

ORIGINAL ARTICLE

Reporting quality of trial protocols improved for non-regulated interventions but not regulated interventions: A repeated cross-sectional study

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Abstract

Objectives: To investigate the adherence of randomised controlled trial (RCT) protocols evaluating non-regulated interventions (including dietary interventions, surgical procedures, behavioural and lifestyle interventions, and exercise programmes) in comparison with regulated interventions to the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) 2013 Statement.

Methods: We conducted a repeated cross-sectional investigation in a random sample of RCT protocols approved in 2012 (n = 257) or 2016 (n = 292) by research ethics committees in Switzerland, Germany, or Canada. We investigated the proportion of accurately reported SPIRIT checklist items in protocols of trials with non-regulated as compared to regulated interventions.

Results: Overall, 131 (24%) of trial protocols tested non-regulated interventions. In 2012, the median proportion of SPIRIT items reported in these protocols (59%, interquartile range [IQR], 53%-69%) was lower than in protocols with regulated interventions (median, 74%, IQR, 66%-80%). In 2016, the reporting quality of protocols with non-regulated interventions (median, 75%, IQR, 62%-83%) improved to the level of regulated intervention protocols, which had not changed on average.

Conclusions: Reporting of RCT protocols evaluating non-regulated interventions improved between 2012 and 2016, although remained suboptimal. SPIRIT recommendations need to be further endorsed by researchers, ethics committees, funding agencies, and journals to optimize reporting of RCT protocols. © 2021 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>)

Keywords: Clinical trial protocol; Randomized controlled trials; Dietary interventions; Surgical procedures; Behavioural and lifestyle interventions; Reporting guidelines

What is new?

- There was an improvement in adherence of trial protocols of non-regulated intervention trials to the SPIRIT (Standard Protocol Items: Recommendations for Interventional Trials) recommendations between 2012 and 2016; their reporting quality reached the level of regulated trials in 2016 but still remained suboptimal.
- A descriptive title identifying the study design, details on data collection, plans on a Data Monitoring Committee, access to data, and details on ancillary care were identified as the worst reported protocol elements in non-regulated trials in 2016.

- The improvements and remaining deficiencies of trial protocols of non-regulated interventions were similar across types of intervention (surgical, dietary, behavioural, exercise).

1. Introduction

Trials of regulated interventions, such as drugs, biologics, or medical devices, must adhere to regulations of responsible authorities (e.g. European Medicines Agency, Swissmedic) [1-4]. Regulators promote completeness and transparency of protocols and prospective registration in a trial register. However, trials assessing non-regulated interventions, such as dietary interventions, surgical proce-

dures, behavioural and lifestyle interventions, or exercise programmes, are not subject to oversight by regulatory agencies.

Although recommendations have been developed for the design, conduct and reporting of trials with non-regulated interventions [5, 6], study reports of these trials often lack important study information, such as final sample size [7], age [8], or health status of participants [8], and adherence to the CONSORT (Consolidated Standards of Reporting Trials) Statement is generally poor [8–12].

Careful writing of a clinical trial protocol is important for all involved stakeholders, i.e. researchers, ethics review boards, funders, journal editors and patients [13], because this document describes the planned research steps and methods in a comprehensive manner. The SPIRIT 2013 Statement (Standard Protocol Items: Recommendations for Interventional Trials), a checklist of a minimal set of items to be reported in a protocol, was developed to improve the reporting quality of study protocols [14]. Empirical evidence on the impact of the SPIRIT recommendations on the quality of trial protocols with non-regulated interventions is lacking.

The aim of the present study was to assess the extent to which RCT protocols with non-regulated interventions adhered to the SPIRIT recommendations in 2012 and 2016, that is, before and after the SPIRIT recommendations were published. Further, we compared adherence to the SPIRIT checklist [15] between trial protocols with non-regulated as compared to regulated interventions.

2. Methods

2.1. Protocol selection and inclusion criteria

The present study is one of the add-on projects of Adherence to SPIRIT Recommendations - Switzerland, Canada, and Germany (ASPIRE-SCAGE) Study. A detailed description of the methodology, including eligibility criteria, process of protocol selection, data extraction, and additional objectives addressed in add-on studies has previously been published [16]. In brief, the ASPIRE-SCAGE investigated adherence of protocols approved by research ethics committees in Switzerland, Germany, or Canada before (2012) and after (2016) the publication of the SPIRIT guidelines in 2013. Protocols were eligible if they described an RCT of a health care intervention in patients. We excluded pilot studies, trials enrolling healthy volunteers, animal studies, studies based on tissue samples, and studies with a quasi-random method of allocation. Results of ASPIRE-SCAGE will be published separately. Originally, we had planned to additionally include protocols from UK research ethics committees in this subproject, but delays in accessing protocols from 2016 rendered this not feasible [16].

In the present study we categorised the protocols included in ASPIRE-SCAGE as follows: 1) drug, 2) bio-

logical, 3) device, 4) dietary supplement, 5) surgery, 6) behavioural, 7) exercise, or 8) other non-regulated.

2.2. Data extraction

From each eligible trial protocol, we extracted main study characteristics and information on the adherence to the SPIRIT checklist [15]. Data extractors assessed whether each item and sub-item of the SPIRIT checklist was reported among eligible trials, either as ‘Yes’, ‘No’, or ‘Not applicable’.

Data were extracted by two independent extractors, using web-based software developed for data collection (www.squiekero.org). All extractors signed confidentiality agreements before starting data extraction. To reduce inter-extractor variability in interpreting individual questions, each of the extractors received personal training provided by one of the project leaders (DG, BvN, MB) and extracted the first protocols with a project leader as the second extractor. The software enabled comparison of extracted data from two extractors and the discussion of discrepancies before making a consensual final decision.

2.3. Data analysis

We expressed *adherence of trial protocols to SPIRIT* by allocating a score between zero and one to each of the 33 SPIRIT items and summing up these scores. Each protocol was able to reach a total score (hereafter referred to as *SPIRIT adherence score*) between zero and 33 points, with higher scores designating better SPIRIT adherence [16].

In case of SPIRIT items consisting of a single variable, we assigned one point if the answer to the question about the variable was “Yes” or “Not applicable” and zero points if the answer was “No” (dichotomization). In case of composite SPIRIT checklist items with two or more questions (sub-items), we applied an approach, which gave equal credit to all sub-items (with dichotomization on sub-item level). The ratio calculated by dividing the number of fulfilled sub-items and the total number of sub-items was allocated as a score to these composite SPIRIT items. This means, for example, that an item consisting of three sub-items received 0.66 points in case two sub-items were fulfilled, while one sub-item remained unfulfilled [16].

We calculated *overall trial adherence to SPIRIT* for different intervention categories (drugs, biologicals, devices, dietary supplements, surgical interventions, behavioural interventions and exercise) as the proportion of SPIRIT items adhered to per protocol. *Adherence to individual SPIRIT checklist items* was calculated as the proportion of trial protocols adhering to a given item. In case of composite items – to give equal credit to each of the sub-items – mean proportions were calculated.

We used descriptive statistical methods to compare characteristics of all intervention categories (drugs, biologicals, devices, dietary supplements, surgical interven-

tions, behavioural interventions and exercise). We conducted three multivariable analyses using a beta regression model [17] to examine whether and how the adherence of regulated and non-regulated trial protocols changed between 2012 and 2016. The proportion of SPIRIT items adhered to per protocol was the dependent variable in all three regression analyses. In the first analysis we used all trial protocols from 2012 and included the following independent variables: regulation status, planned sample size, centre status (single vs multiple), sponsorship, reported logistic or methodological support from a clinical trial unit (CTU) or contract research organisation (CRO). In the second analysis we used all protocols from 2016 with the same set of independent variables. In a third analysis we specifically investigated a potential interaction between year of approval (2012 or 2016) and regulation status, by including a corresponding interaction term in the regression model. An additional multivariable beta regression analysis was restricted to non-regulated trial protocols to reveal the factors that potentially influence the adherence of non-regulated intervention trial protocols to SPIRIT.

We used R version 3.6.1 for data analysis. We performed all statistical testing at the significance level of 0.05.

3. Results

We included 549 trial protocols in our analysis; 257 from 2012 and 292 from 2016. Out of these protocols, 418 (76%) described a trial with a regulated and 131 (24%) a trial with a non-regulated intervention. We summarized main characteristics of the included trial protocols in **Table 1**. Non-regulated intervention trials most often investigated surgical procedures (40.5%) or behavioural/lifestyle interventions (28.2%), while protocols with a dietary (12.2%) or exercise intervention (11.5%) were less common in our sample. As the comparator, non-regulated trial protocols most often had no treatment/standard care (47.3%) or another active treatment (35.9%) rather than placebo (16.8%). Most of the non-regulated trial protocols reported non-industry sponsorship (93.9%), and support from a CTU/CRO was less commonly mentioned than in protocols of regulated interventions (38.9% vs. 62.2%). Planned sample sizes were lower for non-regulated protocols than protocols of regulated intervention trials (median number of participants was 144 vs. 287).

Table 2 provides information on the adherence to the SPIRIT checklist for RCT protocols of both regulated and non-regulated interventions. The reporting quality of protocols with regulated interventions had, on average, not changed substantially from 2012 to 2016 (median of 74% versus 77% of the SPIRIT items were adhered to per protocol, respectively), while we observed for protocols with non-regulated interventions a substantial improvement (median of 59% versus 75% of the SPIRIT items were adhered to per protocol, in 2012 and 2016, respectively). We found

improvements from 2012 to 2016 in all non-regulated intervention subcategories with levels of SPIRIT adherence at baseline ranging from 53% to 65% (**Table 2**).

Non-regulated status was identified as an independent predictor of non-adherence in 2012 (odds ratio 1.25, 95% confidence interval 1.07 to 1.45), but not in 2016 (odds ratio 1.01, 95% confidence interval 0.86 to 1.19) (**Table 3**). This selective improvement of protocols with non-regulated interventions (subgroup effect) is also reflected in the significant interaction term between intervention regulation status and protocol approval year in the third regression model in **Table 3**.

The protocol elements with over 10% difference in the proportion of SPIRIT adherence between regulated and non-regulated trials in 2016 were: (1) details on study design in the title, (2) providing trial registration details, (3) description of trial design, (4) plans about a Data Monitoring Committee, (5) monitoring harms, (6) ways for auditing study conduct, (7) process for making protocol amendments, and (8) provisions for ancillary care. Details on study setting, recruitment, access to data, and dissemination policy were better reported for trials with non-regulated interventions than for the regulated ones (**Table 4**). Details on ancillary care, a descriptive title identifying study design, details on access to data, data collection methods, and plans on a Data Monitoring Committee were identified as the five least reported SPIRIT items in 2016 (**Table 4**).

Multivariable regression model in protocols evaluating non-regulated interventions showed that more recent approval (2016) and CTU/CRO support were independent predictors of better adherence to SPIRIT, while planned sample size, the type of non-regulated intervention (dietary, surgery, behaviour, exercise, other), and being a multicentre or single centre study were not (**Supplementary Table 1**).

4. Discussion

4.1. Summary of principal findings

We found an improvement in the completeness of reporting of protocols for trials evaluating non-regulated interventions between 2012 and 2016. Although reporting quality in 2016 remained suboptimal, it basically reached the level of protocols of regulated interventions, which did not change over time. We saw this improvement not only overall, but in all investigated subcategories of non-regulated interventions, with the smallest improvement for protocols evaluating dietary interventions, and the most pronounced improvement for protocols of exercise programmes. Specific SPIRIT items with particularly poor reporting (all <50% adherence) were description of study design in title, details on data collection, plans about having a Data Monitoring Committee, details on access to data after trial completion, and plans about ancillary care. Apart

Table 1. Characteristics of investigated randomized controlled trial protocols

Characteristics	Drug (n = 268)	Device (n = 79)	Biological (n = 71)	All regulated interventions (n = 418)	Diet (n = 16)	Surgery (n = 53)	Behaviour (n = 37)	Exercise (n = 15)	Other* (n = 10)	All non-regulated interventions (n = 131)
Country of Ethics Committee										
Switzerland	177 (66.1%)	71 (89.9%)	51 (71.8%)	299 (71.5%)	11 (68.8%)	38 (71.7%)	30 (81.1%)	12 (80.0%)	7 (70.0%)	98 (74.8%)
Germany	44 (16.4%)	5 (6.3%)	14 (19.7%)	63 (15.1%)	2 (12.5%)	2 (3.8%)	4 (10.8%)	3 (20.0%)	1 (10.0%)	12 (9.2%)
Canada	47 (17.5%)	3 (3.8%)	6 (8.5%)	56 (13.4%)	3 (18.8%)	13 (24.5%)	3 (8.1%)	0 (0.0%)	2 (20.0%)	21 (16.0%)
Approved in										
2012	118 (44.0%)	42 (53.2%)	45 (63.4%)	205 (49.0%)	9 (56.2%)	26 (49.1%)	9 (24.3%)	5 (33.3%)	3 (30.0%)	52 (39.7%)
2016	150 (56.0%)	37 (46.8%)	26 (36.6%)	213 (51.0%)	7 (43.8%)	27 (50.9%)	28 (75.7%)	10 (66.7%)	7 (70.0%)	79 (60.3%)
Sponsorship										
Industry	168 (62.7%)	31 (39.2%)	61 (85.9%)	260 (62.2%)	3 (18.8%)	4 (7.5%)	1 (2.7%)	0 (0.0%)	0 (0.0%)	8 (6.1%)
Investigator	100 (37.3%)	48 (60.8%)	10 (14.1%)	158 (37.8%)	13 (81.2%)	49 (92.5%)	36 (97.3%)	15 (100.0%)	10 (100.0%)	123 (93.9%)
CTU or CRO support										
	178 (66.4%)	34 (43.0%)	48 (67.6%)	260 (62.2%)	9 (56.2%)	24 (45.3%)	6 (16.2%)	7 (46.7%)	5 (50.0%)	51 (38.9%)
Study design										
Parallel	251 (93.7%)	74 (93.7%)	68 (95.8%)	393 (94.0%)	11 (68.8%)	49 (92.5%)	35 (94.6%)	15 (100.0%)	10 (100.0%)	120 (91.6%)
Crossover	10 (3.7%)	3 (3.8%)	1 (1.4%)	14 (3.3%)	4 (25.0%)	3 (5.7%)	2 (5.4%)	0 (0.0%)	0 (0.0%)	9 (6.9%)
Factorial	7 (2.6%)	2 (2.5%)	2 (2.8%)	11 (2.6%)	1 (6.2%)	1 (1.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.5%)
Comparator										
No treatment/Standard care	45 (16.8%)	30 (38.0%)	4 (5.6%)	79 (18.9%)	0 (0.0%)	21 (39.6%)	24 (64.9%)	11 (73.3%)	6 (60.0%)	62 (47.3%)
Another active treatment	85 (31.7%)	33 (41.8%)	17 (23.9%)	135 (32.3%)	2 (12.5%)	28 (52.8%)	10 (27.0%)	3 (20.0%)	4 (40.0%)	47 (35.9%)
Placebo/sham	138 (51.5%)	16 (20.3%)	50 (70.4%)	204 (48.8%)	14 (87.5%)	4 (7.5%)	3 (8.1%)	1 (6.7%)	0 (0.0%)	22 (16.8%)
Planned number of study centers and participating countries										
Single center	28 (10.4%)	30 (38.0%)	3 (4.2%)	61 (14.6%)	7 (43.8%)	22 (41.5%)	23 (62.2%)	8 (53.3%)	3 (30.0%)	63 (48.1%)
Multicenter, national	32 (11.9%)	11 (13.9%)	7 (9.9%)	50 (12.0%)	7 (43.8%)	10 (18.9%)	12 (32.4%)	5 (33.3%)	3 (30.0%)	37 (28.2%)
Multicenter, international	208 (77.6%)	38 (48.1%)	61 (85.9%)	307 (73.4%)	2 (12.5%)	21 (39.6%)	2 (5.4%)	2 (13.3%)	4 (40.0%)	31 (23.7%)
Number of participants (median, IQR)										
	320 (140-674)	102 (60-293)	444 (183-805)	287 (120-638)	60 (46-233)	150 (75-470)	128 (78-246)	90 (58-110)	310 (203-733)	144 (67-322)

Abbreviations: CTU, clinical trials unit; CRO, contract research organisation; IQR, interquartile range.

When not indicated otherwise, data are expressed as total number (percentage within the corresponding group).

* Other trial protocols that included any type of non-regulated intervention, which we were not able to classify to the four pre-defined non-regulated categories (e.g. intervention with a geriatric evaluation tool; intermittent vs. continuous oxygen saturation monitoring; cold exposure vs. room temperature).

Table 2. Overall protocol adherence to SPIRIT according to intervention category

Year of approval		Drug (n = 268)	Device (n = 79)	Biological (n = 71)	All regulated interventions (n = 418)	Diet (n = 16)	Surgery (n = 53)	Behaviour (n = 37)	Exercise (n = 15)	Other [‡] (n = 10)	All non-regulated interventions (n = 131)
2012	SPIRIT adherence scores median (IQR)*	24.5 (22.8-26.2)	21.83 (18.9-25.1)	25.2 (23.8-26.9)	24.4 (21.9-26.3)	21.5 (19.0-25.3)	19.6 (17.8-23.0)	18.8 (15.9-20.5)	18.3 (16.5-19.5)	17.3 (14.8-20.8)	19.4 (17.5-22.9)
	Median % (IQR) [†]	74 (69-79)	66 (57-76)	76 (72-82)	74 (66-80)	65 (58-77)	60 (54-70)	57 (48-62)	56 (50-59)	53 (45-63)	59 (53-69)
2016	SPIRIT adherence scores, median (IQR)	25.3 (23.4-27.1)	23.9 (21.2-26.3)	25.8 (23.6-26.6)	25.3 (23.0-27.0)	22.5 (15.5-26.1)	24.5 (20.2-26.8)	25.5 (22.3-27.5)	26.6 (22.3-27.1)	24.08 (21.8-28.5)	24.6 (20.5-27.3)
	Median % (IQR)	77 (71-82)	72 (64-80)	78 (72-81)	77 (70-82)	68 (47-79)	74 (61-81)	77 (68-84)	81 (68-83)	73 (66-87)	75 (62-83)

Abbreviation: IQR, interquartile range.

* Spirit adherence scores are expressed as median (IQR) for each intervention category. Each single protocol was able to reach a SPIRIT adherence score between zero and 33 points (i.e. we allocated a score between zero and one for each of the 33 SPIRIT checklist items), with higher scores indicating greater SPIRIT adherence.

[†] % means the median percent of SPIRIT items that were adhered to per protocol.

[‡] Other trial protocols that included any type of non-regulated intervention, which we were not able to classify to the four pre-defined non-regulated categories (e.g. intervention with a geriatric evaluation tool; intermittent vs. continuous oxygen saturation monitoring; cold exposure vs. room temperature).

Table 3. Multivariable regression analyses for the years 2012, 2016 and for all included study protocols for potential predictors of SPIRIT adherence

	2012 (n = 257)		2016 (n = 292)		All protocols (n = 549)	
	OR (95%CI)	P	OR (95%CI)	p	OR (95%CI)	P
Regulation status (regulated vs. non-regulated)	1.25 (1.07 – 1.45)	0.005	1.01 (0.86 – 1.19)	0.92	1.40 (1.20 – 1.63)	<0.001
Planned sample size (in 1000 increments)	1.01 (0.99 – 1.03)	0.32	0.96 (0.91 – 1.02)	0.24	1.01 (0.99 – 1.03)	0.52
Multicentre (vs. single centre)	1.23 (1.05 – 1.46)	0.01	1.20 (1.02 – 1.42)	0.03	1.20 (1.06 – 1.34)	0.003
CTU/CRO support (yes vs. no)	1.37 (1.21 – 1.54)	<0.001	1.44 (1.26 – 1.64)	<0.001	1.43 (1.31 – 1.56)	<0.001
Industry sponsorship (vs investigator)	1.41 (1.22 – 1.62)	<0.001	0.95 (0.81 – 1.11)	0.49	1.15 (1.03 – 1.28)	0.01
Approval year (2016 vs. 2012)	-	-	-	-	1.20 (1.08 – 1.32)	<0.001
Interaction non-regulated interventions – approval year	-	-	-	-	1.54 (1.263 – 1.88)	<0.001

Abbreviations: CI, confidence interval; CRO, contract research organisation; CTU, clinical trials unit; OR, odds ratio.

from the approval year, reported CTU/CRO support in the protocol was an independent predictor of better protocol reporting quality in trials with non-regulated interventions. Adherence was worse than in regulated trials for reporting the study design in the title, trial registration details, study design, plans about a Data Monitoring Committee, about collecting details on harms, about auditing, about the process for making protocol amendments, and about provide or pay for ancillary care. Reporting was better for details on study setting, recruitment, access to data, and dissemination policy.

4.2. Strengths and weaknesses of the study

Strengths of our study include full access to RCT protocols and their associated documents from research ethics

committees in three countries. Included RCTs consist of all or a random sample of approved protocols at a participating research ethics committee. During data extraction we followed a rigorous process with pilot-testing of extraction forms and calibration exercises among all data extractors participating in the project to minimize inter-extractor differences. More than 95% of included protocols approved in 2012 and over 80% of protocols approved in 2016 were extracted and assessed by two independent reviewers.

It was a limitation of our study that, whereas all research ethic committees from Switzerland participated, only a convenience sample of one ethics committee from Germany (Freiburg) and one from Canada (Hamilton) took part. Thereby, Swiss protocols are overrepresented in our sample and we could not conduct meaningful sub-group analyses according to country. Accordingly, we cannot be

Table 4. Adherence to individual SPIRIT checklist items in 2016

SPIRIT checklist items which had to be described in the protocol	Number of SPIRIT checklist sub-items*	Non-regulated interventions (n = 79) %	Regulated interventions (n = 213) %	Differences [†]	Worst reported items for non-regulated
1) Study design, population, and interventions identified in title	1	34.2	64.8	↓	Top 2 worst
2) Registry name and trial identifier	1	68.4	85.4	↓	
3) Protocol version number and date	1	92.4	98.1		
4) Sources of financial/non-financial support	1	77.2	85.0		
5) Roles of protocol contributors, sponsors, funders	4	56.3	56.5		
6) Research question, justification of comparator choice	3	57.6	53.3		
7) Specific objectives for each comparison	1	91.1	94.8		
8) Trial design	1	77.2	87.3	↓	
9) Study setting	1	87.3	44.1	↑	
10) Eligibility criteria for participants	2	79.3	72.8		
11) Intervention, in detail	6	82.8	89.7		
12) Primary outcome, in detail	3	88.2	95.5		
13) Time schedule of enrolment, interventions, assessments and visits for participants	1	91.1	99.5		
14) Sample size calculation, in detail	9	89.9	94.5		
15) Recruitment (location, responsible persons, expected recruitment rate, monitoring, financial and non-financial incentives)	8	56.1	26.9	↑	
16) Allocation methods, in detail	7	67.1	61.0		
17) Blinding of participants, investigators, and outcome assessors	4	83.5	87.8		
18) Data collection (responsible persons and strategies to promote participant retention)	2	47.5	53.1		Top 4 worst
19) Data management methods	1	72.2	76.1		
20) Statistical methods, in detail	6	75.9	85.3		
21) Plans about having a Data Monitoring Committee and to conduct interim analysis	6	48.1	74.2	↓	Top 5 worst
22) Plans for collecting, assessing, reporting, managing adverse events	1	77.2	95.8	↓	
23) Procedures of auditing/ external monitoring	1	63.3	80.3	↓	
24) Affected research ethics committee	1	100	100		
25) Process for making protocol amendments	1	67.1	80.3	↓	
26) Informed consent process described	2	90.5	86.4		
27) Confidentiality of data collection and secure keeping	1	84.8	89.7		
28) Competing interests	1	55.7	64.8		
29) Persons having access to data after trial completion	1	40.5	28.6	↑	Top 3 worst
30) Plans to provide or pay for ancillary care	1	21.5	36.2	↓	Top 1 worst
31) Dissemination policy	4	78.5	67.6	↑	
32) Model consent form	1	97.5	96.2		
33) Details of biological specimen collection	1	97.5	91.5		

* For items with more than one sub-item, the mean proportion of protocols adhering to the sub-items of the given SPIRIT item (%) was calculated

[†] ↓ indicates SPIRIT items where adherence was $\geq 10\%$ worse in case of non-regulated as compared to regulated interventions, while ↑ indicates that adherence for non-regulated intervention protocols was $\geq 10\%$ better than for regulated protocols; Top 1-5 worst indicate those five SPIRIT items, which non-regulated protocols were less likely to adhere to.

sure whether our findings are also externally valid in an international context. A further limitation is that since we included RCT protocols that had already been approved by ethic committees, two of the SPIRIT items (“research ethics approval” and “consent forms provided”) were always fulfilled which inflates our total adherence scores.

The category “dietary interventions” was defined as any alteration in the participant’s diet as part of a controlled clinical trial, including trials with dietary supplements. We did not evaluate whether a health claim was intended based on trial results, instead all dietary interventions were considered to be non-regulated, which may have affected our results. It is important to mention that lack of reporting in the study protocol does not necessarily mean poor study conduct or poor reporting in the subsequent publication. Some studies have found that methodological information missing from protocols may be reported in the final publication [18–20]. Finally, the observed changes in protocol quality for non-regulated interventions between 2012 and 2016 cannot be causally attributed to the publication of SPIRIT due to the observational nature of this study; however, other initiatives and changes that could have had an impact on protocol quality too (e.g. a new Swiss protocol template [21], the enactment of new Legislation on Human Research in Switzerland in 2014, a common protocol template from Transclerate in 2015 [22] might have been influenced by SPIRIT guidance.

4.3. Discussion of findings in light of other studies

To our knowledge, our study is the first that focused on the reporting quality of non-regulated intervention trial protocols, including trials with dietary interventions, surgical procedures, behavioural and lifestyle interventions or exercise programmes. Previous meta-research focused on registration and publication tendencies of non-regulated trials. Dal Ré et al. summarized evidence on low registration and publication tendencies of trials of non-regulated interventions compared with drug trials in 2015. [23] Poor prospective trial registration rate [24–26], incomplete registration data [24–26] and low publication rates [27] were also described in other studies, focusing on specific subgroups of non-regulated intervention trials.

4.4. Implications for practice and future research

As non-regulated trials make up a large proportion of RCTs (i.e. about 40% of RCTs published [23,28]), it is important to set the same expectations for them as for trials of regulated interventions. Independently of whether or not interventions fall under regulations of specific authorities, researchers and research ethics committees should consider recommendations for protocol reporting in the same way.

During trial implementation all researchers have to face several challenges, e.g. recruitment of participants [29], randomisation, blinding [30–32], and the choice of placebo

or sham control [33,34] might be difficult. In addition, there might be specific challenges for trials with non-regulated interventions. For dietary supplementation trials it might be difficult to ensure and control compliance of participants [35, 36]. In surgical trials, a large heterogeneity of surgical patients and procedures [37] and different skills of surgeons in performing a particular procedure [38] may cause difficulties in standardizing surgical interventions [39]. In behavioural clinical trials, standardized training or a comparable, agreed competence level of involved trial investigators is crucial, but not yet common practice [40,41].

Findings of the present study are important as they inform researchers and research ethics committees about protocol elements in non-regulated trials which are often not reported properly. Providing details about trial design and plans about registration in an openly accessible trial register are essential elements of high-quality trial conduct and transparency, and have to be improved in case of non-regulated trials. Having plans for a Data Monitoring Committee, about managing adverse events and procedures for auditing and external monitoring are all trial safeguard issues, which need to be assessed as part of the protocol also in case of non-regulated trials. When preparing or assessing a trial protocol for a non-regulated intervention, researchers and research ethics committees should pay particular attention to a sufficiently detailed description of these protocol elements, shown to be reported poorly.

A high-quality protocol not only facilitates the conduct of the trial as planned but study methods and results can be reported more reliably in a subsequent journal publication. Insufficient reporting quality or missing information in study protocols may subsequently increase the risk of selective reporting of study findings [42] or even lack of publication [43]. The extent to which protocol reporting quality is associated with subsequent study conduct and reporting quality of study reports needs further investigation.

5. Conclusion

To estimate the benefits and harms of non-regulated interventions, there is a need for high quality RCTs and complete and transparent study reports. One important step towards this goal are study protocols that adhere to high quality reporting standards. The reporting quality of protocols of non-regulated interventions improved between 2012 and 2016 in a sample of protocols from Switzerland, Germany, and Canada. The SPIRIT recommendations published in 2013 likely contributed to this development, but causality cannot be shown in an observational study. Further improvement of protocol adherence to SPIRIT recommendations, however, is needed.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jclinepi.2021.05.011.

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