Original Article

Incidence of Postoperative Hypothermia and Factors Effecting the Development of Hypothermia in Patients Undergoing Abdominal Surgery

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Abstract

Purpose: The research is conducted in order to determine the incidence of involuntary hypothermia developed at the patients after abdominal surgery in the postoperative period and the factors affecting the development of the undesired hypothermia.
Methodology: In this research that is conducted in descriptive and sectional style, 189 patients who had abdominal surgery in the general surgery and urology clinics of a university hospital in between 2nd of May – 2nd of October 2019, who are in preoperative period with body temperature 36°C and above. These data are collected via patient identification forms and hypothermia evaluation form and individuals with body temperature below 36°C are considered as in hypothermia. In the evaluation of the data average, percentage distribution and chi-square test are used.
Findings: The ratios of incidence in the postoperative period are determined as 62.4% in 0th postop hour, 42.9% at 1st postop hour, 33.9% at 2nd postop hour, 22.2% at postop 3rd hour and 13.2% at 4th postop hour. The lowest body temperature is measured as (35.69±0.66) at 0th postop hour. In patients with operation time our two hours and in risk classification II and above of the American Society of Anesthesiologists, the ratios of incidence of hypothermia are determined to be significantly higher ($p<0.05$).
Results: In this study, it is determined that the hypothermia incidence in the postoperative period of the patients who had abdominal surgery is high, in the patients with long operation time and who are over risk classification II and above of the American Anesthesiologists Association, the hypothermia is seen more frequently.

Keywords: Hypothermia, postoperative, abdominal surgery

Introduction

The body temperature is normally kept in balance with the homeostatic mechanism of the body. However, this balance may cause involuntary hypothermia in the perioperative process with the effect of the environmental factors and anesthetic agents. Involuntary hypothermia is the dropping of the body temperature below 36°C during the period from preoperative period (one hour before anesthesia) to postoperative period (first 24 hours after anesthesia (Turkish Anesthesia Practice Guidelines, 2013; National Institute for Health Care Excellence, 2017). It is reported in the literature that the prevalence of perioperative hypothermia is in between 50-90% (Soysal & Ilçe, 2018; Association of Surgical Technologist, 2015; Bilgin, 2017) and it is indicated that 70% of the patients who go under surgery are affected (Giuliano & Hendricks, 2017). Today, despite of the current technological and scientific developments regarding its prevention and management, the hypothermia continues to be a problem in the perioperative period (Hooper et al., 2010).

The involuntary hypothermia is seen most frequently within the intraoperative period (Duman &Yılmaz, 2016) and this condition continues in the early postoperative period (Duman & Yılmaz, 2016; Luis et al., 2012; Prado et al., 2015). In the intraoperative period, the factors contributing the prevalence of hypothermia include cold operation room environment, skin and abdominal opening, use of intravenous liquids, irrigation liquids and inhaled gases (National Institute for Health Care Excellence, 2017; Hooper et al., 2010). Also, anesthesia inhibiting the hypothalamus and causing the later activation of the thermoregulation mechanism, sedative and anesthetic drugs rendering the vasoconstriction unobtainable and not decreasing heat loss are among the causes of involuntary hypothermia (National Institute for Health Care Excellence, 2017).

The involuntary hypothermia is also associated with many complications including cardiac complications, surgical region infections, increase in bleeding amount, disruption of thermal comfort of the patient, pressure ulcer development, delaying of discharge from the post anesthesia care unit (PACU) (Hooper et al., 2010; Turkish Anesthesia Practice Guidelines, 2013), time in the intensive care unit (Lista et al., 2012; Kiekkas et al., 2018) and in the hospital (Jeyadoss et al., 2013). When hypothermia based problems and complications are considered, prevention of the development of hypothermia is important regarding the safety of the patient. Therefore, many professional societies like Association of Perioperative Registered Nurses (AORN) (AORN's Guidelines for Perioperative Practice, 2019) and National Institute of Health and Care Excellence (NICE) (National Institute for Health Care Excellence, 2017) emphasize the requirement for the monitoring the body temperature for early detection of perioperative hypothermia and provision of normothermia, and thus prevention of hypothermia and improvement of its management in the perioperative period.

The perioperative hypothermia is a multidisciplinary problem requiring coordinated work of the physician, nurse and anesthetists (Hooper et al., 2010). The interventions to be performed during the postoperative period contribute to shortening of the time for the patients with hypothermia to return to the normal body temperature (reheating period), and to decreasing the prevalence of the hypothermia based complications. Thus, it may positively affect the success of the surgical intervention and the healing process (Kursun & Dramalı, 2011). In this regard, it is believed that the study can be an important resource regarding the determination of the incidence of the hypothermia developing in the postoperative period and the factors causing the development of hypothermia, thus planning of the interventions regarding the prevention of the involuntary hypothermia.

Methodology: The research is conducted in descriptive and sectional type in order to determine the incidence of involuntary hypothermia in the postoperative first four hours in the patients who had abdominal surgery, and to determine the factors that affect the development of involuntary hypothermia like demographical properties, surgery type, anesthesia type, surgery time.

The research population consists of patient who had abdominal surgery in the general surgery and urology clinics in a university hospital in between May – October 2019. In determination of the sample, the sample size with known population formula is used. According to the records of the institution where the study is performed, the surgery number in between January-March 2019 is 1457. For the studies with known population, with 95% confidence level and ± 5% acceptable error, the sample size is determined as 154 with mean impact factor. 189 patients are accepted in the study who are 18 years old and above, had abdominal surgery, had body temperature of 36-37,5^{o}C one hour before admission to surgery, had no oral communication hindrances, and agreed to participate in the study. The patients whose physical status was not stable during the study process, who had cognitive and communication hindrances and who did not agree to the study are not included in the research.

Data Collection Tools: The data are acquired via patient identification form and hypothermia risk evaluation form.

Patient Identification Form; this form has been prepared in line with the literature survey of the researchers and consists of questions of age, gender, body mass index (BMI), illness diagnosis, conducted operation and presence of a chronic illness.

Hypothermia Risk Evaluation Form: In line with the literature, it consists of 12 questions prepared regarding the determination of risk

factors that may cause hypothermia in patients (operation type, anesthesia type, operation time, bleeding amount, drain output, vomiting and tremors) (National Institute for Health Care Excellence, 2017; Duman &Yılmaz, 2016). Also, this form is subjected to ASA classification using the risk assessment score of the American Society of Anesthesiologist. The body temperatures of all the patients are recorded on the form. In creation of the form, opinions of a physician and two academic staffs, expert in the field of surgery, are taken. Before the stage of data collection, the form is evaluated on 30 patients and the deficiencies are corrected.

Application: In the process of the research, the patients who meet the criteria for inclusion to the study are informed on the purpose and importance of the study on the day they shall go under surgery and for the patients who accepted to participate in the study, the individual identification form is applied one hour before the surgery. The body temperatures of the patients are evaluated within five minutes of their admission to PACU and this first value is recorded as postop 0^{th} hour. After the patients are delivered from PACU to the clinic, the measurements are continued within the first four hours and the results of these measurements are recorded at each hour (postop 1^{st}, postop 2^{nd}, postop 3^{rd}, and postop 4^{th} hour). In addition, the ASA risk classification, operation time, operation type and anesthesia type information is taken from the patient file. This process is continued until the sample size is completed. The body temperature measurements are performed by a tympanic membrane thermometer that is provided by the researcher and is calibrated, and the same measurement device is used on all patients.

Ethical Aspect: Before the data are collected the permits are obtained from the ethics board of a University of Republic (Decree No: 2018-01/27) and the hospital of the university of republic where the research is conducted. Also, the each individual who shall participate in the study is informed on the contents of the study and the participation being voluntary before they go under surgery and their oral consent is taken.

Assessment of the Data : In the assessment of the data, SPSS 22.0 package program is used. In the assessment of the data, in addition to the mean and percentage distribution, chi-square test is used in the comparison of the individual characteristics of the patients and the hypothermia incidence. In the statistical evaluation the significance is taken as $p<0.05$.

Results

Of the patients who are admitted to the study, 82% are under the age of 70 and 50.5% are women and BMI average is 27.50±5.60 kg/m^2. It is determined that of the patients, 53.9% are gone under open surgical intervention and 69.3% are at ASA classification II and above, 71.4% have gone under surgery under general anesthesia and the operations of 72.5% are under two hours. The ratio of the patients with vomiting in the postoperative period is 9.5% and the ratio of feeling cold is 19.6% (Table 1).

It is determined that the average of the body temperatures of the patients is 36.43±0.37°C in the preoperative period, 35.69±0.66°C at waking up unit, 35.89±0.64°C at postop 1^{st} hour, 36.06±0.58°C at postop 2^{nd} hour, 36.17±0.52°C at postop 3^{rd} hour, 36.29±0.49°C at postop 4^{th} hour (Table 2).

When the hypothermia and normathermia conditions of the patients in the postoperative period are examined; it is determined that of the patients 62.4% in the waking unit, 42.9% at postop 1^{st} hour, 33.9% at postop 2^{nd} hour, 22.2% at postop 3^{rd} hour, and 13.2% at postop 4^{th} hour are hypothermic (Table 3).

In the chi-square test conducted to assess the relation between the age, gender, BMI, ASA classification, operation time, operation type, anesthesia type, vomiting and tremors in postoperative period of the patients and the hypothermia, it is determined that the hypothermia prevalence is significantly higher for the patients with operation time over 2 hours compared to ones with operation time under 2 hours, and for the patients with ASA classification at ASA classification II and above compare to the ones with ASA classification I ($p<0.05$). Notwithstanding the above, it is determined that there is no significant relation between the hypothermia prevalence and age, gender, BMI, operation type, anesthesia type, vomiting and tremors in the postoperative period ($p>0.05$) (Table 4).

Table 1. Characteristics of the Patients regarding Demographics and Operation (n=189)

Characteristics	n	%
Age		
Under 70 years	155	82.0
70 years and above	34	18.0
Gender		
Female	95	50.3
Male	94	49.7
Operation Type		
Open	102	54.0
Laparoscopic	87	46.0
ASA classification		
ASA I	58	30.7
ASA II and above	131	69.3
Anesthesia Type		
General	135	71.4
Spinal	54	28.6
Operation Time		
Under 2 hours	137	72.5
Over 2 hours	52	27.5
Presence of Vomiting		
Yes	18	9.5
No	171	90.5
Feeling Cold/Tremors		
Yes	37	19.6
No	152	80.4
BMI (kg/m^2) (Average±SD)	27.50 ±5.60 (min=17, max=46)	

BMI (Body mass index), ASA (American Society of Anesthesiologists)

Table 2. Averages of the Body Temperatures of the Patients in Preoperative and Postoperative Periods

	M±SD	Min.	Max.
Preoperative	36.43±0.37	36.0	37.5
Postoperative 0^{th} hour	35.69±0.66	34.0	37.8
Postoperative 1^{st} hour	35.89±0.64	34.1	37.2
Postoperative 2^{nd} hour	36.06±0.58	34.3	37.6
Postoperative 3^{rd} hour	36.17±0.52	34.8	37.8
Postoperative 4^{th} hour	36.29±0.49	35.0	37.8

M = Mean, SD = Standard deviation

Table 3. Hypothermia and Normothermia Distribution of the Patients in the Postoperative Period

Hour	n	%
Postop 0th hour		
Hypothermia	118	62.4
Normothermia	71	37.6
Postop 1st hour		
Hypothermia	81	42.9
Normothermia	108	57.1
Postop 2nd hour		
Hypothermia	64	33.9
Normothermia	125	66.1
Postop 3rd hour		
Hypothermia	42	22.2
Normothermia	147	77.8
Postop 4th hour		
Hypothermia	25	13.2
Normothermia	164	36.8

Table 4. Comparison of the Characteristics regarding the Demographics and Operation of the Patients with Hypothemic and Normothermic Body Temperature in the Postoperative Period

Characteristics	Hypothermia n (%)	Normothermia n (%)	Test
Age			
Under 70 years	70(45.2)	85 (54.8)	X^2= 0.263
Over 70 years	17 (50)	17 (50)	p= 0.608
Gender			
Female	49 (51.6)	46 (48.4)	X^2= 2.366
Male	38(40.4)	56 (59.6)	p= 0.124
BMI			
Under 25	30 (40.5)	44 (59.5)	X2=1.476
25 and above	57 (49.6)	58 (50.4)	p=0.224
ASA classification			
I	20 (34.5)	38 (65.5)	X^2=4.493
II and above	67 (51.1)	64 (48.9)	**p= 0.034***
Operation Type			
Open	42 (41.2)	60 (58.8)	X^2=2.103
Laparoscopic	45 (51.7)	42 (48.3)	
Anesthesia Type			

General	59(43.7)	76 (56.3)	X^2=1.031
Spinal	28 (51.9)	26 (48.1)	p= 0.310
Operation Time			
Under 2 hours	57(41.6)	80 (58.4)	X^2=3.926
Over 2 hours	30 (57.7)	22 (42.3)	**p= 0.048***
Presence of Vomiting			
Yes	10 (55.6)	8 (44.4)	X^2=0,726
No	77 (45.0)	94 (55.0)	p= 0.394

*p<0.05, BMI (Body mass index), ASA (American Society of Anesthesiologists) P = P values; χ^2 = Pearson Chi-square test

Discussion

The prevention of hypothermia is a high priority patient safety problem and it is a preventable complication (Steelman, Perkhounkova & Lemke, 2015). However, it is indicated that there is high prevalence of involuntary hypothermia in the postoperative period (Luis et al., 2012; Prado et al., 2015). In this study the hypothermia prevalence in the postoperative period is determined as 62.4% in the waking unit, 42.9% at postop 1st hour, 33.9% at postop 2nd hour, 22.2% at postop 3rd hour, and 13.2% at postop 4th hour. When the literature is examined, there are lower rates (Konsayereepong et al., 2003; Abelha et al., 2005; Aksu et al., 2019) as well as higher rates (Luis et al., 2012; Prado et al., 2015) reported compared to our findings. Prado et al. (2015), in their study, reported that 88.6% of the patients just before leaving the operation room, and Luís et al. (2012), in their study, reported that 86% of the patients monitored in the PACU are hypothermic. However Epi FANZCA et al. (2017), in their study, detected that 30% of the patients in PACU have body temperatures under 36°C. Whereas in the patients taken into intensive care after non-cardiac major surgery, it is determined that hypothermia develops in ratios ranging between 36-58% (Karalapillai et al., 2009; Slotman, Jed & Burchard, 1985; Konsayereepong et al., 2003; Abelha et al., 2005). The findings show that hypothermia is still a widespread problem. However, it is shown that the hypothermia incidence is significantly lowered with the routine use of body heating devices and the applications conducted to prevent and manage preoperative hypothermia (Aksu et al., 2019). In the institution where the research is conducted, the patients are not subjected to the active heating protocol and standardized measures to prevent hypothermia. The findings acquired in the study reveals these deficiencies.

When the body temperatures of the patients are compered regarding the measurement times, it is seen that the lowest temperature is measured at postop 0th hour (35.69±0.66) and the body temperature values increase with time. Similar to the findings of the study, in a study including the orthopedics patients, it is determined that the patients have the lowest body temperature average in the postoperative period at the postop 0th hour (Duman &Yılmaz, 2016). The finding of the study is considered to be due to the heat losses occurring in the intraoperative period in addition to the heat losses during the transfer from the operation room.

American Society of Anesthetists indicates that being in the ASA risk classification II and above, the age of 70 and above, female gender and BMI under 25 kg/m^2 pose risk for hypothermia (ASA Standards, Guidelines, and Statements, 1999). In this study, it is seen that age, BMI and gender are not effective factors on hypothermia; however the hypothermia rate in patients in ASA classification II and above is found to be significantly higher. Similarly, Steelman, et al. (2015) in their study indicated that the 47.9% of the patients who are hypothermic in PACU entrance are in ASA classification III and IV. Kongsayreepong et al. (2003) in their study detected that hypothermia is seen more frequently in patients in ASA classification II and above. However Luis et al. (2012), in their study, determined no relation between ASA classification and hypothermia.

In the literature open surgical intervention (Bush et al., 1995; Schmied et al.,1996), extended operation time (Prado et al., 2015; Kongsayreepong et al., 2003; Putzu et al., 2007; Aksu et al., 2014), general anesthesia (Sessler, 2001; Aksu et al., 2014) etc. factors dependent on the undergone surgical interventions are determined to be risk factors for hypothermia.

Whereas, in this study, it is determined that the operation time is an effective factor on the development of hypothermia. In a multicentric study, it is determined that the hypothermia incidence is 17.1% in surgical interventions that take under 2 hours and 44.8% in ones that take longer times (Yi et al., 2015). Luis et al. (2012), in their study, reported that the anesthesia time can be considered as an independent risk factor for hypothermia. However, in a separate study, it is indicated that the length of operation time does not affect the hypothermia development (Kongsayreepong et al., 2003). Operation time being longer also means that the anesthesia time is longer. Thus, the length of operation time is a condition expected to be effective on hypothermia development.

Limitations} The study has some limitations. This study is a sectional study conducted in single center and with only patients who undergone abdominal surgery. Also in the study, for the assessment of the body temperature, instead of temperature monitoring, tympanic thermometer is used and only the temperature measurements at first four hours in the postoperative period are assessed.

Result: Involuntary hypothermia is a condition that is widely seen in postoperative period and causes serious complications. In this study, it is determined that more than half of the patients who have gone under abdominal surgery develop involuntary hypothermia in the postoperative period, and in the patients who are in ASA risk assessment II and above and whose operation time is long, the hypothermia is seen more frequently. In line with the findings, it is recommended that in order to prevent the involuntary hypothermia, efficient interventions are planned, active heating methods are used in perioperative period and trainings are held to increase the knowledge level of the operation room team.

References

Abelha, FJ., Castro, MA., Neves, AM., Landeiro, NM., Santos, CC. (2005) Hypothermia in a surgical intensive care unit. BMC Anesthesiology 5:7. doi:10.1186/1471-2253-5-7

Aksu, C., Kuş, A., Topbaş, Ö., Erdoğan, S., Gürkan,Y. (2019) Perioperative Hypothermia Incidence: Where are we After 5 Years? JARSS 27(3):198-203. doi: 10.5222/jarss.2019.40085

Aksu, C., Kuş, A., Gürkan, Y., Solak, M., Toker, K. (2014) Survey on Postoperative Hypothermia Incidence In Operating Theatres of Kocaeli University. Turkish Journal of Anaesthesiol and Reanimation 42:66-70. doi: 10.5152/TJAR.2014.15010

ASA: Standards, Guidelines, and Statements. Park Ridge, IL, ASA, 1999.

Association of Surgical Technologist (AST). AST standards of practice for maintenance of normothermia in the perioperative patient. 2015. Available from: http://www.ast.org/uploadedFiles/Main_Site/Content/About_Us/SOP_For_Normothermia.pdf (Accessed, October 2020).

Bilgin, H. (2017) Inadverdent Perioperative Hypothermia. Turkish Journal of Anaesthesiol and Reanimation 45:124-6. doi: 10.5152/TJAR.2017.200501

Bush, HL., Hydo, LJ., Fischer, E., Fantini, GA., Silane, MF., Barie, PS. (1995) Hypothermia during elective abdominal aortic aneurysm repair: the high price of avoidable morbidity. Journal of Vascular Surgery 1: 392-400.

Duman, AY. & Yılmaz, E. (2016) Incidence of perioperative hypothermia in orthopaedic surgery and risk factors. Cukurova Medical journal 41(4):687-694. doi: 10.17826/cutf.254195

Epi Fanzca, UGM., Frca Fanzca, CS., Fulbrook P. (2017) Perioperative hypothermia during hip fracture surgery: An observational study. Journal of Evaluation in Clinical Practice 23:762–766. doi.org/10.1111/jep.12712

Guideline for Prevention of Unplanned Patient Hypothermia In: AORN's Guidelines for Perioperative Practice 2019. Available from: https://www.aorn.org/guidelines/about-aorn-guidelines/evidence-tables (Accessed October 2020).

Giuliano, KK. & Hendricks, J. (2017) Inadvertent perioperative hypothermia: Current nursing knowledge. AORN Joırnal 105(5):453-463. doi: 10.1016/j.aorn.2017.03.003.

Hooper, VD., Chard, R., Clifford, T., Fetzer, S., Fossum, S., Godden, B. et al. (2010) ASPAN's evidence-based clinical practice guideline for the promotion of perioperative normothermia: second edition. Journal of PeriAnesthesia Nursing 25(6):346-65. doi: 10.1016/j.jopan.2010.10.006.

Jeyadoss, J., Thiruvenkatarajan, V., Watts, RW., Sullivan, T., van Wijk, RM. (2013) Intraoperative hypothermia is associated with an increased intensive care unit length-of-stay in patients undergoing elective open abdominal aortic aneurysm surgery: A retrospective cohort study. Anaesth Intensive Care 41(6):759-764. doi: 10.1177/0310057X1304100611

Karalapillai, D., Story, DA., Calzavacca, P., Licari, E., Liu, YL., Hart, GK. (2009) Inadvertent hypothermia and mortality in postoperative intensive care patients: retrospective audit of 5050 patients. Anaesthesia, 64:968–972. doi: 10.1111/j.1365-2044.2009.05989.x

Kiekkas, P., Fligou, F., Igoumenidis, M., Stefanopoulos, N., Konstantinou, E., Karamouzos, V. et al.(2018) Inadvertent hypothermia and mortality in critically ill adults: Systematic review and meta-analysis. Australian Critical Care 31:12-22. doi: 10.1016/j.aucc.2017.01.008

Kongsayreepong, S., Chaibundit, C., Chadpaibool, J., Komoltri, C., Suraseranivongse, S., Suwannanonda, P. et al. (2003) Predictor of core hypothermia and the surgical intensive care unit. Anesthesia & Analgesia 96: 826-33. doi: 10.1213/01.ANE.0000048822.27698.28

Kursun, Ş. & Dramalı, A. (2011) Effect of warming with electrical blanket on the rewarming time of the patients undergoing abdominal surgery in the postoperative period. General Medıcal Journal 21:1-4.

Lista, F., Doherty, CD., Backstein, RM., Ahmad, J. (2012) The impact of perioperative warming in an outpatient aesthetic surgery setting. Aesthetic Surgery journal 32(5):613-620. doi: 10.1177/1090820X12449342

Luís, C., Moreno, C., Silva, A., Páscoa, R., Abelha, F. (2012) Inadvertent postoperative hypothermia at post-anesthesia care unit: incidence, predictors and outcome. Open Journal of Anesthesiol 2:205-13. doi:10.4236/ojanes.2012.25047

National Institute for Health Care Excellence (NICE). Inadvertent perioperative hypothermia overview. 2017. Available from: https://pathways.nice.org.uk/pathways/inadvertent-perioperative-hypothermia (Accessed, October 2020).

Prado, CBC., Barichello, E., Pires, PS., Haas, VJ., Barbosa, MH. (2015) Occurrence and factors associated with hypothermia during elective abdominal surgery. Acta Paul Enferm 28:475-42. doi:10.1590/1982-0194201500079

Putzu, M., Casati, A., Berti, M., Pagliarini, G., Fanelli, G. (2007) Clinical Complications, Monitoring and Man- agement of Perioperative Mild Hypothermia: Anesthesi- ological Features. Acta BioMedical 78(3): 163-169.

Schmied, H., Kurz, A., Sessler, DI., Kozek, S., Reiter, A. (1996) Mild hypothermia increases blood loss and transfusion require- ments during total hip arthroplasty. Lancet 347: 289-92.

Sessler, DI. (2001) Complications and treatment of mild hypothermia. Anesthesiology 95:531-43. doi: 10.1097/00000542-200108000-00040

Slotman, GJ., Jed, EH. & Burchard, KW. (1985) Adverse effects of hypothermia in postoperative patients. American Journal of Surgery 149: 495–501.

Soysal, GE. & İlçe, A. (2018) Evidence Based Practices on the Unplanned Perioperative Hypothermia. Bozok medical journal 8(2):72-9. doi:10.16919/bozoktip.337029

Steelman, VM., Perkhounkova, YS. & Lemke, JH. (2015) The gap between compliance with the quality performance measure "perioperative temperature management" and normothermia. Journal of Healthcare Quality 37(6):333-341. doi: 10.1111/jhq.12063

Turkish Anesthesia and Reanimation Association (TARA). Anesthesia Practice Guidelines 2013: A guide to preventing unwanted perioperative hypothermia. Available from: https://tard.org.tr/assets/kilavuz/yeni.pdf (Accessed, October 2020).

Yi, J., Xiang, Z., Deng, X., Fan, T., Fu, R., Geng, W et al. (2015) Incidence of inadvertent intraoperative hypothermia and its risk factors in patients undergoing general anesthesia in Beijing: a prospective regional survey. PLoS One 10(9):e0136136 doi: 10.1371/journal.pone.0136136