin with the reply envelope or scan it and email it to donorstudies@sanquin.nl.

If you have any questions about filling in the diary, you can email donorstudies@sanquin.nl or call 06xxxxxxx.

Thank you for your participation!

The FIND'EM study team

.....

Date donation:

Location donation:

Please enter the number that suits you best.

1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree

Date:							
I experience:	Donation	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Fatigue	X						
Dizziness	X						
Discomfort	X						
Headache	X						

Please enter the number that suits you best.

1 = Very Bad, 2 = Bad, 3 = Fair, 4 = Good, 5 = Excellent

How do you experience your:	Donation	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Energy level	X						
Quality of sleep	X						
General Health	X						

Please enter the number that suits you best.

1 = Not at all, 2 = No, 3 = Not really, 4 = Neutral, 5 = Fair, 6 = Yes, 7 = Completely

Recalling your last blood donation, to what extent:	Donation	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Are you feeling good about yourself?	X						
Do you feel emotionally positive about yourself?	X						
Do you have a warm feeling inside?	X						

Please enter the number that suits you best.

1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree

Enter the date on which you enter the diary

Date:	10/5	11/5	12/5	13/5	14/5	15/5	16/5
I experience:	Donation	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Fatigue	X	1					
Dizziness	X	1					
Discomfort	X	1					
Headache	X	4					

On day 2, I experienced headache and no further complaints

EXAM